

# Sugar Substitutes & Their Uses

Sugar substitutes refer to substances that have little to no calories or other nutrients. You may be familiar with various product names for example Equal® (which can contain aspartame), or Splenda® which contains sucralose, or Truvia™, which contains stevia. We are going to review the sugar substitute ingredients approved by the US Federal Drug Administration (FDA), the agency that regulates our food safety. More about the approval process, adverse effects, and recommended intake limits will be covered later. Right now, let's review some characteristics of the sweetener ingredients.



## Saccharin, or where it all started

Once the leader of sugar substitutes, saccharin was discovered in the late 1800s at John Hopkins University by a scientist working on a coal-tar derivative. Recognizing the possibilities, the scientist-turned-entrepreneur patented and marketed saccharin as an "all-purpose curative." Initially sold in a New York City shop, saccharin was used by doctors to treat headaches, nausea, and overweight. The "miracle" product, 300 times sweeter than sugar, enjoyed high sales, and eventually entered the food industry and, eventually, consumers' homes. We've been using it ever since as a tabletop sweetener, in baked goods, jams, chewing gum, canned fruit, candy, dessert toppings and salad dressings.

## Aspartame

One of the most debated sweeteners, Aspartame, was discovered in 1965 and was approved by the FDA as a dry ingredient in foods (table top sweeteners, gelatins, etc.) in 1981, and since then, has been used in a variety of foods. Aspartame is about 200 times sweeter than table sugar and is one of the most commonly used sweeteners today.

## Acesulfame-K

Acesulfame-K is also 200 times sweeter than sugar with each table top packet containing the sweetness of two teaspoons of sugar. An advantage of this one is that it does not break down in heat so it can be used in cooking or baking. Some sugar substitutes tend to break down when subjected to heat, leaving an off-taste. Approved in 1998 by the FDA, the "K" in acesulfame-K refers to the mineral potassium, which is naturally found in our bodies. Studies show that 95% of the consumed sweetener basically ends up excreted in the urine because the body can't break it down.

## Sucralose

Ironically, sucralose starts out as cane sugar but ends up 600 times sweeter than table sugar. It came on the scene in 1976 and was approved by the FDA in 1999. After some laboratory wizardry which changes the sugar molecule, its structure now prevents it from being absorbed by the body so that it's eliminated through the urine and feces. The result? No calories! Like Acesulfame-K, sucralose is also heat stable making it a superb sweetener for cooking and baking. Another advantage is its long shelf life. It retains its sweetness significantly longer than aspartame, for example, which can break down over time.



## Stevia

Stevie who? Stevia was first introduced outside the United States, and has become a popular sweetener in recent years. This “natural” sweetener (as it’s marketed) comes from the leaves of the Stevia Rebaudiana Bertoni bush native to Central and South America. (Note: there is no FDA definition or standard for the term “natural.”) Two forms can be extracted from the plant: Reb A and stevioside. Both are 200-300 times sweeter than sugar and are calorie-free but only highly purified Reb A has been generally recognized as safe [GRAS] by the FDA in 2008 for use as a tabletop sweetener and in prepared foods. This is because there have been no adverse effects reported.

## Did you know?

- The average American ingests 22 teaspoons of added sugar a day according to the 2001–2004 National Health and Nutrition Examination Survey (NHANES) study. At 16 calories per teaspoon, that’s 352 added calories per day. Over a week, that translates to an additional 2464 calories.
- Of 2,157 teenagers (ages 12 to 18) NHANES 2001–2004 found the average daily consumption of added sugars was 119 grams (28.3 tsp or 476 calories), accounting for 21.4 percent of their total energy! Those who ate the most added sugar had higher levels of cholesterol and the worst lipid profiles.
- A 12-ounce can of sugar sweetened soda contains about 150 calories and 9 teaspoons of sugar. Substituting just one diet soft drink daily for regular soda can amount to savings of 4500 calories a month with a potential weight loss of about 1 pound per month.
- If you’re overweight, just losing 10% of your body weight (20 pounds in a 200 pound person, for example) can help improve cholesterol, blood sugar, blood fats, and blood pressure.
- Adults may be able to better manage weight when sugary foods and beverages are replaced with a lower/no sugar counterpart. Although studies are limited, using sucralose or aspartame does not seem to result in weight gain among children or adults. In fact, when substituted for higher sugar foods, sugar substitutes have the potential to aid in a reduction of calories, which may lead to weight loss in children and adolescents who are overweight or at risk for overweight.

## Who should avoid sugar substitutes?

### PKU (Phenylketonuria)

People with a rare genetic disorder called PKU (Phenylketonuria) should avoid phenylalanine, the substance found in the sweetener aspartame (i.e., Equal® or foods and beverages containing aspartame). These individuals are unable to break down the amino acid phenylalanine, found in aspartame. Pregnant women who carry this gene should also avoid aspartame because the fetus cannot break down the amino acid phenylalanine. However, neotame can be used by those with this genetic predisposition. Although related to aspartame, neotame is chemically different enough to allow its use. However, you should check with a registered dietitian or your health care provider.

### Pregnancy

Based on limited human research data, experts believe that using FDA approved artificial sweeteners is generally safe for women during pregnancy. However, moderation is prudent. The American Medical Association advises women to avoid saccharin during pregnancy because the fetus may not be able to clear the substance quickly enough, leading to build-up and it is not known what the resulting long-term effects, if any, would be.

