

In the News

Sugar Substitutes

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Overview

- Controversy
- Types of sweeteners
- FDA-approved sugar substitutes
 - Safety
- Weight studies
- Recommendations



Controversy



- Cons— Opponents claim sugar substitutes cause:
 - Cancer
 - Seizures
 - Multiple sclerosis
 - Behavior conditions (ADD, ADHD)
- Pros: Proponents claim sugar substitutes are:
 - Calorie-free (assist weight management)
 - Reduced glycemc response (diabetes control)
 - Prevent dental caries

Types of Sweeteners

- **Nutritive Sweeteners**
 - Sugar (sucrose, fructose)
 - Polyols (sugar alcohols)
 - Contain less energy (calories) than sugar
 - Absorbed slowly and incompletely from intestines
 - Lower glycemic response than sugar
 - Excessive sugar alcohols can cause diarrhea (50 g/day of sorbitol, 20 g/day of mannitol)

Sugar Alcohols

Name	Calories /gram	Regulatory Status	Description
Sorbitol	2.6	GRAS (label must warn about laxative effect)	50-70% as sweet as sucrose
Mannitol	1.6	Approved food additive (label must warn about laxative effect)	50-70% as sweet as sucrose
Xylitol	2.4	Approved food additive for use in foods for special dietary uses	As sweet as sucrose
Erythritol	0.2	GRAS	60-80% as sweet as sucrose
Malitol	2.1	GRAS affirmation petition filed	90% as sweet as sucrose

*GRAS-Generally Recognized as Safe by FDA

Types of Sweeteners







- **Nonnutritive Sweeteners**
 - No energy (calories) or insignificant amount
 - Little or no glycemic response
 - Other names for nonnutritive sweeteners:
 - Sugar substitutes
 - Sugar replacers
 - Artificial Sweeteners
 - High-intensity sweeteners (many times sweeter than sucrose)

FDA-approved Sugar Substitutes

- Approved as food additives:
 - Saccharin
 - Aspartame
 - Acesulfame potassium (acesulfame K)
 - Sucralose
 - Neotame
- GRAS status:
 - Stevia



Brand Names of Sweeteners

Sweetener	Brand Names
Saccharin	Sweet N' Low Sweet Twin Sugar Twin 
Aspartame	Nutrasweet Equal 
Acesulfame K	Sunett Sweet One 
Sucralose	Splenda
Neotame	N/A 
Stevia	Truvia Pure Via A Sweet Leaf  

FDA Approval: GRAS

- **GRAS: Generally Recognized As Safe**
 - “The use of a food substance may be GRAS either through scientific procedures or, for a substance used in food before 1958, through experience based on common use in food.”
 - GRAS determination can be made by experts outside of the government
 - Safety of food additives is determined by the FDA (government)

FDA Approval: Food Additive

- Artificial sweeteners are considered food additives by the FDA.
- Food additives are more strictly regulated and monitored than any other time in history.
- Before a food additive is marketed, the manufacturer must petition the FDA for its approval.
 - Manufacturer must provide evidence that the substance is safe for the ways in which it will be used.

FDA Approval: Food Additive

- When evaluating the safety of a food additive, the FDA considers:
 - The composition and properties of the substance
 - The amount that would typically be consumed
 - Immediate and long-term health effects
 - Various safety factors
- Determine an appropriate level of use that has a built-in safety margin.

Saccharin Approval



- 1972—Approved as a sweetener
- 1977—FDA proposed a ban on use of saccharin because it was reported to cause bladder cancer in rats
- Same year, Congress placed 18-month moratorium on FDA ban and required products containing saccharin to bear following warning:
 - “Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals.”

Saccharin Approval



- 2000—saccharin delisted from National Toxicology Program of the National Institutes of Health *Report on Carcinogens*
 - Warning label repealed
 - Studies showed that mechanism leading to cancer in rats was not relevant in humans
 - No evidence that saccharin causes cancer in humans

Saccharin Uses



- **200-700 times sweeter** than sucrose (table sugar)
- Approved as food additive to foods and beverages, tabletop sugar substitute, and gum
- Can be used in cosmetics and pharmaceuticals
- Not as common in foods as sucralose and aspartame due to bitter after taste
- Does not cause glycemic response



