Artificial Sweeteners

What We Know

› Artificial sweeteners are non-nutritive sweeteners (NNSs; containing zero to negligible calories) used as substitutes for sucrose (table sugar) for the purpose of reducing the caloric and glycemic impact of prepared foods and beverages. NNSs tend to have a significantly higher intensity of sweetness in comparison to sucro and therefore are able to reproduce the sweetness of sucrose in a fraction of the quantity. Inspite of their intense sweetness, NNSs do not directly impact blood glucose levels, making them useful in the dietary management of diabetes mellitus (DM). The eight NNSs that have been approved by the Food and Drug Administration (FDA) for use in food production in the United States are acesulfame-potassium (Ace-K), advantame, aspartame, luo han guo (i.e., Siraitia grosvenorii Swingle fruit extract [SGFE]), neotame, saccharin, steviol glycosides (stevia extracts), and sucralose

• Ace-K is about 200 times sweeter than sucrose and is frequently used in combination with other sweeteners. It is sold under the brand names Sunett and Sweet One. Ace-K can be found on food labels as the names acesulfame K, acesulfame potassium, or Ace-K

• Advantame is about 20,000 times sweeter than sucrose

• Aspartame is about 200 times sweeter than sucrose. Aspartame is one of the most commonly used NNSs and is sold under brand names Nutrasweet, Equal, and Sugar Twin. Phenylalanine is a component of aspartame. Individuals with phenylketonuria (PKU) are unable to adequately metabolize phenylalanine; therefore the labels of foods containing aspartame are required to include a statement to inform consumers of phenylalanine content

• SGFE, commonly known as luo han guo or monk fruit extract, is about 100–250 times the sweetness of sucrose

• Neotame is about 7,000–13,000 times the sweetness of sucrose and is sold under the brand name Newtame

• Saccharin is 200–700 times sweeter than sucrose and is sold under the brand names Sweet and Low, Sweet Twin, Sweet’N Low, and Necta Sweet. At one time saccharin-containing foods were required to carry a warning label as a possible carcinogen. After numerous human studies demonstrated that saccharin is safe for human consumption, the National Toxicology Program of the National Institutes of Health determined in 2000 that saccharin should be removed from the list of potent carcinogens. The warning label is no longer required

• Steviol glycosides are extracts of stevia (i.e., Stevia rebaudiana Bertoni) leaves and are 200–400 times sweeter than sucrose. High-purity stviol glycosides are considered safe. However, stevia leaf and crude stevia extracts have not been approved by the FDA for use as sweeteners

• Sucralose is about 600 times sweeter than sucrose and is sold under the brand name Splenda

› Research findings on artificial sweeteners

• Researchers who analyzed data from the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) determined that in normal-weight individuals, consumption of artificial
sweeteners was positively associated with developing diabetes. The same association was not found for overweight and obese individuals, in whom higher artificial sweetener intake was found to be associated with better insulin resistance results\(^{(12)}\)

- A meta-analysis of randomized controlled trials (RCTs) and prospective cohort studies was conducted to investigate the impact of artificial sweeteners on body weight. While a few observational studies indicated a positive association between artificial sweetener intake and body mass index (BMI), the data collected from the RCTs revealed that the substitution of NNSs for regular-calorie versions of the same foods/beverages resulted in modest weight loss\(^{(7)}\)
- Although many short-term studies have shown little or no detrimental effects associated with the intake of the artificial sweetener aspartame, and it is FDA approved, findings from long-term, population-based studies indicate that there are negative effects associated with aspartame consumption that merit further investigation\(^{(2,3,5)}\)
  - A large study assessing the effects of aspartame intake on rats for the duration of their lifetime found that aspartame intake increased the risk for lymphoma, leukemia, and transitional cell carcinoma of the pelvis, ureter, and bladder.\(^{(2)}\)
  - Another study revealed that aspartame consumption raised blood glucose levels in diabetes-prone mice\(^{(6)}\)
- According to researchers, individuals who consume diet soft drinks (which primarily use aspartame but can also use saccharin, Ace-K, neotame, or sucralose) daily have a 36% higher risk for metabolic syndrome (MetS; i.e., a condition characterized by hyperglycemia, hypertension, abdominal obesity, and high triglycerides) and a 67% higher risk for diabetes mellitus type 2 (DM2), compared with those who do not regularly consume diet soft drinks.\(^{(4,6)}\)
  - Evidence also indicates that overweight and obese adults drink more diet beverages than healthy-weight adults (11% of healthy-weight, 19% of overweight, and 22% of obese adults consume diet beverages)\(^{(3)}\)
  - According to observations made from the Framingham Heart Study Offspring cohort, a long-term community-based study following over 4,300 participants, consumption of artificially sweetened, but not sugar sweetened, soft drinks is positively associated with the risk of both dementia and ischemic stroke. Researchers note that, as an observational study, these results do not prove a causal relationship; further research is necessary to examine the mechanisms potentially responsible for these observed associations\(^{(9)}\)
  - Researchers report that girls who consume caffeinated and artificially sweetened soft drinks have an increased risk of early menarche. Early menarche is associated with DM2, nonalcoholic fatty liver disease (NAFLD), cardiovascular disease (CVD), and hormone-related cancers\(^{(8)}\)
  - Evidence from the San Antonio Longitudinal Study of Aging indicates that increasing diet soda intake is associated with increasing abdominal obesity. Over a follow-up period averaging 2.6 years, participants who consumed diet soda had twice the increase in waist circumference of persons who did not consume diet soda and participants who consumed diet soda daily had 3 times the increase in waist circumference when compared to participants who did not consume diet soda\(^{(5)}\)

**What We Can Do**

› Become knowledgeable about the physiologic effects of consuming NNSs so you can accurately assess your patients’ personal characteristics and health education needs; share this information with your colleagues
› Assess your patients’ health and diet history for intake of NNSs and assess risk factors for obesity, DM2, and CAD. As appropriate, provide your patients with evidence-based information regarding the impact of NNS intake on these conditions
› Educate your patients on the benefits of eating a balanced diet that includes unsaturated fats, lean proteins, complex carbohydrates, and a wide variety of fresh fruits and vegetables
References


