

Sugar Substitutes: Americans Opt for Sweetness and Lite

by John Henkel

"Sugar in the morning, sugar in the evening, sugar at suppertime ..."

The lyrics of that old song go a long way toward describing the cravings of many Americans. A bowl of sugary breakfast cereal may be followed by a mid-morning donut, a lunch time soda, ice cream at supper, and, in between, snacks of pudding, pie or pastry. Not to mention all the goodies that are part of Valentine's Day, Halloween, and the year-end holiday season. It all adds up to one massive national sweet tooth.

So much so that the average American eats the equivalent of 20 teaspoons of sugar a day, according to figures from the most recent federal Continuing Survey of Food Intakes by Individuals (1994-1996). Nearly 60 percent of this intake, says the trade group The Sugar Association, is from corn sweeteners, used heavily in sodas and other sweetened drinks. Another 40 percent is from sucrose (table sugar), and a small amount comes from other sweeteners, such as honey and molasses.

There's nothing unusual about craving sweets, experts say. Humans naturally have an appetite for sugary things. But in excess, sugary foods can take a toll. Large quantities add up to surplus calories, which can contribute to weight gain. In order to lose weight, the total calories from foods, especially those with lots of calories from sugars as well as fats, must be decreased and physical activity increased. As a result, many consumers seeking to control their weight have turned to sugar substitutes as one way to help lower the daily calorie count without having to give up their favorite foods.

"Anything that can help people cut back on [excess] calories is good," says Adam Drewnowski, Ph.D., director of nutritional science at the University of Washington. He emphasizes that weight loss is complex and can't be attributed to any one food product. But existing studies, some of which he has conducted, show that sugar substitutes can help certain people maintain a weight loss. Because sugar substitutes, also called artificial sweeteners, are many times sweeter than sugar, it takes much less of them to create the same sweetness. The resulting calorie count of the amount used is negligible.

According to a 1998 survey by the Calorie Control Council, 144 million American adults regularly consume low-calorie, sugar-free products such as artificially sweetened sodas and desserts. The Food and Drug Administration has approved four sugar substitutes-- saccharin, aspartame, acesulfame-K, and sucralose--for use in a variety of foods. At least three other sweeteners are under FDA review but had not been approved at press time.

Two approved sugar substitutes, saccharin and aspartame, have been the subject of ongoing controversy that, in the case of saccharin, dates back more than 20 years.

Aspartame has come under fire in recent years from individuals who have used the Internet in an attempt to link the sweetener to brain tumors and other serious disorders. But FDA stands behind its original approval of aspartame, and subsequent evaluations have shown that the product is safe. A tiny segment of the population is sensitive to one of the sweetener's byproducts and should restrict intake. However, the agency continually monitors safety information on food ingredients such as aspartame and may take action to protect public health if it receives credible scientific evidence indicating a safety problem.

Other organizations give aspartame and the other approved sugar substitutes a thumbs up. For example, the American Heart Association endorses their use by diabetics and those on weight-loss diets. The American Diabetes Association calls sugar substitutes "free foods" because they make food taste sweet, but they have essentially no calories and do not raise blood sugar levels.

More Than a Century of Use

The granddaddy of all sugar substitutes is saccharin. Discovered in 1879, it was used during both world wars to sweeten foods, helping to compensate for sugar shortages and rationing. It is 300 times sweeter than sugar.

An early attempt to ban saccharin came in 1911 when a board of federal scientists called the artificial sweetener "an adulterant" that should not be used in foods. This same board later decided to limit saccharin just to products "intended for invalids," a restriction that was lifted after World War I began.

In 1958, Congress passed the Food Additives Amendment to the Food, Drug, and Cosmetic Act, which required premarket approval from FDA for food additives developed after 1958. This requirement did not apply to ingredients "generally recognized as safe," or GRAS. Saccharin was considered GRAS, so it remained on the market.

FDA began reviewing hundreds of GRAS substances--including saccharin--in the early 1970s to ensure that the latest scientific information continued to back up their safety. Studies in 1972 and 1973 of rats fed saccharin raised concerns about the sweetener's role in causing bladder cancer, but data analysis later suggested that impurities, not saccharin, may have caused the tumors.

Then in 1977, a Canadian study that looked specifically at the role of impurities--and of other suspected tumor causes, such as parasites in test animals--showed convincingly that saccharin itself was causing bladder cancer in rats. That same year, FDA proposed to ban saccharin for all uses except as an over-the-counter drug in the form of a tabletop sweetener. At the time, saccharin was the only available alternative to sugar.

