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Sweeteners

Aspartame: Decades of Science Point to Serious Health Risks

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Posted on March 25, 2022 by Stacy Malkan

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Key Facts About Diet Soda Chemical

- Dozens of studies have linked aspartame — the world’s most widely used artificial sweetener — to serious health problems, including cancer, cardiovascular disease, Alzheimer’s disease, seizures, stroke and dementia, as well as negative effects such as intestinal dysbiosis, mood disorders, headaches and migraines.
- Evidence also links aspartame to weight gain, increased appetite and obesity-related diseases. See our fact sheet: **Diet Soda Chemical Tied to Weight Gain.**
 - Evidence linking aspartame to weight gain raises questions about the legality of marketing aspartame-containing products as “diet” drinks or weight loss products. In April 2015, US Right to Know petitioned the Federal Trade Commission (FTC) and the Food and Drug Administration (FDA) to investigate the marketing and advertising practices of “diet” products that contain aspartame. See [FTC response](#) and [FDA response](#).
- The U.S. Food and Drug Administration said aspartame is “safe for the general population under certain conditions.” The agency first approved aspartame for some uses in 1981. Many scientists, then and now, have said the approval was based on suspect data and should be reconsidered.

What is Aspartame?

- Aspartame is the world’s most widely used artificial sweetener. It is also marketed as NutraSweet, Equal, Sugar Twin and AminoSweet.
- Aspartame is present in more than 6,000 products, including Diet Coke and Diet Pepsi, Kool Aid, Crystal Light, Tango and other artificially sweetened drinks; sugar-free Jell-O products; Trident, Dentyne and most other brands of sugar-free gum; sugar-free hard candies; low- or no-sugar sweet condiments such as ketchups and dressings; children’s medicines, vitamins and cough drops.

- Aspartame is a synthetic chemical composed of the amino acids phenylalanine and aspartic acid, with a methyl ester. When consumed, the methyl ester breaks down into methanol, which may be converted into formaldehyde.

Decades of Studies Raise Concerns about Aspartame

Since aspartame was first approved in 1974, both FDA scientists and independent scientists have raised concerns about possible health effects and shortcomings in the science submitted to the FDA by the manufacturer, G.D. Searle. (Monsanto bought Searle in 1984).

In 1987, UPI published a series of investigative articles by Gregory Gordon reporting on these concerns, including early studies linking aspartame to health problems, the poor quality of industry-funded research that led to its approval, and the revolving-door relationships between FDA officials and the food industry. Gordon's series is an invaluable resource for anyone seeking to understand the history of aspartame/NutraSweet:

- Did Searle Ignore Early Warning Signs? (10/12/87)
- Seizure, Blindness Victims Point to NutraSweet (10/12/87)
- What the Critics Say about NutraSweet (10/12/87)
- NutraSweet Approval Marred by Controversy (and part 2) (10/13/87)
- Maverick Scientist at Center of NutraSweet Controversy (10/13/87)
- Sweet Corporate Victories (10/14/87)
- These stories, follow ups and response from NutraSweet Company posted here (PDF)

Flaws in EFSA Assessment

In a July 2019 paper in the Archives of Public Health, researchers at the University of Sussex provided a detailed analysis of the EFSA's 2013 safety assessment of aspartame and found that the panel discounted as unreliable every one of 73 studies that indicated harm, and used far more lax criteria to accept as reliable 84% of studies that found no evidence of harm. "Given the shortcomings of EFSA's risk assessment of aspartame, and the shortcomings of all previous official toxicological risk assessments of aspartame, it would be premature to conclude that it is acceptably safe," the study concluded.

See EFSA's response and a follow up by researchers Erik Paul Millstone and Elizabeth Dawson in the Archives of Public Health, Why did EFSA to reduce its ADI for aspartame or recommend its use should no longer be permitted? News coverage:

- "World's most popular artificial sweetener must be banned, say experts. Two food safety experts have called for the widely used artificial sweetener, aspartame, to be banned in the UK and questions why it was deemed acceptable in the first place," New Food Magazine (11.11.2020)
- "'Sales of aspartame should be suspended': EFSA accused of bias in safety assessment," by Katy Askew, Food Navigator (7.27.2019)

Health Effects and Key Studies

While many studies, some of them industry sponsored, have reported no problems with aspartame, dozens of independent studies conducted over decades have linked aspartame to a long list of health problems, including:

Cancer

A large 2022 cohort study in PLOS Medicine, involving 102,865 French adults, found that artificial sweeteners — especially aspartame and acesulfame-K — were associated with increased cancer risk. Higher risks were observed for breast cancer and obesity-related cancers. “These findings provide important and novel insights for the ongoing re-evaluation of food additive sweeteners by the European Food Safety Authority and other health agencies globally,” the researchers wrote.

