The Beverage Institute For Health & Wellness

BEVERAGE SCIENCE Q&A: ASPARTAME

What is aspartame?

Aspartame is a potently sweet compound used as a low-calorie sugar substitute to sweeten thousands of food and beverage products.

Although commonly used as a sugar substitute, aspartame actually provides calories -- just like sugar and other food components. However, because aspartame is approximately 200 times more potent than common table sugar, a mere 1/200 of a teaspoon is needed to replace each teaspoon of sugar in a food or beverage. Thus, even though aspartame provides the same number of calories as a similar weight of table sugar (16 calories per teaspoon), so little is needed to sweeten foods and beverages that its actual calorie contribution is negligible.

Discovered in 1965 and approved for the first time by the US Food and Drug Administration (FDA) in 1981, aspartame can be found in more than 6,000 products around the world, including carbonated soft drinks, powdered soft drinks, chewing gum, confections, gelatins, dessert mixes, puddings and fillings, frozen desserts, yogurt, tabletop sweeteners, and some pharmaceuticals like vitamins and sugar-free cough drops.

How is aspartame made?

Although it has a sweet taste, aspartame is actually made by linking the amino acid aspartic acid to the methyl ester of a second amino acid called phenylalanine. Amino acids, including aspartic acid and phenylalanine, are the building blocks for nearly every protein in the diet, as well as the structural and functional proteins that make up the human body -- organs like the brain and heart, tissues like skeletal muscle and blood vessels, and enzymes that help digest food. Methyl esters are natural structural components of fruit and vegetables. Such natural methyl esters include the gum known as pectin, a natural carbohydrate found in many fruits, including apples, plums, gooseberries, lemons, limes, grapefruits and oranges. The pectin used to thicken jellies and jams is commonly obtained from these fruit sources.

How is aspartame handled by the body?

Aspartame is fully metabolized by the body, just like protein and other food components. Enzymes in the digestive tract break aspartame down into its building block components: aspartic acid, phenylalanine and methanol. These components are subsequently absorbed and used by the body in the exactly the same way as they are when derived from other dietary sources. In other words, the amino acids derived from aspartame are handled just like the amino acids derived from milk, chicken or any dietary source of protein; the methanol is handled just like the methanol obtained from the complex carbohydrates present in tomato juice or many other fruits and vegetables.

Because the amount of aspartame needed to sweeten beverages is so small, the levels of aspartic acid, phenylalanine and methanol derived from aspartame-sweetened beverages are also small. In fact, the digestion of 12-ounce glass of milk produces 13 times more aspartic acid and more than six times more phenylalanine, and digestion of a 12-ounce glass of tomato juice provides nearly six times more methanol, than the digestion of the same size serving of an aspartame-sweetened beverage.

Because neither aspartame nor its components accumulate in the body over time, it can be safely used by the entire family except for the few individuals born with a rare but serious genetic defect called phenylketonuria or PKU. People born with PKU are unable to properly metabolize the amino acid phenylalanine, which is one of the two amino acids used to make aspartame.

About 1 out of every 15,000 people is born with PKU, a condition which, if left untreated with a low-phenylalanine diet, causes phenylalanine and its breakdown products to accumulate in the bloodstream, resulting in brain damage and progressive mental retardation. Fortunately, because this genetic defect is readily detectable within days of birth using the small blood sample routinely collected via the Guthrie heel prick, phenylketonuria screening is routinely done in most industrialized countries in conjunction with testing for thyroid function and other genetic disorders of metabolism. This is important because, when diagnosed and early enough, those born with PKU can grow up with normal brain development by eating a special diet low in phenylalanine. Managing the diet for PKU can be extremely challenging, however, because not only is phenylalanine present in all dietary proteins in relatively high levels, it is also one of the nine essential dietary amino acids needed to build the structural and functional proteins of the human body. To control phenylalanine intake, the PKU diet is nearly protein-free. It severely restricts or eliminates foods high in phenylalanine, such as breast milk, meat, chicken, fish, nuts, cheese and other dairy products, as well as some starchy foods such as potatoes, bread, pasta, and corn. And, because phenylalanine is used to make aspartame, aspartame-sweetened foods and beverages are also avoided. Those with PKU also consume a special PKU formula that provides the other amino acids and nutrients that would otherwise be lacking in a protein free diet. Because PKU is a genetic disease, it is not possible to acquire it later in life.

