WHAT'S THAT STUFF? ARTIFICIAL SWEETENERS

No-calorie sugar substitutes provide options for enjoying the sweet life

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Quoting from a popular song by U.S. rap group the Beastie Boys, "I like my sugar with coffee and cream." In other words, my morning java has to be sweet!

Most days my coffee is accompanied by packets of artificial sweetener instead of spoonfuls of sucrose—the compound we call sugar. But what exactly are the no-calorie sugar substitutes that help me keep my figure while satisfying my sweet tooth?

"Sweeteners are not no-calorie per se, but you use so little of them," says Diane Stadler, research assistant professor and bionutritionist at Oregon Health & Science University, in Portland. "You only need minuscule amounts to reach the same sweetening power as sucrose," so sweeteners are considered virtually noncaloric.

Of the five sweeteners currently approved as food additives by most national health agencies, saccharin and aspartame have the longest history on the market and have received perhaps the most attention in the health and safety debate.

Saccharin, the oldest commercial sweetener, was discovered by scientists at Johns Hopkins University in 1879. According to Eric Walters, a professor of biochemistry and molecular biology at Rosalind Franklin University of Medicine & Science, in Chicago, whose research has focused on sweeteners, a Hopkins researcher accidentally spilled lab material on his hand, then noticed an unaccountable sweet taste while eating dinner that night.

The material was saccharin, a heterocyclic compound derived from toluene or methyl anthranilate that tastes 300 times sweeter than sucrose. Saccharin was first sold in the U.S. from the late 1890s to the 1940s in tablet form. It was introduced in granulated form as the tabletop sweetener Sweet‘N Low in 1957, says Abraham I. Bakal, president of ABHC International Consultants and representative of Cumberland Packing Corp., the makers of the signature pink packets.

Products that contain saccharin most often include the sodium or calcium salts, which are highly soluble. Because of the sweetener's strength, a packet of Sweet‘N Low contains only 36 mg of calcium saccharin combined with dextrose, a filler; cream of tartar, a taste modifier; and calcium silicate, an anticaking agent.

Although saccharin is not metabolized when ingested, a Canadian study released in 1977 convinced the Food & Drug Administration that saccharin was causing bladder cancer in lab rats. The agency proposed a ban on saccharin, which met with enough public resistance that Congress passed a law protecting the sweetener's place on the market until more studies could be conducted. The law also required products containing saccharin to carry a warning of its risks as a carcinogen. Since then, more than 30 human studies have concluded that saccharin is safe to ingest.

"The first studies that showed bladder tumors in rats were using huge doses of a blend of cyclamate and saccharin in a rat breed that is already prone to tumors," Walters says. Bakal says the high concentrations of sweetener altered the composition of the rats' urine and caused latent carcinogens, which would have been flushed from the system, to become active. This altered urine chemistry in rats does not occur in humans.

In 2000, saccharin was delisted from a national report on carcinogens, and then-president Bill Clinton signed legislation to remove the warning label from saccharin-containing products.

Aspartame, marketed as tabletop sweeteners NutraSweet and Equal in the U.S. and Canderel in Europe, is another government-approved sweetener that has generated concerns regarding public health. According to Walters, a chemist at G. D. Searle was researching treatments for gastric
ulcers in 1965 when he accidentally spilled aspartylphenylalanine methyl ester, simply called aspartame, on his hands. When he licked his fingers to pick up some paper, he noticed they tasted sweet.

Aspartame is synthesized from aspartic acid and phenylalanine. The body breaks down aspartame into these amino acids along with a small amount of methanol. Methanol is metabolized to formaldehyde and formic acid. Formaldehyde is classified by the World Health Organization as a probable human carcinogen and is the major source of controversy over aspartame's safety.

Searle petitioned FDA to commercialize aspartame as a food additive in 1973, but because of concerns about health risks, the agency demanded rigorous safety tests first, Stadler says. More than 100 clinical trials, including tests on infants, pregnant women, and other high-risk populations, culminated in FDA approval for aspartame in 1981.

"The historical background on aspartame is really astounding," Studler says. "It establishes criteria that research on new food additives needs to live up to."

According to Walters, the body has mechanisms for filtering out small amounts of methanol. About 24 g of methanol is considered a lethal dose, but aspartame, which is 180 times sweeter than sugar, is used only in milligram amounts. What's more, Studler notes, methanol already occurs in many foods at higher levels than those delivered by products containing aspartame.

However, Walters says, people with the rare genetic disorder phenylketonuria (PKU) lack an enzyme for properly metabolizing phenylalanine, so they need to regulate their aspartame intake. In the U.S., all products containing aspartame must, by law, carry a warning for PKU patients.

Neotame, a new FDA-approved sweetener derived from aspartame, has a structure that prevents the peptide bond between phenylalanine and aspartic acid from breaking, making it safer for PKU patients. The other two major sweeteners on global markets are acesulfame potassium, an oxathiazinone dioxide, and sucralose, a derivative of sucrose in which three hydroxyl groups have been replaced with chlorine.

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