- “Study suggests association between consuming artificial sweeteners and increased cancer risk,” Science Daily (3.24.2022)

Three lifespan studies conducted by the Cesare Maltoni Cancer Research Center of the Ramazzini Institute, provide consistent evidence of carcinogenicity in rodents exposed to the substance.

- Aspartame “is a multipotential carcinogenic agent, even at a daily dose of ... much less than the current acceptable daily intake,” according to a 2006 lifespan rat study in Environmental Health Perspectives.
- A follow-up study in 2007 found significant dose-related increases in malignant tumors in some of the rats. “The results ... confirm and reinforce the first experimental demonstration of [aspartame’s] multipotential carcinogenicity at a dose level close to the acceptable daily intake for humans ... when life-span exposure begins during fetal life, its carcinogenic effects are increased,” the researchers wrote in Environmental Health Perspectives.
- The results of a 2010 lifespan study “confirm that [aspartame] is a carcinogenic agent in multiple sites in rodents, and that this effect is induced in two species, rats (males and females) and mice (males),” the researchers reported in American Journal of Industrial Medicine.

A 2021 review of the Ramazzini Institute data validated the conclusions of the original RI studies. See, “Aspartame and cancer — new evidence of causation,” Environmental Health. The findings, “confirm that aspartame is a chemical carcinogen in rodents. They confirm the very worrisome finding that prenatal exposure to aspartame increases cancer risk in rodent offspring.”

Harvard researchers in 2012 reported a positive association between aspartame intake and increased risk of non-Hodgkin lymphoma and multiple myeloma in men, and for leukemia in men and women. The findings “preserve the possibility of a detrimental effect ... on select cancers” but “do not permit the ruling out of chance as an explanation,” the researchers wrote in the American Journal of Clinical Nutrition.

In a 2014 commentary in American Journal of Industrial Medicine, the Maltoni Center researchers wrote that the studies submitted by G. D. Searle for market approval “do not provide adequate scientific support for [aspartame’s] safety. In contrast, recent results of life-span carcinogenicity bioassays on rats and mice published in peer-reviewed journals, and a prospective epidemiological study, provide consistent evidence of [aspartame’s] carcinogenic potential. On the basis of the evidence of the potential carcinogenic effects ... a re-evaluation of the current position of international regulatory agencies must be considered an urgent matter of public health.”

Brain Tumors

In 1996, researchers reported in the Journal of Neuropathology & Experimental Neurology on epidemiological evidence connecting the introduction of aspartame to an increase in an aggressive type of malignant brain tumors. “Compared to other environmental factors putatively linked to brain tumors, the artificial sweetener aspartame is a promising candidate to explain the recent increase in incidence and degree of malignancy of brain tumors ... We conclude that there is need for reassessing the carcinogenic potential of aspartame.”

- Neuroscientist Dr. John Olney, lead author of the study, told 60 minutes in 1996: “there has been a striking increase in the incidence of malignant brain tumors (in the three to five years following the approval of aspartame) ... there is enough basis to suspect aspartame that it needs to be reassessed. FDA needs to reassess it, and this time around, FDA should do it right.”

Early studies on aspartame in the 1970s found evidence of brain tumors in laboratory animals, but those studies were not followed up.

Cardiovascular Disease

A 2017 meta-analysis of research on artificial sweeteners, published in the Canadian Medical Association Journal, found no clear evidence of weight loss benefits for artificial sweeteners in randomized clinical trials, and reported that cohort studies associate artificial sweeteners with “increases in weight and waist circumference, and higher incidence of obesity, hypertension, metabolic syndrome, type 2 diabetes and cardiovascular events.” See also:

- “Artificial sweeteners don’t help with weight loss and may lead to gained pounds,” by Catherine Caruso, STAT (7.17.2017)
- “Why one cardiologist has drunk his last diet soda,” by Harlan Krumholz, Wall Street Journal (9.14.2017)
- “This cardiologist wants his family to cut back on diet soda. Should yours, too?” by David Becker, M.D., Philly Inquirer (9.12.2017)

A 2016 paper in Physiology & Behavior reported, “there is a striking congruence between results from animal research and a number of large-scale, long-term observational studies in humans, in finding significantly increased weight gain, adiposity, incidence of obesity, cardiometabolic risk, and even total mortality among individuals with chronic, daily exposure to low-calorie sweeteners – and these results are troubling.”

