

FACTS ABOUT LOW-CALORIE SWEETENERS

INTERNATIONAL FOOD INFORMATION COUNCIL FOUNDATION

Low-calorie sweeteners (sometimes referred to as non-nutritive sweeteners, artificial sweeteners, or sugar substitutes) are ingredients added to foods and beverages to provide sweetness without adding a significant amount of calories. In fact, they can also play an important role in a weight management program that includes both good nutrition choices and physical activity.

Low-calorie sweeteners have a long history of safe use in a variety of foods and beverages, ranging from soft drinks to puddings and candies to table-top sweeteners. They are some of the most studied and reviewed food ingredients in the world today and have passed rigorous safety assessments. In the U.S., the most common and popular low-calorie sweeteners permitted for use in foods and beverages today are:

- acesulfame potassium (ace-K)
- aspartame
- neotame
- saccharin
- stevia sweeteners
- sucralose

When added to foods and beverages, these low-calorie sweeteners provide a taste that is similar to that of table sugar (sucrose), and are generally several hundred to several thousand times sweeter than sugar. They are often referred to as “intense” sweeteners. Because of their intense sweetening power, these sweeteners can be used in very small amounts and thus add only a negligible amount of calories to foods and beverages. As a result, they can substantially reduce or completely eliminate the calories in certain products such as diet beverages, light yogurt and sugar-free pudding. In addition, many low-calorie sweeteners do not contribute to cavities or tooth decay.

The following are some helpful facts about the safety, benefits, and uses of low-calorie sweeteners.

FACT: Low-calorie sweeteners are reviewed for safety by the federal government before being approved for use in foods and beverages.

Low-calorie sweeteners are thoroughly tested and carefully regulated by U.S. and international regulatory authorities, as well as scientific organizations, to ensure the safety of foods, beverages and other products that contain them. Also, food and beverage manufacturers are required to list low-calorie sweeteners in the ingredients list on the product label.

The Acceptable Daily Intake (ADI) must be determined by the U.S. Food and Drug Administration (FDA) prior to approval for any food ingredient, including low-calorie sweeteners, for use in foods and beverages in the U.S. The ADI is the amount of an ingredient (expressed in milligrams per kilogram of body weight) that a person can safely consume every day over a lifetime without risk. The ADI is set at one one-hundredth of the amount that has been found not to produce any adverse health effects in key animal studies. Therefore, it would be very difficult for a person to consume enough of any low-calorie sweetener to reach the ADI. In fact, current intake of each low-calorie sweetener is well below the ADI.

FACT: All approved low-calorie sweeteners can be safely consumed by the general population, including people with diabetes, pregnant women and children.

One exception is people who have a rare hereditary condition called phenylketonuria (PKU), which means they cannot metabolize phenylalanine, a component of aspartame. All products containing aspartame must carry a statement warning people with PKU of the presence of aspartame on the label.

For people with diabetes, who must control their blood-sugar levels through careful monitoring of their sugar and carbohydrate intake, low-calorie sweeteners can offer a sweet alternative that does not affect blood glucose levels.

In addition, pregnant women and children can safely consume foods and beverages sweetened with low-calorie sweeteners. Current low-calorie sweetener consumption in children is well below the

Acceptable Daily Intake (ADI) for all approved low-calorie sweeteners. However, pregnant women and young children are not encouraged to restrict their calorie intake, so they should talk with their healthcare provider and/or dietitian about ensuring that dietary plans including low-calorie sweeteners still meet the desired calorie and nutrient goals.

FACT: Low-calorie sweeteners do not cause or increase the risk of cancer.

Studies have repeatedly shown that low-calorie sweeteners do not cause or increase the risk of developing cancer. The following discusses cancer research conducted on each approved low-calorie sweetener.

Ace-K. Acesulfame potassium (ace-K) has been thoroughly tested in several long-term animal studies which used amounts of ace-K that were far higher than any person could potentially consume, and no evidence of cancer or tumors was found.

