

Nonnutritive Sweeteners

Sandra Bastin, Food and Nutrition



Sucrose, or table sugar, is one of the most widely used ingredients in the foods we buy. We compare the sweetness of all other sweeteners to sugar, which is classified as a “nutritive sweetener.” Nutritive sweeteners not only add flavor to our foods, but they also provide calories from carbohydrates. They are found naturally in some foods, like fruit and milk, and are added to other foods. Other nutritive sweeteners found on ingredient labels include fructose, dextrose, lactose, maltose, honey, corn syrup, high-fructose corn syrup (HFCS), molasses, invert sugars, concentrated fruit-juice sweeteners, sorbitol, mannitol, xylitol, and other sugars.

Nonnutritive sweeteners are much sweeter than table sugar and only small amounts are needed to provide added sweetness to foods. They do not contain energy in the form of carbohydrates and generally will not have an impact on blood glucose levels. The food industry is using sugar substitutes, or alternative sweeteners, more and more because of our changing dietary habits and the improved quality of nonnutritive sweeteners.

In the United States, sweeteners are regulated by the 1958 Food Additives Amendment to the Food, Drug, and Cosmetic Act. According to the amendment, a sweetener is considered safe if it is tested and approved or if it has been used for many years. These sweeteners are deemed “generally recognized as safe” (GRAS). Sweeteners on the GRAS list are approved as a food additive. The GRAS list includes ingredients that were commonly used in foods before 1958 as well as ingredients that are judged by scientific evaluation to be safe to add directly or indirectly to food. The ADI (acceptable daily intake) is the amount of a food additive a person can safely consume on a daily basis over a lifetime.

Major Alternative Sweeteners

Food items made with nonnutritive sweeteners will often be labeled as “diet,” “no sugar added,” or “sugar free.” Six nonnutritive sweeteners have been approved by the U.S. Food and Drug Administration (FDA): saccharin, aspartame, acesulfame K, sucralose, neotame, and advantame. FDA approval is being sought for others, including cyclamate, which is used in many other countries, including Canada, Australia, and Mexico.

Saccharin

Saccharin is the oldest nonnutritive sweetener on the market in the United States. It was discovered by an American chemist in 1879 and is currently produced from a manufactured substance that also occurs naturally in grapes. Saccharin is approximately 300 to 400 times sweeter than sugar. In high concentrations it can leave a bitter aftertaste.

Researchers have been investigating the safety of saccharin for more than 50 years, ever since a long-term study showed that rats who were fed high levels of saccharin had an increased number of urinary bladder tumors. As a result of this study, the FDA proposed a ban on saccharin in 1977. The public opposed the ban because no other low-calorie sweeteners were on the market. So instead of banning saccharin, the FDA required that manufacturers place the following health warning label on all products containing saccharin: “Use of this product may be hazardous to your health. This product contains saccharin, which has been determined to cause cancer in laboratory animals.”

More recent research has changed the negative view on saccharin. In 2000, saccharin was removed as a possible carcinogen from the Report on Carcinogens, ninth edition, published by the National Institutes of Health. The following year, legislation allowed the warning label to be removed from saccharin products. An ADI has been established for saccharin, and saccharin levels in products cannot exceed 12 milligrams per fluid ounce in beverages, 30 milligrams per serving in processed foods, and sweetening power of one teaspoon of sugar in packets.

Saccharin is most commonly used as a tabletop sweetener and in beverages. Most people are familiar with brand-name tabletop sweeteners Sweet'N Low, Sugar Twin, and Necta Sweet. Saccharin is also used in cosmetics, vitamins, and drugs.

Aspartame

The sweetener aspartame contains the amino acids phenylalanine and aspartic acid. Aspartame was discovered by accident in 1965. It is digested as a protein and provides four calories per gram of food. Because it is approximately 200 times sweeter than sugar, only small amounts are necessary to sweeten food, and thus the calorie content per serving is small. It was approved by the FDA in 1981 and has grown so popular that it is now found in over 6,000 products. Over 200 scientific studies indicate that long-term consumption of aspartame does not cause health problems. An ADI of 50 milligrams per kilograms of body weight has been established for aspartame. A 150-pound person would have to consume 20 diet soft drinks or use 97 sweetening packets in one day to reach this level.

Information for people with phenylketonuria (PKU) is required on the food label of all products that contain aspartame. PKU is a rare inherited disorder that causes a buildup of phenylalanine, an amino acid, in the body. Health-care professionals recommend that people with PKU avoid consuming large amounts of aspartame.

Aspartame is not appropriate for use in baking unless it is added at the end of the cooking cycle. It loses sweetness when exposed to high temperatures for a long time. Aspartame is marketed under the brand name NutraSweet in food products and Equal as a tabletop sweetener. It can be bought in liquid, granular, encapsulated (to protect sweetening power during cooking), and powder forms. The patent expired in 1992, and additional brands of aspartame are now on the market. In addition to being used as a tabletop sweetener, aspartame is used in cereals, chewing gum, dry beverage mixes, carbonated and tea beverages, frozen stick novelties, gelatins, yogurt, and frozen desserts. It is also used in some prescription chewable tablets and sugar-free liquids.

