

Nonnutritive Sweeteners

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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.” 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 sugar alcohols. Nutritive sugars not only add flavor to our foods but they also add calories.

Because of our changing dietary habits and the improved quality of nonnutritive sweeteners, the food industry is using sugar substitutes, or alternative sweeteners, more and more. These improved sugar substitutes offer consumers and food manufacturers a greater number of food choices. Now diabetics who must restrict their consumption of simple sugars and people trying to lose weight can reduce their sugar intake by eating a variety of foods that contain alternative 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 generally recognized as safe (GRAS), in which case the substance does not require FDA pre-approval, or if the substance has been comprehensively tested by the manufacturer to establish safety and acceptable daily intake (ADI) and has been approved for use by the FDA. 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 is the amount of a food additive a person can safely consume on a daily basis over a lifetime.

Characteristics

To be competitive in the marketplace, nonnutritive sweeteners must be colorless, odorless, and leave no aftertaste. Consumers want sweeteners that taste as sweet as sugar with a sweetness that is experienced immediately. Low-calorie sweeteners must also be inexpensive to produce and should not cause cancer.

When food products are reformulated with alternative sweeteners, the sugar is not simply replaced by nonnutritive sweetener. A bulking agent is used to replace the bulk and functional properties of sugar. Bulking agents include cellulose, polydextrose, maltodextrins, and alcohol sugars.

Although there are no perfect low-calorie sweeteners, new and combination products are getting closer to the true characteristics of sugar.

Major Alternative Sweeteners

Researchers did not discover nonnutritive sweeteners until the turn of the century. Today, only five low-calorie alternative sweeteners have been approved by the FDA: saccharin, aspartame, acesulfame-K, sucralose, and neotame. FDA approval is being sought for others such as alitame, cyclamate, neohesperidine, stevia, and thaumatin.

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 mg per fluid ounce in beverages, 30 mg 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 mg per kg 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.

Aspartame seems harmless, although information for people with phenylketonuria (PKU) is required on the label of all products that contain it. People with PKU cannot utilize phenylalanine, and harmful by-products build up in their bodies. For this reason, large amounts of aspartame are not recommended for people with PKU.

One of aspartame's limitations is that it loses sweetness when exposed to high temperatures for a long time. This limits its use in baking unless it is added at the end of the cooking cycle. Aspartame is marketed under the brand name NutraSweet in food products and Equal as a tabletop sweetener. It can be bought in a 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 cold cereals, chewing gum, dry beverage mixes, carbonated and tea beverages, frozen stick novelties, gelatins, yogurt, and frozen desserts. It also is used in selected prescription drugs and as a flavor enhancer, especially with fruits.

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 mg per kg 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 is noncaloric. 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 Sunnette in food products and Sweet One or Swiss Sweet as a tabletop sweetener. It also is used in chewing gum, dry beverage mixes, instant coffees, teas, gelatin, puddings, and nondairy creamer. Application has been made for its use in carbonated beverages, baked goods, and hard and soft confections. It is used in more than 1,000 food products worldwide.

Sucralose

Sucralose has become a highly marketed nonnutritive sweetener, sold under the brand name Splenda in food products. Sucralose is a manufactured substance that is 600 times sweeter than sugar. The FDA approved its safety in 1998, and an ADI of 5 mg per kg 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 leaves no aftertaste. These qualities allow Sucralose to be used in an array of products, especially baked goods and beverages.

Neotame

The most recently approved nonnutritive sweetener is neotame. It received FDA approval in 2002 and has slowly started to enter the market. It is similar to aspartame but 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 8,000 times sweeter than sugar, allowing minute amounts to be needed for sweetening. An ADI has been recognized at 2 mg per kg of body weight. Neotame will likely be found in beverages, tabletop sweeteners, baked goods, cereals, and frozen desserts.

Future Sweeteners

Five possible nonnutritive sweeteners are seeking approval by the FDA. Alitame and cyclamate sought approval in 1986 and 1982, respectively. Because of drawbacks, work is continuing to make them ready for FDA approval. Neohesperidine, stevia, and thaumatin are newer products and require more scientific evidence before they will be ready for FDA approval.

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