Aspartame. The vast majority of the research conducted over the last three decades has concluded that aspartame does not cause cancer. The National Cancer Institute (NCI) recently concluded that aspartame is not associated with increased risk of cancer, even among individuals with high aspartame intakes. In September 2007, a panel of experts published a safety report on aspartame which found “no credible evidence that aspartame is carcinogenic” (Magnuson, 2007). While two recent studies by a group of Italian researchers reported a link between aspartame and cancer in rats, the FDA found “significant shortcomings” in the design and interpretation of both studies. FDA subsequently stated that it does not plan to change its position on the safety of aspartame, and the European Food Safety Authority (EFSA) published an official Opinion of the same tone in April 2009.

Neotame. Prior to its approval as a general-purpose sweetener in 2002, more than 100 scientific studies were conducted on neotame, including cancer studies. Human studies were also conducted and “no significant effects of neotame were observed.”

Saccharin. While saccharin’s safety has been the subject of ongoing controversy, the sweetener has been established as safe for many years. Studies conducted several decades ago found a link between saccharin consumption and bladder cancer in rats, which raised concerns. This caused FDA to propose a ban on saccharin in 1977 and require a warning label on products containing saccharin. However, since then, researchers have concluded that the findings on bladder cancer in the rats do not apply to humans. (NCI, 2006) Other human studies on saccharin have found no consistent evidence to link saccharin with bladder cancer in humans. As of 2001, products containing saccharin no longer have to carry a warning label.

Stevia sweeteners. Several studies conducted on stevia sweeteners since the 1980s have shown that they are not associated with cancer. Recent research confirmed the conclusions of earlier research that steviol glycosides, the primary components of stevia sweeteners, do not pose a cancer risk. Additionally, in June 2008, the Joint Expert Committee on Food Additives (JECFA) completed a multi-year review of all the available scientific data on high purity steviol glycosides, and concluded that they are safe for use as general purpose sweeteners.

Sucralose. Extensive research on sucralose and health has been conducted over the last two decades. Comprehensive toxicology studies designed to meet the highest scientific standards have clearly demonstrated that sucralose is not cancerous.

FACT: Low-calorie sweeteners do not cause or increase the risk of other health conditions.

Low-calorie sweeteners are often inaccurately linked to adverse health effects, such as seizures, infertility, stomach ailments, and possible effects on kidney and liver function. However, the existing body of research does not support such effects. Health authorities around the world have verified that low-calorie sweeteners are safe. The following information on each low-calorie sweetener demonstrates that they do not cause or increase the risk of these or other health conditions.

Ace-K. There is a large body of scientific evidence that supports the safety of ace-K for use in foods and beverages. Throughout more than 15 years of extensive use, there have been no documented health problems in humans from consuming ace-K. The FDA has concluded that the safety of ace-K is consistent with research findings from other countries. EFSA's re-examination of the sweetener in 2000 reaffirmed its safety.

Aspartame. Both the French Food Safety Agency and EFSA re-evaluated and re-confirmed the safety of aspartame in 2002. In addition, the review by Magnuson, et al (2007) examined over 500 scientific studies, articles, and reports published over the last 25 years looking at mechanisms of aspartame absorption and metabolism, worldwide consumption levels, and toxicology data. Based on their review, the panel concluded that aspartame does not cause cancer, seizures, or other adverse effects on behavior, cognitive function, or neural function. In addition, EFSA again convened a Panel in 2009 to review all available evidence on aspartame safety and concluded that aspartame does not cause cancer or genotoxic effects, and there is no reason to revise the previously established ADI for aspartame.

Neotame. Of over 100 scientific studies conducted on neotame, no link has been found between neotame consumption and adverse health conditions, including toxicity, developmental and reproductive problems, or cancer.

Saccharin. Saccharin has been evaluated by credible health and science organizations and confirmed to be safe. The American Dietetic Association (ADA), American Cancer Society (ACS), and American Medical Association (AMA) all agree that saccharin is safe and acceptable for use.

