There’s no mistaking it: Americans love to eat. Enjoying good food with good company is one of life’s great pleasures. And yet, frequent over-indulgences can have a detrimental impact on conditions like obesity and type 2 diabetes, which take a substantial toll on individuals, communities and our healthcare system. Replacing foods and beverages high in calories and added sugars with ones that are lower in sugar is one option to help reduce intake of excess calories. In turn, this may help reduce the risk of obesity and related chronic diseases. One type of low-calorie sweetener, aspartame, has been used in foods and beverages for decades as a way to lower intake of added sugars, while still providing satisfaction from enjoying something sweet. This fact sheet will examine many topics of interest around aspartame and health so that you can make informed decisions about its place in your diet.

**WHAT IS ASPARTAME?**

Aspartame consists of the amino acids aspartic acid and phenylalanine, which are building blocks of protein, and is about 200 times sweeter than sugar. When ingested, it is broken down into these amino acids and a small amount of methanol, a compound that is naturally found in foods like fruits and vegetables. Just like sugar, aspartame contains 4 calories per gram. However, because aspartame is much sweeter than sugar, very little is needed in foods and beverages to match the sweetness provided by sugar. This keeps the calories contributed by aspartame very low per serving. To closely match the volume and flavor that sugar provides, aspartame is typically blended with a small amount of carbohydrate. This is why a packet of aspartame sweetener seems equal in quantity to a packet of table sugar, for example.

Aspartame is available as a tabletop sweetener, the most common brands being Equal®, Canderel® and Pal Sweet®.

It is also found in beverages (sodas, juices, flavored waters), dairy products (light yogurt, low-fat, flavored milk), nutrition bars, desserts (sugar-free puddings and gelatins, light ice cream, popsicles), chewing gum, sauces, syrups and condiments. Some prescription and over-the-counter medications and chewable vitamins may contain aspartame to increase palatability. Aspartame is not well-suited for foods that require baking for a long time at high temperatures, so it’s not commonly used in most baked goods.
IS ASPARTAME SAFE TO CONSUME?

**YES.** Aspartame is one of the most exhaustively studied substances in the human food supply, with over 200 studies supporting its safety. The Food and Drug Administration (FDA) approved its use in dry foods in 1981, in carbonated beverages in 1983 and in all foods in 1996. Leading global health authorities such as the European Food Safety Authority (EFSA), the FAO/WHO Joint Expert Committee on Food Additives, Japan’s Ministry of Health, Labor and Welfare, Food Standards Australia New Zealand and Health Canada have also found aspartame to be safe.

The FDA established an acceptable daily intake (ADI) for aspartame of 50 milligrams per kilogram of body weight (mg/kg) per day. The ADI represents an amount 100 times less than the quantity of aspartame found to be safe in research studies. For a person weighing 150 pounds (68 kg), this equates to 3,400 mg of aspartame — the amount found in 19 cans of diet soda or more than 100 individual packets of aspartame — consumed, on average, every day over a lifetime. EFSA has established a slightly lower ADI of 40 mg/kg per day. In people who report consuming aspartame, the estimated average intake is 4.9 mg/kg per day, which is less than 10 percent of the FDA’s ADI (Magnuson 2007). For those in the 95th percentile of aspartame consumption, intake is estimated at 13.3 mg/kg per day — still far below the ADI. Globally, aspartame intake also remains well below the ADI. A 2018 study noted that only in rare instances did individuals exceed more than 20 percent of the ADI, even in the highest-consuming groups (Martyn 2018).

WHAT IS AN ADI?

The acceptable daily intake, or ADI, is the average daily intake over a lifetime that is expected to be safe based on significant research (WHO 2009). It is usually derived by determining the highest intake level found to have no adverse effects in lifetime studies in animal models. These studies are required by FDA and other regulatory agencies around the world before permitting any new food ingredient. That amount is then divided by 100 to determine the ADI (Renwick 1991). The ADI is a conservative number that the vast majority of people will not reach.