The FDA proposal prompted a public outcry, fueled in part by media reports that the test rats were fed the equivalent of as many as 800 diet sodas a day. Congress responded by

passing the Saccharin Study and Labeling Act, which placed a two-year moratorium on any ban of the sweetener while additional safety studies were conducted. The law also required that any foods containing saccharin must carry a label that reads "Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals." Congress has extended the moratorium several times, most recently renewing it until 2002.

Saccharin has remained on the market and continues to have a fairly large appeal as a tabletop sweetener, particularly in restaurants, where it is available in single-serving packets under trade names such as Sweet 'n Low. Because it has a good shelf life, saccharin is used widely in fountain sodas, and its stability at high temperatures makes it an option for sweetening baked goods, unlike aspartame, which degrades when heated. Saccharin also is favored economically because it can be made inexpensively.

But given saccharin's continuing tentative status, should consumers use it? "We know for certain that it causes cancer in animals," says Andrew Laumbach, Ph.D., consumer safety officer in FDA's Office of Premarket Approval. He acknowledges, however, that animal studies do not always predict the behavior of a substance in the human body.

The National Cancer Institute states in its "Cancer Facts" documents that "epidemiological studies do not provide clear evidence" of a link to human cancer. Regina Ziegler, Ph.D., an NCI epidemiologist, says, "Typical intakes of saccharin at normal levels for adults show no evidence of a public health problem."

The government's National Toxicology Program has kept saccharin on its roster of "anticipated carcinogens," though it periodically considers "de-listing" the sweetener based on available safety evidence.

In the late 1970s FDA and NCI conducted a population-based study of saccharin's role in causing bladder cancer in humans and found that "in general," people who used the sweetener had no greater risk of bladder cancer than the population at large. However, the study found "suggestive evidence" that heavy saccharin users--defined as those using six or more servings of the sweetener a day--may have an increased risk. Laumbach says that for consumers who use saccharin, the key to a lower risk may be moderation, as is the case with many foods that can cause problems when eaten in excess. Other health groups, including the American Medical Association, the American Cancer Society, and the American Dietetic Association, agree that saccharin use is acceptable.

The Aspartame Controversy

While questions about saccharin may persist, the safety of another artificial sweetener, aspartame, is clear cut, say FDA officials. FDA calls aspartame, sold under trade names such as NutraSweet and Equal, one of the most thoroughly tested and studied food additives the agency has ever approved. The agency says the more than 100 toxicological and clinical studies it has reviewed confirm that aspartame is safe for the general population.

This message would not necessarily be apparent to consumers surfing the Internet, especially those who use Web-based search engines to find information about sugar substitutes or artificial sweeteners. Websites with screaming headlines and well-written text attempt to link aspartame consumption to systemic lupus, multiple sclerosis, vision problems, headaches, fatigue, and even Alzheimer's disease. One report distributed nationally over e-mail systems claims that aspartame-sweetened soft drinks delivered to military personnel during the Persian Gulf War may have prompted Gulf War syndrome.

No way, says FDA, along with many other health organizations such as the American Medical Association. David Hattan, Ph.D., acting director of FDA's division of health effects evaluation, says there is no "credible evidence," to support, for example, a link between aspartame and multiple sclerosis or systemic lupus. Some Internet reports claim that patients suffering from both conditions went into remission after discontinuing aspartame use. "Both of these disorders are subject to spontaneous remissions and exacerbation," says Hattan. "So it is entirely possible that when patients stopped using aspartame they might also coincidentally have had remission of their symptoms."

It is true, says Hattan, that aspartame ingestion results in the production of methanol, formaldehyde and formate--substances that could be considered toxic at high doses. But the levels formed are modest, and substances such as methanol are found in higher amounts in common food products such as citrus juices and tomatoes.

Other circulating reports claim that two amino acids in aspartame--phenylalanine and aspartic acid--can cause neurotoxic effects such as brain damage. "This is true in certain individuals and in high enough doses," says Hattan. He explains that a very small group of people who have the rare hereditary disease phenylketonuria have to watch their intake from other sources as well. Women with certain genetic traits (e.g., phenylketonurics) may metabolize the amino acid, phenylalanine, poorly and thus accumulate far higher than normal blood levels of phenylalanine. During pregnancy, high maternal levels of blood phenylalanine can be transferred to the fetus and produce serious adverse effects on brain development. While the protein eaten by these pregnant women contributes most of the resulting elevation of phenylalanine, they should also be aware of the presence of phenylalanine in beverages and foods that contain aspartame. FDA requires all products containing aspartame to be labeled for phenylalanine so consumers will be aware of the substance's presence and can avoid or restrict it.