Women who consumed more than two diet drinks per day “had a higher risk of [cardiovascular disease] events ... [cardiovascular disease] mortality ... and overall mortality,” according to a 2014 study from the Women’s Health Initiative published in the Journal of General Internal Medicine.

Stroke, Dementia and Alzheimer’s Disease

People drinking diet soda daily were almost three times as likely to develop stroke and dementia as those who consumed it weekly or less. This included a higher risk of ischemic stroke, where blood vessels in the brain become obstructed, and Alzheimer’s disease dementia, the most common form of dementia, reported a 2017 study in Stroke.

- See also: Boston University School of Medicine video of the study by neurologist Matthew Pase, “Daily Consumption of Sodas, Fruit Juices and Artificially Sweetened Sodas Affect Brain.”
- “Study links diet soda to higher risk of stroke, dementia,” by Fred Barbash, Washington Post (4.21.2017)

In the body, the methyl ester in aspartame metabolizes into methanol and then it may be converted to formaldehyde, which has been linked to Alzheimer’s disease. A two-part study published in 2014 in the Journal of Alzheimer’s Disease linked chronic methanol exposure to memory loss and Alzheimer’s Disease symptoms in mice and monkeys.

- “[M]ethanol-fed mice presented with partial AD-like symptoms ... These findings add to a growing body of evidence that links formaldehyde to [Alzheimer’s disease] pathology.” (Part 1)

- “[M]ethanol feeding caused long-lasting and persistent pathological changes that were related to [Alzheimer’s disease] ... these findings support a growing body of evidence that links methanol and its metabolite formaldehyde to [Alzheimer’s disease] pathology.” (Part 2)

Seizures

“Aspartame appears to exacerbate the amount of EEG spike wave in children with absence seizures. Further studies are needed to establish if this effect occurs at lower doses and in other seizure types,” according to a 1992 study in Neurology.

Aspartame “has seizure-promoting activity in animal models that are widely used to identify compounds affecting ... seizure incidence,” according to a 1987 study in Environmental Health Perspectives.

Very high aspartame doses “might also affect the likelihood of seizures in symptomless but susceptible people,” according to a 1985 study in The Lancet. The study describes three previously healthy adults who had grand mal seizures during periods when they were consuming high doses of aspartame.

Neurotoxicity, Brain Damage and Mood Disorders

Aspartame has been linked to behavioral and cognitive problems including learning problems, headache, seizure, migraines, irritable moods, anxiety, depression, and insomnia, wrote the researchers of a 2017 study in Nutritional Neuroscience. “Aspartame consumption needs to be approached with caution due to the possible effects on neurobehavioral health.”

“Oral aspartame significantly altered behavior, anti-oxidant status and morphology of the hippocampus in mice; also, it may probably trigger hippocampal adult neurogenesis,” reported a 2016 study in Neurobiology of Learning and Memory.

“Previously, it has been reported that consumption of aspartame could cause neurological and behavioural disturbances in sensitive individuals. Headaches, insomnia and seizures are also some of the neurological effects that have been encountered,” according to a 2008 study in the European Journal of Clinical Nutrition. “[W]e propose that excessive aspartame ingestion might be involved in the pathogenesis of certain mental disorders ... and also in compromised learning and emotional functioning.”

“(N)eurological symptoms, including learning and memory processes, may be related to the high or toxic concentrations of the sweetener [aspartame] metabolites,” states a 2006 study in Pharmacological Research.

Aspartame “could impair memory retention and damage hypothalamic neurons in adult mice,” according to a 2000 mice study published in Toxicology Letters.

“(I)ndividuals with mood disorders are particularly sensitive to this artificial sweetener and its use in this population should be discouraged,” according to a 1993 study in the Journal of Biological Psychiatry.