IS ASPARTAME SAFE FOR CHILDREN?

**YES.** Foods sweetened with aspartame can add sweetness to a child’s diet without contributing to increased calorie intake, sugar intake, or risk of cavities. As with adults, current intake of low-calorie sweeteners in children is considered to be well within acceptable levels. The Academy of Nutrition and Dietetics states that both nutritive and low-calorie sweeteners can be part of a healthful diet in line with the Dietary Guidelines for Americans and individual health goals (Fitch 2012). Due to limited studies in children, the American Academy of Pediatrics does not have official recommendations on low-calorie sweetener intake.

CAN PREGNANT AND BREASTFEEDING WOMEN CONSUME ASPARTAME?

**YES.** Pregnant and lactating women are frequently concerned about the influence of foods, beverages and medications on their babies’ health. Research has shown that aspartame has no adverse effects on expecting or nursing mothers or on the fetus. Aspartame is rapidly metabolized to the amino acids phenylalanine and aspartic acid and a small amount of methanol after ingestion, so it is not present in breast milk (Sylvetsky 2015, Magnuson 2016). All women should try to consume the necessary nutrients and calories for their baby’s growth during pregnancy and breastfeeding, while taking care not to exceed their needs. This may include being mindful of all sources of sweeteners, whether they be from sugar or low-calorie sweeteners.
CAN PEOPLE WITH DIABETES CONSUME ASPARTAME?

**YES.** Products containing aspartame provide a sweet taste and are often low or lower in carbohydrates, which is important for people who must monitor their carbohydrate intake. Aspartame does not raise blood sugar levels or otherwise affect blood glucose control. The 2018 American Diabetes Association Standards of Medical Care in Diabetes state that, “The use of nonnutritive sweeteners may have the potential to reduce overall calorie and carbohydrate intake if substituted for caloric (sugar) sweeteners and without compensation by intake of additional calories from other food sources. Nonnutritive sweeteners are generally safe to use within the defined acceptable daily intake levels.”

This statement is supported by the Academy of Nutrition and Dietetics, Diabetes UK and Diabetes Canada. People with diabetes should talk with a registered dietitian, health care professional or a certified diabetes educator for advice on healthy eating to improve blood sugar control.

WILL ASPARTAME HELP ME LOSE OR MAINTAIN MY WEIGHT?

Substituting foods and beverages sweetened with aspartame for their full-sugar counterparts can play a role in weight loss or weight management. In a survey of members of the National Weight Control Registry, the largest longitudinal study of successful weight loss maintainers, over 50 percent of all respondents stated that they regularly consume low-calorie beverages, 78 percent of whom felt that doing so helped control their calorie intake (Catenacci 2014).

Data from randomized controlled trials, considered to be the gold standard for assessing causal effects, support that substituting low-calorie sweetener options for regular-calorie versions leads to modest weight loss (Miller 2014, Rogers 2016, Sylvetsky & Rother 2018). For example, in one study, over 300 participants were assigned to consume either water or low-calorie sweetened beverages for one year as part of a weight-loss program. Those who were assigned to the low-calorie sweetener group lost 6.21 kg on average, compared to those in the water group, who lost 2.45 kg (Peters 2016).

Some observational studies have demonstrated an association between low-calorie sweeteners and increased weight and waist circumference (Fowler 2016). Observational studies, which examine the relationship between an exposure (such as aspartame intake) and an outcome (such as body weight or a health condition), are not able to provide evidence of cause and effect. Additionally, observational studies are not randomized, so they cannot control for all of the other exposures or factors that may be causing or influencing the results. For example, one hypothesis is that people may compensate for “calorie-free” choices by eating or drinking more calories in other food choices or future meals (Mattes 2009). Think of a person who may justify ordering dessert at a restaurant because they had a diet soda with their meal: the extra calories from the dessert will
DOES ASPARTAME AFFECT BLOOD SUGAR CONTROL?