# How Much Is Too Much?



## Are there Adverse Effects?

In the US, all food additives must be approved by the US Food and Drug Administration (FDA). Testing involves determining whether a substance is toxic, causes or increases risk for cancer, and whether it would affect a developing fetus. After passing these tests and being approved by the FDA, why—is there still controversy? Questions regarding the effects of non-nutritive sweeteners have been posed for the past 200 years beginning with the discovery and use of the first artificial sweetener, saccharin. Even despite decades of scientific research demonstrating the safety of artificial sweeteners, some still remained unconvinced.

These six sweeteners—acesulfame-K, aspartame, neotame, saccharin, stevia and sucralose—have been approved by the FDA for use in foods and/or drinks. Although the majority of research has been conducted on aspartame and saccharin, studies have not documented adverse effects related to the intake of these or other non-nutritive sweeteners, even when human subjects have consumed relatively large amounts. The American Dietetic Association (ADA), through its Evidence Analysis Library, examined the research on the effects of nonnutritive sweeteners on human subjects. There is strong evidence that aspartame, in particular, after testing for a wide range of possible effects over decades, is not associated with adverse effects in the general population. However, pregnant women should avoid aspartame because the fetus cannot break down the amino acid. Additionally, consistent with the findings of the FDA, the available research from peer-reviewed journals supports the safety of all these ingredients for the general adult population; however, the ADA suggests that continued post-market surveillance is needed; and that only limited research currently exists regarding possible adverse effects in children.

The FDA states that these six sugar substitutes are safe to eat in the amounts that consumers typically consume them. The next section discusses what amount is acceptable and safe.

## Acceptable Daily Intake (ADI)

The FDA has set Acceptable Daily Intake (ADI) levels for each artificial sweetener. The ADI is the maximum amount of a food additive that can be safely consumed on a daily basis over a person's lifetime without any adverse effects and includes a 100-fold safety factor. You might think, "just look at the number of diet soft drinks and other "sugar free" products we devour!" However, US intake of sugar substitutes is well below the ADI...even for the heaviest users, namely, dieters, adults and children with diabetes, and women of child-bearing age. One study showed that the average daily aspartame intake of those described above plus pregnant women was minimal, only 5-10% of the ADI. In general, children and adults with diabetes are the top users of sugar substitutes and they still do not exceed the ADI.

- How much of sugar substitutes can be consumed without adverse effects? Find out below:  
(Formula: Pounds/2.2 X ADI sweetener (mg) divided by amount sweetener (mg) in can beverage or pkg of sweetener)

### Acceptable Daily Intake (ADI) of Common Sugar Substitutes

(Based on an 150 Pound Adult)

Sweetener	Number of 12 oz cans diet soda to reach the ADI	Number of artificial sweetener packets to reach the ADI
Acesulfame-K	25.6	20.4
Aspartame	17	97.4
Saccharin	2.4	8.6
Sucralose	4.8	68.2
Stevia/Reb A	Product info not available...sodas containing stevia are not widely available.	30

These amounts of sweetener would need to be consumed over a person's lifetime! The ADI also includes a 100 fold safety factor, which means the FDA takes the minimum amount considered to be without adverse effects and then takes one one-hundredth of that amount to establish the ADI.

\* Average amount as Acesulfame-K is usually mixed with 90 mg aspartame

Sources: *Guide to Medical Nutrition Therapy for Diabetes*. American Diabetes Association. Chicago, IL; 2005.

*Rebiana. Recommended Intakes (ADI) and Metabolism*. Coca-Cola Beverage Institute for Health and Wellness. Available at: [www.thebeverageinstitute.org/articles/article-rebiana.htm](http://www.thebeverageinstitute.org/articles/article-rebiana.htm). Accessed 29 Mar 2011.

### Acceptable Daily Intake (ADI) of Common Sugar Substitutes

(Based on a 50 Pound Child)

Sweetener	Number of 12 oz cans diet soda to reach the ADI	Number of artificial sweetener packets to reach the ADI
Acesulfame-K	8.6	6.8
Aspartame	5.6	32.4
Saccharin	.8	2.8
Sucralose	1.6	22.8
Stevia/Reb A	Product info not available...sodas containing stevia are not widely available.	10

These amounts of sweetener would need to be consumed over a person's lifetime! The ADI also includes a 100 fold safety factor, which means the FDA takes the minimum amount considered to be without adverse effects and then takes one one-hundredth of that amount to establish the ADI.

\* Average amount as Acesulfame-K is usually mixed with 90 mg aspartame

Sources: *Guide to Medical Nutrition Therapy for Diabetes*. American Diabetes Association. Chicago, IL; 2005.

*Rebiana. Recommended Intakes (ADI) and Metabolism*. Coca-Cola Beverage Institute for Health and Wellness. Available at: [www.thebeverageinstitute.org/articles/article-rebiana.htm](http://www.thebeverageinstitute.org/articles/article-rebiana.htm). Accessed 29 Mar 2011.

Interpreting these charts: If you are a 150 pound adult, it is acceptable/safe for you to consume 97 packets of aspartame, or 17 twelve ounce cans of diet soda containing aspartame daily. If you are a 50 pound child, it is acceptable/safe for you to consume 22 packets of sucralose or 1 twelve ounce can of diet soda containing sucralose daily.