Aspartic acid also has the potential to cause brain damage at very high doses. But under normal intake levels, the brain's mechanism for controlling aspartic acid levels ensures no adverse effects. It is unlikely that any consumer would eat or drink enough aspartame to cause brain damage: FDA figures show that most aspartame users only consume about 4 to 7 percent of the acceptable daily intake the agency has set for the sweetener.

Still other reports attempt to link aspartame to seizures and birth defects. Regarding seizures, Hattan cites animal and human studies showing that the sweetener neither causes nor enhances the susceptibility of seizures. Aspartame also has been evaluated for its potential to cause reproductive effects or birth defects. Again, researchers found no

evidence, even in test animals fed the sweetener at doses much higher than those to which humans would be exposed.

Approved in 1981, aspartame is 180 times sweeter than sugar. It is used in products such as beverages, breakfast cereals, desserts, and chewing gum, and also as a tabletop sweetener. In 1996, a study raised the issue that aspartame consumption may be related to an increase in brain tumors following FDA's approval of the sweetener in 1981. But analysis of the National Cancer Institute's database on cancer incidence showed that cases of brain cancers began increasing in 1973--well before aspartame was approved--and continued to increase through 1985. In recent years, brain tumor frequency has actually decreased slightly. NCI currently is studying aspartame and other dietary factors as part of a larger study of adult brain cancer.

Other Sweetener Choices

FDA also has approved two other artificial sweeteners, acesulfame potassium and sucralose, both of which are available in products such as fruit drinks and gelatin desserts.

Acesulfame Potassium: First approved in 1988 as a tabletop sweetener, acesulfame potassium, also called Sunett, is now approved for products such as baked goods, frozen desserts, candies, and, most recently, beverages. More than 90 studies verify the sweetener's safety.

About 200 times sweeter than sugar and calorie free, acesulfame potassium often is combined with other sweeteners. One major beverage maker mixes acesulfame potassium with aspartame to sweeten one of its diet sodas. Worldwide, the sweetener is used in more than 4,000 products, according to its manufacturer, Nutrinova. Acesulfame potassium has excellent shelf life and does not break down when cooked or baked.

Sucralose: Also known by its trade name, Splenda, sucralose is 600 times sweeter than sugar. After reviewing more than 110 animal and human safety studies conducted over 20 years, FDA approved it in 1998 as a tabletop sweetener and for use in products such as baked goods, nonalcoholic beverages, chewing gum, frozen dairy desserts, fruit juices, and gelatins. Earlier this year, FDA amended its regulation to allow sucralose as a general-purpose sweetener for all foods.

Sucralose tastes like sugar because it is made from table sugar. But it cannot be digested, so it adds no calories to food. Because sucralose is so much sweeter than sugar, it is bulked up with maltodextrin, a starchy powder, so it will measure more like sugar. It has good shelf life and doesn't degrade when exposed to heat. Numerous studies have shown that sucralose does not affect blood glucose levels, making it an option for diabetics.

Sugar Alcohols: Though not technically considered artificial sweeteners, sugar alcohols are slightly lower in calories than sugar and do not promote tooth decay or cause a sudden increase in blood glucose. They include sorbitol, xylitol, lactitol, mannitol, and

maltitol and are used mainly to sweeten sugar-free candies, cookies, and chewing gums. FDA classifies some of these sweeteners as "generally recognized as safe" and others as approved food additives.

Other "natural sweeteners" are available, but these are variations of table sugar and contain about the same amount of calories. These products include honey, molasses, evaporated cane juice, rice syrup, barley malt, and fructose.

Another product, stevia, is derived from a South American shrub. Though it can impart a sweet taste to foods, it cannot be sold as a sweetener because FDA considers it an unapproved food additive. "The safety of stevia has been questioned by published studies," says Martha Peiperl, a consumer safety officer in FDA's Office of Premarket Approval. "And no one has ever provided FDA with adequate evidence that the substance is safe." Under provisions of 1994 legislation, however, stevia can be sold as a "dietary supplement," though it cannot be promoted as a sweetener.

Three other sugar sweeteners are currently under FDA review. One of them, cyclamate, was marketed in the 1960s, but FDA banned it in 1970 after evidence emerged linking it to bladder cancer. Subsequent studies have failed to verify that link, so FDA is considering a petition to reapprove cyclamate. The other sweeteners under review are neotame and alitame.

Though sugar substitutes have a long history of controversy, the Calorie Control Council says Americans are continually searching for good-tasting, low-calorie products as part of a healthy lifestyle. Market surveys show that calorie-conscious consumers want more low-calorie foods and beverages. And though artificially sweetened products are not magic foods that will melt pounds away, they can be, experts say, a helpful part of an overall weight control program that includes exercise and other dietary factors.

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