High doses of aspartame “can generate major neurochemical changes in rats,” reported a 1984 study in American Journal of Clinical Nutrition.

Experiments indicated brain damage in infant mice following oral intake of aspartate, and showing that “aspartate [is] toxic to the infant mouse at relatively low levels of oral intake,” reported a 1970 study in Nature.

Headaches and Migraines

“Aspartame, a popular dietetic sweetener, may provoke headache in some susceptible individuals. Herein, we describe three cases of young women with migraine who reported their headaches could be provoked by chewing sugarless gum containing aspartame,” according to a 1997 paper in Headache Journal.

A crossover trial comparing aspartame and a placebo published in 1994 in Neurology, “provides evidence that, among individuals with self-reported headaches after ingestion of aspartame, a subset of this group report more headaches when tested under controlled conditions. It appears that some people are particularly susceptible to headaches caused by aspartame and may want to limit their consumption.”

A survey of 171 patients at the Montefiore Medical Center Headache Unit found that patients with migraine “reported aspartame as a precipitant three times more often than those having other types of headache ... We conclude aspartame may be an important dietary trigger of headache in some people,” 1989 study in Headache Journal.

A crossover trial comparing aspartame and a placebo on the frequency and intensity of migraines “indicated that the ingestion of aspartame by migraineurs caused a significant increase in headache frequency for some subjects,” reported a 1988 study in Headache Journal.

Kidney Function Decline

Consumption of more than two servings a day of artificially sweetened soda “is associated with a 2-fold increased odds for kidney function decline in women,” according to a 2011 study in the Clinical Journal of American Society of Nephrology.

Weight Gain, Increased Appetite and Obesity Related Problems

Several studies link aspartame to weight gain, increased appetite, diabetes, metabolic derangement and obesity-related diseases. See our fact sheet: **Diet Soda Chemical Tied to Weight Gain.**

This science linking aspartame to weight gain and obesity-related diseases raises questions about the legality of marketing aspartame-containing products as “diet” or weight loss aids. In 2015, USRTK petitioned the Federal Trade Commission and FDA to investigate the marketing and advertising practices of “diet” products that contain a chemical linked to weight gain. See related news coverage, response from FTC, and response from FDA.

Diabetes and Metabolic Derangement

Aspartame breaks down in part into phenylalanine, which interferes with the action of an enzyme intestinal alkaline phosphatase (IAP) previously shown to prevent metabolic syndrome (a group of symptoms associated with type 2 diabetes and cardiovascular disease) according to a 2017 study in Applied Physiology, Nutrition and Metabolism. In this study, mice receiving aspartame in their drinking water gained more weight and developed other symptoms of metabolic syndrome than animals fed similar diets lacking aspartame. The study concludes, “IAP’s protective effects in regard to the metabolic syndrome may be inhibited by phenylalanine, a metabolite of aspartame, perhaps explaining the lack of expected weight loss and metabolic improvements associated with diet drinks.”

- See also: Massachusetts General Hospital press release on the study, “Aspartame may prevent, not promote, weight loss by blocking intestinal enzyme’s activity”

People who regularly consume artificial sweeteners are at increased risk of “excessive weight gain, metabolic syndrome, type 2 diabetes, and cardiovascular disease,” according to a 2013 Purdue review over 40 years published in Trends in Endocrinology & Metabolism.

In a study that followed 66,118 women over 14 years, both sugar-sweetened beverages and artificially sweetened beverages were associated with risk of Type 2 diabetes. “Strong positive trends in T2D risk were also observed across quartiles of consumption for both types of beverage ... No association was observed for 100% fruit juice consumption,” reported the 2013 study published in American Journal of Clinical Nutrition.

Intestinal Dysbiosis, Metabolic Derangement and Obesity

A 2022 study in Frontiers in Nutrition found that maternal consumption of aspartame and stevia influences the gut microbiota of offspring. “Consumption of low-dose aspartame and stevia showed limited influence on the overall structure of cecal microbiota in dams but significantly altered cecal microbiota of their 3-week old offspring.”

Artificial sweeteners can induce glucose intolerance by altering the gut microbiota, according to a 2014 study in Nature. The researchers wrote, “our results link NAS [non-caloric artificial sweetener] consumption, dysbiosis and metabolic abnormalities, thereby calling for a reassessment of massive NAS usage ... Our findings suggest that NAS may have directly contributed to enhancing the exact epidemic [obesity] that they themselves were intended to fight.”