Acesulfame K

Acesulfame K, or acesulfame potassium, was discovered in Germany in 1967 and was approved for use in the United States in 1988. An ADI was established at 15 milligrams per kilogram of body weight. It is 200 times sweeter than sugar and has no aftertaste except when used alone in large amounts. Acesulfame

K is not digested by humans, so it does not provide calories. Because it is heat stable, it can be used in cooking and baking. It also has an increased sweetening effect when combined with other sweeteners. Acesulfame K is marketed under the brand name Sunette in food products and Sweet One or Swiss Sweet as a tabletop sweetener. It is used in chewing gum, dry beverage mixes, instant coffees, teas, carbonated beverages, baked goods, hard and soft confections, gelatin, puddings, and nondairy creamer.

Sucralose

Sucralose is a popular nonnutritive sweetener sold under the brand name Splenda. Sucralose is 600 times sweeter than sugar. The FDA approved its safety in 1998, and an ADI of 5 milligrams per kilogram of body weight has been established. Sucralose does not lose its sweetness when exposed to heat. It does not interact with any other food substance and can be used in a variety of products. Its sweetness is maintained in storage for long periods.

Neotame

Neotame received FDA approval in 2002. It is made of two amino acids: aspartic acid and phenylalanine. Neotame does not have to carry the warning for PKU patients because the amount of phenylalanine released from it during digestion does not affect the body. It is 7,000 to 13,000 times sweeter than sugar, allowing very small amounts to be used for sweetening. An ADI has been recognized at 2 milligrams per kilogram of body weight. Neotame is found in beverages, tabletop sweeteners, baked goods, cereals, and frozen desserts.

Advantame

The most recently approved nonnutritive sweetener is Advantame. It received FDA approval in 2014 as a sweetener and flavor enhancer but is not to be used in meat and poultry. It has a similar chemical structure to Neotame. Advantame stays sweet when exposed to heat, so it can be used in baked goods. It is approximately 20,000 times sweeter than table sugar, so very small amounts are needed.

Sweet Without the Sugar

Foods made with sugar alternatives, or nonnutritive sweeteners, may be a suitable option for people monitoring their blood glucose levels or for those who are lowering their caloric intake. In general, these sweeteners do not pose a risk for dental cavities if general oral hygiene practices are followed. Food manufacturers may choose to use these additives as a bulking agent, to preserve the product, or for the sweet flavor. These products may be used in the processing of food for economic reasons, as these products may be more affordable than table sugar. Sugar alternatives also may be used in food processing by producers and consumers to minimize the calories or added sugar of their products. These sugar substitutes offer consumers and food manufacturers a greater number of food choices.

References

- U.S. Food and Drug Administration. (May 21, 2014). Food Additives Permitted for Direct Addition to Food for Human Consumption; Advantame. Federal Register: The Daily Journal of the United States Government. Accessed at: <https://www.federalregister.gov/documents/2014/05/21/2014-11584/food-additives-permitted-for-direct-addition-to-food-for-human-consumption-advantame>.
- U.S. Food and Drug Administration. (2023). How Sweet It Is: All About Sweeteners. Accessed at: <https://www.fda.gov/consumers/consumer-updates/how-sweet-it-all-about-sweeteners>.
- U.S. Food and Drug Administration. (2023). Aspartame and Other Sweeteners in Food. Accessed at: <https://www.fda.gov/food/food-additives-petitions/aspartame-and-other-sweeteners-food>.
- Fitch, C., and Keim, K. S. (2012). Position of the Academy of Nutrition and Dietetics: Use of Nutritive and Nonnutritive Sweeteners. Journal of the Academy of Nutrition and Dietetics, 112(5), 739–758. <https://doi.org/10.1016/j.jand.2012.03.009>
- U.S. Food and Drug Administration. (2019). Generally Recognized as Safe (GRAS). Accessed at: <https://www.fda.gov/food/food-ingredients-packaging/generally-recognized-safe-gras>.

Revised by Anna Cason, Dietetics and Human Nutrition

Cooperative Extension Service

Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT

Educational programs of Kentucky Cooperative Extension serve all people regardless of economic or social status and will not discriminate on the basis of race, color, ethnic origin, national origin, creed, religion, political belief, sex, sexual orientation, gender identity, gender expression, pregnancy, marital status, genetic information, age, veteran status, physical or mental disability or reprisal or retaliation for prior civil rights activity. Reasonable accommodation of disability may be available with prior notice. Program information may be made available in languages other than English. University of Kentucky, Kentucky State University, U.S. Department of Agriculture, and Kentucky Counties, Cooperating.

Lexington, KY 40506 Revised 06-2024



Disabilities
accommodated
with prior notification.