Why do labels on aspartame-sweetened foods and beverages have an alert regarding presence of phenylalanine?

Because phenylalanine is one of two amino acids used to make aspartame, foods and beverages that contain this sweetener are required to carry a statement on their labels to alerts people with a rare inherited disease called phenylketonuria (PKU) that there is phenylalanine in the product. Beverages sweetened with sugar substitutes other than aspartame do not carry this precautionary alert because they do not contain phenylalanine.

The US Food and Drug Administration (FDA) and other food safety agencies globally initially required this alert when aspartame was new and those with PKU were not yet familiar with it as a source of phenylalanine. Although most people living with PKU today are very familiar with aspartame as a source of phenylalanine, the labeling requirement has not changed. People born with PKU must not only avoid aspartame, but also all phenylalanine-containing foods, including milk, meat, seafood, eggs, cheese, beans, nuts and grains. For all other consumers, the phenylalanine alert should be thought of like statements on other food products, such as “contains soy” or “contains peanuts,” that provide information to those with allergies. In other words, these statements, like the phenylalanine statement on aspartame-sweetened foods and beverages, are not meant for consumers in general and do not imply they should be avoided.

Unfortunately, some consumers erroneously believe that the phenylalanine alert indicates a high or potentially unhealthy level of phenylalanine – which is untrue. In fact, because phenylalanine is a key amino acid building block for nearly all proteins, the amount of phenylalanine obtained from aspartame-sweetened foods and beverages small compared to other foods that people routinely consume:

Phenylalanine Content of Common Foods		
Food	Serving	Phenylalanine Content (mg)
Aspartame-sweetened cola	12 oz (360 ml)	100
Roast Chicken	3 oz (100 g)	1230
1% Low-fat Milk	12 oz (360 ml)	600
Peas, cooked	1 cup	300
Almonds	1 oz (30 g)	325
Tofu	½ cup (124 g)	487 mg

Are there guidelines for how much aspartame a person should consume?

Yes. Food safety authorities such as the US Food and Drug Administration (FDA) have established legal body weight-based standards called Acceptable Daily Intakes (ADIs), which are the estimated amount that a person can safely consume on average *every day over a lifetime* without risk. In the US, the FDA has set the ADI for aspartame at 50 mg/kg of body weight, which translates into a 150 pound (70 kg) person consuming nearly 20 12-ounce cans of soft drinks sweetened entirely with aspartame every day over his or her lifetime. This is the highest ADI awarded for any of the sugar substitute sweeteners approved for use in the US (i.e., saccharin, aspartame, acesulfame-K, sucralose and neotame). In Europe and Canada, the ADI for aspartame is set slightly lower, at 40 mg/kg of body weight per day.

The amount of aspartame Americans consume is monitored through dietary surveys. Those surveys show that adults with the highest level of intake, those at the 90th percentile of aspartame consumption, consume roughly 3.0 mg/kg of body weight per day – or just 6% of the US ADI.

Is aspartame safe for children?

Yes, aspartame can be safely incorporated into a healthful diet for children, and if aspartame-sweetened foods and beverages are substituted for those containing table sugar and other higher-calorie sweeteners, there is a potential for energy savings that can help children, particularly adolescents, manage their energy intake.

Children, like adults, metabolize aspartame's natural building blocks in the exactly the same way as when these food components are derived from other dietary sources. In addition, aspartame studies in laboratory animals demonstrated no effects on growth and development even when extremely large doses of aspartame were given from the prenatal period all the way to adulthood. Numerous studies have also shown that aspartame does not affect the behavior of children, including those diagnosed with Attention Deficit Disorder (ADD).

A task force of the American Academy of Pediatrics' Committee on Nutrition has also determined that aspartame is safe for both the mother and developing baby. Of course, it is important for all pregnant women to consult with their doctors regarding nutritional needs during pregnancy, and for parents to discuss issues related to their children's weight and diet with their pediatrician or primary care physician.

Does aspartame cause unhealthy levels of methanol in the bloodstream?

No. Although it is true that methanol in large doses can cause serious health problems, the amount of methanol produced by the digestion of the methyl ester of phenylalanine in aspartame-sweetened beverages is extremely small. In fact, the digestion of a cup (240 ml) of tomato juice produces six times more methanol than does the digestion of the same volume of an aspartame-sweetened soft drink: 82 milligrams per cup of tomato juice verses 14 milligrams per cup of an aspartame-sweetened soft drink.