Stevia sweeteners. The safety of stevia sweeteners for human consumption has been established through rigorous peer-reviewed research, including metabolism and pharmacokinetic studies, general and multi-generational safety studies, intake studies and human studies. This research is consistent with JECFA’s review of steviol glycosides, completed in 2008, which concluded that steviol glycosides are safe for human consumption.

Sucralose. More than 100 scientific studies have been conducted over a 20-year period on sucralose, looking at a variety of health conditions, such as toxicity, cancer, reproductive health, kidney health, brain and blood disorders, children’s health, and nutrition. These studies have demonstrated that sucralose does not cause

adverse health effects and is safe for use as a sweetening ingredient. The research on sucralose's safety has also been reviewed by scientific and regulatory bodies including JECFA and EFSA, both of which concluded it is safe for human consumption.

FACT: Low-calorie sweeteners can help with weight management and do not cause weight gain.

As Americans face increasing obesity rates, low-calorie sweeteners can offer help with weight management. Research indicates that people who incorporate foods and beverages sweetened with low-calorie sweeteners into their diet *in place of* calorie-containing sweeteners actually consume fewer calories than those who do not. Additionally, since they are not deprived of sweets, individuals consuming low-calorie sweeteners may feel more satisfied with their eating plans, helping them to lose weight and keep it off.

In one recent study, researchers at Purdue University found that consumption of saccharin led to increased appetite and weight gain in rats. However, due to a known affinity for saccharin of rats, small sample size, and other flaws in the study design, many experts agree that the results cannot be applied to humans. While a few studies have suggested that low-calorie sweeteners may cause cravings and/or lead to weight gain, these studies have not changed the overall scientific consensus that low-calorie sweeteners can aid in weight management.

Clinical studies conducted in humans over the past 20 years have shown that low-calorie sweeteners can help with weight loss and/or maintenance. A 2006 review of aspartame's role in weight management demonstrated a weight loss of 0.2 kg/week (or 0.4 lb/week) when aspartame-sweetened products were substituted for those sweetened with sugar. Similar findings were seen in a 1997 study published in the *American Journal of Clinical Nutrition*. Experts agree that successful weight management requires more than just calorie reduction – moderation, along with eating a balanced diet and regular exercise, is key to reaching an optimal weight.

More on the Six Low-Calorie Sweeteners

Each low-calorie sweetener has a slightly different set of characteristics:

Acesulfame-Potassium (Ace-K) - Ace-K is a combination of an organic acid and potassium, and is 200 times sweeter than sugar. It is a popular sweetener used in low-calorie sweetener blends to create an optimal flavor profile in foods and beverages.

Ace-K was approved by the U.S. Food and Drug Administration (FDA) in 1988 for use in numerous food products and as a tabletop sweetener. In 1998, the FDA extended its approval to beverages, and finally as a general purpose sweetener in 2003. Ace-K is approved for use in nearly 90 countries.

Ace-K is not broken down by the body and is eliminated unchanged by the kidneys. It has no effect on serum glucose, cholesterol or triglycerides, and people with diabetes may safely include products containing ace-K in their diet.

Aspartame – Discovered in 1965, aspartame is used in foods and beverages in more than 100 countries worldwide. FDA approved aspartame for use in foods in 1981, followed by beverages in 1983. In 1996 it received approval as a general purpose sweetener.

Aspartame is a molecule consisting of two amino acids – phenylalanine and aspartic acid. People who have a rare hereditary condition called phenylketonuria (PKU) cannot metabolize phenylalanine; therefore, all products containing aspartame must carry a statement warning people with PKU of the presence of aspartame on the label.

Aspartame provides four calories per gram. However, it is used in very small amounts, contributing negligible calories to the diet. Aspartame is approximately 180 times sweeter than sugar. It is not heat-stable and is not suggested for use in cooking or baking.

Neotame - Neotame is also a derivative of aspartic acid and phenylalanine. It is approximately 7,000 to 8,000 times sweeter than sugar, although some report a sweetening power of up to 13,000 times that of sugar. It is partially absorbed, but rapidly metabolized and excreted from the body.