Saccharin: Acceptable Daily Intake

- ADI = 5 mg/kg of body weight
 - Divide body weight by 2.2
 - Then multiple by 5
 - If you weight 150 lbs...
 - $150/2.2 = 68$ kg
 - 68 kg x 5 mg = **340 mg/day of saccharin**
- FDA regulations for saccharin in foods/drinks:
 - Cannot exceed 12 mg/fluid ounce in beverages
 - Cannot exceed 30 mg per serving in packaged foods



Aspartame Approval

- 1981—approved as a sweetener for dry use (tabletop sweetener, cold breakfast cereal, gelatins and puddings)
- 1983—approval expanded to include carbonated beverages
- 1996—FDA approved aspartame as a “general purpose sweetener” for use in all foods and beverages



Aspartame Structure and Stability

- Aspartame is made up of two amino acids (protein building blocks) that occur naturally in protein-containing foods
 - Phenylalanine
 - Aspartic acid
- When consumed, aspartame is broken down
 - Aspartic acid
 - Phenylalanine
 - Methanol



Comparison of Aspartame Components

Food	Phenylalanine (mg)	Aspartic Acid (mg)	Methanol (mg)
Aspartame-sweetened beverage (12 oz)	90	72	18
Non-fat milk (12 oz)	606	953	—
Chicken Breast (3 oz)	1,059	2,377	—
Tomato juice (12 oz)	58	346	107



Aspartame Safety

- Approved for use in over 100 countries
- Scientific groups that have reviewed safety:
 - US Food and Drug Administration (FDA)
 - European Food Safety Authority (EFSA)
 - Food and Agriculture Organization (FAO)/World Health Organization (WHO) Joint Expert Committee on Food Additives (JECFA)
 - Health Canada
 - Food Standards Australia/New Zealand (FSANZ)



Aspartame Safety

- **NOT SAFE FOR INDIVIDUALS WITH PKU**
 - Phenylketonuria (PKU) is an inherited condition in which individuals cannot metabolize (break down) phenylalanine (a component of aspartame)
 - Excess intake of this amino acid can cause dangerous blood levels of phenylalanine in those with PKU
 - Harmful to central nervous system, including brain damage
 - Foods and beverages containing aspartame must contain label “PHENYLKETONURICS: CONTAINS PHENYLALANINE”



Aspartame Uses

- More than 6,000 products use aspartame as a sweetener
 - Carbonated and other beverages
 - Cereals
 - Chewing gum
 - Dairy products (flavored milk, light yogurt)
 - Canned fruits
 - Tabletop sweeteners
- Aspartame is not heat stable—not recommended for baking or cooking



Aspartame Characteristics

- **160-220 times sweeter** than sucrose
- Provides 4 calories/gram (same as sucrose)
 - Because of intense sweetness of aspartame, only minute amounts need to be added to food/beverage
 - Amount of energy from aspartame is negligible
- Does not cause glycemic response



Aspartame: Acceptable Daily Intake

- ADI = 50 mg/kg of body weight
- For a 150 lb person: 3,400 mg/day
- Amount in some common foods:
 - Up to 225 mg in 12-oz diet soda (ADI = 15 cans)
 - 80 mg in 8-oz yogurt
 - 32 mg in $\frac{3}{4}$ cup sweetened cereal
- General population who consume aspartame only average **6% of the ADI**

Sucralose Approval



- 1998—approved as tabletop sweetener and for use in a number of desserts, confections, and nonalcoholic beverages
- 1999—approved as a general-purpose sweetener



Sucralose Safety

- FDA reviewed more than 110 studies in humans and animals and concluded that sucralose **does not pose carcinogenic, reproductive, or neurologic risk** to humans.
- Scientific groups that have reviewed safety:
 - European Union Scientific Committee on Food
 - FDA
 - FSANZ
 - JECFA
 - Japan's Ministry of Health and Welfare
 - Health Protection Branch of Health and Welfare Canada

Sucralose Uses



- More than 4,000 products use sucralose as a sweetener
 - Dairy products (low-fat flavored milk, light yogurt, low-fat coffee creamer)
 - Cereals and cereal bars
 - Snack foods
 - Beverages (light juice, iced and hot tea, diet soda)
- Heat stable—can be used for baking and cooking



Sucralose Characteristics

- **600 times sweeter** than sucrose
- Poorly absorbed by the body
 - Provides no calories
 - Any absorbed sucralose is excreted in urine unchanged
- Does not cause glycemic response