Foods and beverages made with aspartame are frequently recommended to people with diabetes as an alternative to sugar-sweetened foods and beverages. Extensive research shows that aspartame does not raise blood sugar levels or otherwise affect blood glucose control in humans (Nichol 2018, Romo-Romo 2017, Santos 2017), and a recent consensus statement by experts in nutrition, medicine, physical activity and public health concluded that the use of low-calorie sweeteners in diabetes management may contribute to better glycemic control (Serra-Majem 2018). For example, in a recent study, aspartame ingestion had no effect on blood glucose or insulin over the 12-week intervention as compared to a placebo (Higgins 2018).

Despite these conclusions, some studies have periodically raised questions about aspartame and blood glucose control. A few observational studies have demonstrated an association between low-calorie sweetener consumption and risk for type 2 diabetes (Sakurai 2014, Imamura 2015, Kuk 2016) but are not able to directly link cause and effect, and as with the studies on body weight and obesity, they are at risk of confounding. For instance, many studies do not adjust for obesity status, a direct contributor to developing type 2 diabetes. Given that overweight and obese individuals tend to consume more low-calorie sweetened beverages compared to lean individuals (Bleich 2014), this is a critical omission.

Many medical, nutrition and public health organizations around the world, backed by a large body of evidence, support the consumption of low-calorie sweeteners in people with diabetes. These individuals, or those who are at risk for developing diabetes, should be mindful of food and beverage intake from all sources, including those containing low-calorie sweeteners and sugars. It is important to discuss nutrition with a doctor or registered dietitian and to eat a healthful, balanced diet to keep blood sugar levels under control.
Highly palatable foods activate brain regions of reward and pleasure. This positive association can enhance appetite, and if left unchecked, the resulting increase in food intake can lead to overweight and obesity (Singh 2014). Substituting full-calorie and sugar-containing foods with their counterparts made with low-calorie sweeteners has exhibited a similar effect on reward pathways, but without contributing additional calories.

Some have expressed concern that activating reward pathways without delivering sugar to the body may have unintended consequences, and the role that low-calorie sweeteners have on appetite and food cravings is a developing area of research. As noted in recent reviews (Fowler 2016, Sylvetsky & Rother 2018), some research in animal models has demonstrated changes in food intake and appetite-related hormones after consuming low-calorie sweeteners. And yet, similar effects have not been seen in humans. To date there is no strong evidence that low-calorie sweeteners, including aspartame, enhance appetite or cravings in humans (Rogers 2017), and some randomized trials have demonstrated the opposite effect — including a decrease in hunger (Peters 2016) and reduced dessert intake compared to those who drank water (Piernas 2013).

These discrepancies underscore an area in which animals and humans are inherently different as research subjects. In humans, the link between physiology, psychology, personal experiences and food is unmistakably complex, and the translation of animal research to this area of study should be viewed with caution.
EMERGING RESEARCH:
WHAT ABOUT THE MICROBIOME?

The microbes living in our intestinal tract have become recognized as potentially significant contributors to our health, though research on the gut microbiome is still in its infancy. Studies on aspartame’s effect on the gut microbiome are lacking, and its route and location of digestion may be a factor in the lack of research. Because aspartame is digested to its component amino acids and a small amount of methanol in the small intestine, it is unlikely that intact aspartame reaches gut microbes, which predominantly cluster at the end of the intestinal tract. One animal study (Palmnäs 2014) showed an increased number of total bacteria and change in abundance of several bacterial species in rats consuming both aspartame and a high-fat diet. One very small study in humans compared the microbial profiles of aspartame consumers and non-consumers (Frankenfeld 2015). There were no differences in the abundance of gut bacteria, though bacterial diversity differed between groups. There are significant differences between the microbiome profiles from one person to another and research has shown that the gut microbiome changes in response to changes in the diet (David 2014). A great deal of research is still needed to identify a microbiome profile and degree of diversity considered to be “optimal” in populations and in individuals.