Neotame was approved by FDA in July 2002 as a general purpose sweetener. Neotame has also received favorable evaluation by JECFA and is approved for use in other countries, including most parts of Eastern Europe, Australia, Russia, Mexico and several South American countries.

Because of the extraordinary sweetening power of a small amount of neotame, the level of exposure to phenylalanine as it is released into the bloodstream is considered clinically insignificant. Therefore, products sweetened with neotame are not required to carry a statement on the label alerting persons with PKU to the presence of phenylalanine.

Saccharin - Originally discovered in 1878, saccharin is considered the oldest of the low-calorie sweeteners approved for food and beverage use. Today saccharin is still used safely and widely and often in combination with other sweeteners. Saccharin is 300 times sweeter than sugar, although some reports have indicated it can be up to 700 times sweeter than sugar. It is not broken down by the body and is eliminated without providing any calories. Saccharin is heat stable, therefore making it suitable for cooking and baking.

Stevia sweeteners - The stevia plant is native to South America, and today, it can be found growing in many countries including China, Brazil, Argentina, Paraguay, India and South Korea. Hundreds of foods and beverages consumed around the world are sweetened with stevia sweeteners.

Stevia sweeteners are highly purified steviol glycosides, which make up the sweetest part of the stevia plant. In December 2008, the FDA stated it had no questions regarding the conclusion of an expert panel that steviol glycosides are generally recognized as safe (GRAS) for use as general purpose sweeteners. Prior to this, stevia (in its unpurified form) was only permitted for use as a dietary supplement in the U.S. Stevia sweeteners are natural, contain zero calories, and are 200-300 times sweeter than sugar.

Stevia sweeteners are approved for food and beverage use in several countries and can be found in the U.S. in many food and beverage products, including some juice and tea beverages, as well as some tabletop sweeteners.

Sucralose - In 1998, FDA approved sucralose for use in 15 food and beverage categories – the broadest initial approval ever given to a food additive. In 1999, FDA extended the approval to all categories of foods and beverages as a general-purpose sweetener.

Six hundred times sweeter than sugar, the intense sweetness of sucralose is made from a process that begins with regular table sugar (sucrose); however, it is not sugar. It is produced through a process whereby three hydrogen-oxygen groups on the sugar molecule are replaced with three chlorine atoms. Sucralose is not recognized by the body as a carbohydrate. It is poorly absorbed and is excreted unchanged from the body. As a result, sucralose provides no calories. Because sucralose is very stable, it can be used almost anywhere sugar is used, including in cooking and baking.

See Table 1 below for more general information on each low-calorie sweetener.

Table 1.

Low-Calorie Sweeteners At-A-Glance			
Sweetener	Date Approved	Sweeter Than Sugar	Brand Name(s)
Ace-K	1988	200x	Sunett®, Sweet One®
Aspartame	1981	180x	NutraSweet®, Equal®, others
Neotame	2002	7,000x	n/a
Saccharin	Years prior to 1958	300x	Sweet 'N Low®, Sweet Twin, Sugar Twin®, others
Stevia Sweeteners	2008	200x	Truvia™, PureVia™, Sun Crystals®
Sucralose	1998	600x	Splenda®
Sources: <i>Comprehensive Reviews in Food Science and Food Safety</i> , IFT, 2006 <i>Food and Chemical Toxicology</i> , 2008			

For more information on low-calorie sweeteners, visit these resources on the FoodInsight.org Web site:

- [Everything You Need to Know About Aspartame](#)
- [Everything You Need to Know About Acesulfame-Potassium](#)
- [Everything You Need to Know About Sucralose](#)
- [Gestational Diabetes and Low-Calorie Sweeteners: Answers to Common Questions](#)
- [Healthy Eating During Pregnancy](#)
- [IFIC Review: Low-Calorie Sweeteners and Health](#)
- [The Lowdown on Low-Calorie Sweeteners \(CPE module\)](#)
- [Stevia Sweeteners: Another Low-Calorie Option](#) (*Food Insight* article)



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