Most people do not realize that small amounts of methyl esters and methanol are naturally present in many foods and beverages that we consume every day -- without ill effect. According to the American Council on Science and Health, all fermented foods and beverages can be expected to contain trace amounts of methanol as well as other alcohols, while vegetables, fruits and their juices can contain substantial amounts. For example, digesting a cup of apple juice produces 1.5 times more methanol than digesting the same amount of aspartame-sweetened soft drink. To put this in perspective, the American Council on Science and Health notes that, "to obtain a fatal dose of methanol from apple juice, an individual would have to consume between 100 and 10000 quarts of apple juice at a single sitting – an obviously absurd scenario."

Methanol toxicity occurs when it is ingested in large enough amounts to overwhelm the body's ability to handle it. This was a serious problem during Prohibition in the 1930s when some people

tried to satisfy their desire for alcohol (ethanol) by drinking wood alcohol -- which is 100 percent methanol.

Has the safety of aspartame been recently examined?

Yes. Aspartame is one of the most thoroughly studied food ingredients in the world, with more than 200 scientific studies confirming its safety. It was first approved for use in the US Food and Drug Administration (FDA) in 1981 and shortly thereafter for use in Europe by the Joint Expert Committee on Food Additives of the Codex Alimentarius Commission (JECFA) and the Scientific Committee for Food of the European Union (SCF). Aspartame is now approved for use in food and beverage products in more than 100 countries.

Recent Safety Reviews Confirm Aspartame Safety: Although the safety of aspartame has been studied and confirmed by many food safety and health experts, the European Commission asked the Scientific Committee on Food (SCF) to revisit its previous aspartame safety assessment in 2001 following the publication of anecdotal reports that cast doubt on aspartame's safety. After reviewing more than 500 papers published in the scientific literature between 1988 and 2001, including studies supporting the safety of aspartame and others pointing to potential adverse effects, the SCF concluded that there was no evidence to suggest a need to revise the outcome of their earlier risk assessment or change the recommended ADI, which in Europe is set at 40 mg/kg of body weight per day.

In early 2006, the European Food Safety Authority (EFSA) published a further review on the safety of aspartame in response to a study published by the Ramazzini Foundation of Bologna, Italy in July 2005. That study claimed to have shown that rats given dosages of aspartame equivalent to the Acceptable Daily Intake (ADI) may develop leukemia. However, because EFSA had numerous concerns about the design and conduct of this study and given the large number of studies that confirm aspartame's safety and with no suggestion of leukemia or other forms of cancer, they concluded that there was no need to further review the safety of aspartame or revise the established ADI.

Also in 2006, the US National Cancer Institute (NCI) published a large-scale epidemiological study that reconfirmed there is no link between the consumption of aspartame-containing beverages and leukemias, lymphomas or brain tumors. That study evaluated nearly 500,000 men and women between the ages of 50 and 69 over a five-year period and found no increased risk of leukemia, lymphomas and brain tumors among those who drank aspartame-containing beverages and those who did not.

Does aspartame cause headaches?

No. In one of the best designed studies testing whether aspartame caused headaches or migraines, Duke University researchers gave a large dose of aspartame or a placebo to people who were convinced that aspartame caused their headaches. The results, which were published in the New England Journal of Medicine, showed no difference in headache frequency, blood pressure, or blood histamine concentrations (a measure of allergenic potential) between the experimental and control groups. The researchers concluded that aspartame was not the cause of these individuals' headaches or migraines.

This of course does not mean that people with headaches and migraines are not experiencing real problems – just that aspartame is most likely not the culprit. People get headaches, as well as upset stomachs, and aches and pains of all kinds on a regular basis for no easily determined reason. If they recall having consumed aspartame when one of these ailments strikes, the sweetener may be judged to be guilty by association.

Aspartame Information Resources:

FDA
[www.fda.gov]

Health Canada
[www.hc-sc.gc.ca]

Food Standards Agency (UK)
[www.food.gov.uk]

European Food Safety Authority
[www.efsa.europa.eu]

American Dietetic Association
[www.eatright.org]

International Food Information Council
[www.ific.org]

The Calorie Control Council
[www.caloriecontrol.org/]

Ajinomoto
[www.aboutaspartame.com]

Did you know?

Aspartame is 200 times more potent than sugar, which means a little goes a long way. In fact, 8 ounces (240 ml) of diet Coke contains just 1/25 of a teaspoon (or 125 milligrams) of aspartame.