Sucralose: Acceptable Daily Intake

- ADI = 5 mg/kg of body weight
- For a 150 lb person: 340 mg/day
- Estimated daily intake for consumers is 1.6 mg/kg of body weight

Acesulfame K

- 1988—approved by FDA as general-purpose sweetener, not including meat and poultry
- **200 times sweeter** than sucrose
- 95% of sweetener is excreted unchanged in urine
 - Does not provide energy (calories)
- Heat stable—used in cooking and baking
- Small amount added to foods—usually combined with other sweeteners
- ADI = 15 mg/kg of body weight

Neotame

- 2002—approved by FDA as a general-purpose sweetener
- **7,000-13,000 times sweeter** than sucrose
- Partially absorbed, rapidly metabolized, and excreted in urine and feces
- Found in baked goods, beverages, gum, frozen desserts, jams, syrups
- ADI = 18 mg/day

Stevia



- *Stevia rebaudiana* is an herb native to South America
 - Widely grown for its sweet leaves
- Two compounds that give stevia its sweet taste
 - Stevioside
 - Rebaudioside
- **200 times sweeter** than sucrose
- Does not cause glycemic response

Stevia



- Only highly refined Stevia preparations have GRAS status from the FDA (2008)
 - Rebaudioside A
- Whole leaf stevia and crude extracts have NOT been approved by FDA
 - Concerns about possible health effects
 - Effects on kidneys and cardiovascular and reproductive systems
 - Possible carcinogen

Weight and Use of Artificial Sweeteners

Do artificial sweeteners aid in weight loss, or promote weight gain?



Artificial Sweeteners and Appetite

- Past studies have suggested an increase in appetite after consuming artificial sweeteners
 - Most supporting studies used foods or beverages that provide little or no calories
- Most studies using food or beverages that do provide calories found no increase in appetite after consumption.

Diet sodas are usually calorie-free—so do they increase appetite?

▫ Probably NOT

1. Beverages are often consumed with food (calories), so this negates the calorie-free condition for increased hunger
2. Even if appetite IS increased, studies have not shown that this translates to increased calorie consumption.

Artificial Sweeteners and Calorie Intake

- Some studies have shown an increased calorie intake after consuming beverages sweetened with artificial sweeteners
 - Short-term trials provide mixed results
 - Long-term trials consistently indicate that the use of artificial sweeteners results in lower calorie intakes by 5-15%

Artificial Sweeteners and BMI

- Some observational studies suggest that artificial sweeteners promote weight gain
 - 1986 American Cancer Society survey found that those who used artificial sweeteners were significantly more likely to gain weight than non-users (weight difference < 2 lbs)
 - San Antonio Heart Study (1979-1988) found dose-dependent relation between artificially-sweetened beverage consumption and incidence of overweight or obesity

Artificial Sweeteners and BMI

- Intervention trials consistently fail to show that artificial sweeteners promote weight gain
 - Long-term studies show that artificial sweetener users better maintain weight loss long-term (2 years)
- No strong evidence to date that artificial sweeteners promote weight gain
- New research currently being conducted on possible mechanisms that may promote weight gain

Recommendations for Customers

- The 5 FDA-approved artificial sweeteners are safe for most populations (exception: aspartame for individuals with PKU)
 - Rigorous safety evaluation before being approved as a food additive
- Only highly refined stevia preparation (Rebaudioside A) has GRAS recognition by FDA
 - Stevia leaves and crude extracts are NOT approved

Recommendations for Customers

- American Diabetes Association
 - “Artificial sweeteners also **do not have any carbohydrates** and do not increase blood glucose levels. So if you have diabetes and a sweet tooth, using sugar substitutes in drinks and foods may be a good way to enjoy a sweet treat without raising blood glucose quite as much!”
- Foods sweetened with artificial sweeteners are not necessarily carbohydrate free, so remind customers to look at total carbohydrate content

Recommendations for Customers

- Artificial sweeteners are
 - Calorie-free (or negligible calories)
 - Do not cause a glycemic response
 - Do not promote dental caries

Recommendations for Customers

- There is currently not enough evidence that artificial sweeteners cause weight gain.
- Substituting artificial sweeteners for nutritive sweeteners and reducing overall calorie consumption can promote weight loss.



QUESTIONS?

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