IS IT POSSIBLE TO BE SENSITIVE TO ASPARTAME?

Despite aspartame’s safety approvals by many international institutions, anecdotal reports of symptoms presumed to be related to aspartame intake (most commonly, headaches) continue to surface. Only a few studies have been conducted on this possible connection, all of which are marked by small sample sizes and methodological difficulties. In a 2016 review (Martin 2016), two of four studies found that aspartame exposure was associated with increased headache frequency, but the other two found no difference between aspartame and control groups. Each of these studies used doses of aspartame that are higher than the amount normally consumed in the diet. Additionally, a United Kingdom Food Standards Agency randomized control trial did not find differences in physical, biochemical or psychological symptoms after consuming aspartame in self-reported “aspartame-sensitive” participants (Sathyapalan 2015). It is important to remember that aspartame is broken down in the intestinal tract to aspartic acid, phenylalanine and methanol, all of which are naturally present in other foods and beverages in much higher quantities. This makes a biological mechanism for aspartame-specific symptoms difficult to hypothesize.
WHAT IS THE BOTTOM LINE?

All types of foods and beverages can have a place in our diets, including those made with aspartame. Aspartame has been FDA-approved for nearly four decades, and its safety has been acknowledged by many international health agencies. However, people with phenylketonuria (PKU) should avoid or restrict intake of aspartame along with other sources of phenylalanine.

Aspartame’s impact on and association with chronic metabolic conditions like obesity and diabetes have been extensively studied. Observational studies linking low-calorie sweeteners to weight gain inherently cannot demonstrate a causal relationship, while randomized controlled trials consistently support that low-calorie sweeteners like aspartame can be useful in nutritional strategies to assist with weight-loss and weight-maintenance goals. Aspartame has no impact on blood sugar or insulin levels in randomized trials and no effect on appetite. Evidence of sensitivity to aspartame is slim, as there is no biological mechanism for aspartame-specific symptoms. Studies of aspartame’s effects on the gut microbiome have been conducted, though because it is consumed in small amounts and absorbed in the small intestine, it is unlikely that intact aspartame reaches gut microbes.

Adopting a healthful, active lifestyle that is tailored to personal goals and priorities is vital to supporting one’s well-being. Choosing foods and beverages sweetened with low-calorie sweeteners such as aspartame is one way to control sugar intake and keep calories in check, which are important components of maintaining health and reducing risk for diet-related disease.

WHAT IS PHENYLKETONURIA?

Phenylketonuria (PKU) is a rare genetic disease that makes an affected person unable to properly metabolize phenylalanine, one of the amino acids found in aspartame and many common foods. Individuals with PKU need to avoid or restrict their intake of phenylalanine from all sources of food, so all aspartame-containing foods and beverages must include a statement on the product informing people of its presence.

ASPARTAME AT A GLANCE

<table>
<thead>
<tr>
<th>SCIENTIFIC NAME:</th>
<th>Aspartame</th>
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<tbody>
<tr>
<td>BRAND NAME:</td>
<td>Equal®, Canderel®, Pal Sweet® and other store brands</td>
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<tr>
<td>DATE APPROVED BY FDA:</td>
<td>1981 for dry foods 1983 for carbonated beverages 1996 for all foods</td>
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<tr>
<td>NUMBER OF TIMES SWEETER THAN SUGAR:</td>
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<td>SAFE FOR CHILDREN?:</td>
<td>Yes</td>
</tr>
<tr>
<td>SAFE FOR PREGNANT AND BREASTFEEDING WOMEN?:</td>
<td>Yes</td>
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REFERENCES


Fowler SPG. Low-calorie sweetener use and energy balance: Results from experimental studies in animals, and large-scale prospective studies in humans. *Physiol Behav*. 2016 Oct 1;164(Pt B):517-523.


ASPARTAME