- See also: “Artificial Sweeteners May Change our Gut Bacteria in Dangerous Ways,” by Ellen Ruppel Shell, Scientific American (4.1.2015)

A 2016 study in Applied Physiology Nutrition and Metabolism reported, “Aspartame intake significantly influenced the association between body mass index (BMI) and glucose tolerance... consumption of aspartame is associated with greater obesity-related impairments in glucose tolerance.”

According to a 2014 rat study in PLOS ONE, “aspartame elevated fasting glucose levels and an insulin tolerance test showed aspartame to impair insulin-stimulated glucose disposal ... Fecal analysis of gut bacterial composition showed aspartame to increase total bacteria...”

Pregnancy Abnormalities: Pre Term Birth

According to a 2010 cohort study of 59,334 Danish pregnant women published in the American Journal of Clinical Nutrition, “There was an association between intake of artificially sweetened carbonated and noncarbonated soft drinks and an increased risk of preterm delivery.” The study concluded, “Daily intake of artificially sweetened soft drinks may increase the risk of preterm delivery.”

- See also: “Downing Diet Soda Tied to Premature Birth,” by Anne Harding, Reuters (7.23.2010)

Overweight Babies

Artificially sweetened beverage consumption during pregnancy is linked to higher body mass index for babies, according to a 2016 study in JAMA Pediatrics. “To our knowledge, we provide the first human evidence that maternal consumption of artificial sweeteners during pregnancy may influence infant BMI,” the researchers wrote.

- See also: “Diet Soda in Pregnancy is Linked to Overweight Babies,” by Nicholas Bakalar, New York Times (5.11.2016)

Early Menarche

The National Heart, Lung, and Blood Institute Growth and Health Study followed 1988 girls for 10 years to examine prospective associations between consumption of caffeinated and noncaffeinated sugar- and artificially sweetened soft drinks and early menarche. "Consumption of caffeinated and artificially sweetened soft drinks was positively associated with risk of early menarche in a US cohort of African American and Caucasian girls," concluded the study published in 2015 in *Journal of American Clinical Nutrition*.

Sperm Damage

"A significant decrease in sperm function of aspartame treated animals was observed when compared with the control and MTX control," according to a 2017 study in the *International Journal of Impotence Research*. "... These findings demonstrate that aspartame metabolites could be a contributing factor for development of oxidative stress in the epididymal sperm."

Liver Damage and Glutathione Depletion

A mouse study published in 2017 in *Redox Biology* reported, "Chronic administration of aspartame ... caused liver injury as well as marked decreased hepatic levels of reduced glutathione, oxidized glutathione, γ -glutamylcysteine, and most metabolites of the trans-sulphuration pathway..."

A rat study published in 2017 in *Nutrition Research* found that, "Subchronic intake of soft drink or aspartame substantially induced hyperglycemia and hypertriacylglycerolemia... Several cytoarchitecture alterations were detected in the liver, including degeneration, infiltration, necrosis, and fibrosis, predominantly with aspartame. These data suggest that long-term intake of soft drink or aspartame-induced hepatic damage may be mediated by the induction of hyperglycemia, lipid accumulation, and oxidative stress with the involvement of adipocytokines."

Caution for Vulnerable Populations

A 2016 literature review on artificial sweeteners in the *Indian Journal of Pharmacology* reported, "there is inconclusive evidence to support most of their uses and some recent studies even hint that these earlier established benefits ... might not be true." Susceptible populations such as pregnant and lactating women, children, diabetics, migraine, and epilepsy patients "should use these products with utmost caution."

Industry PR Efforts and Front Groups

From the start, G.D. Searle (later Monsanto and the NutraSweet Company) deployed aggressive PR tactics to market aspartame as a safe product. In October 1987, Gregory Gordon reported in UPI:

"The NutraSweet Co. also has paid up to \$3 million a year for a 100-person public relations effort by the Chicago offices of Burson Marsteller, a former employee of the New York PR firm said. The employee said Burson Marsteller has hired numerous scientists and physicians, often at \$1,000 a day, to defend the sweetener in media interviews and other public forums. Burson Marsteller declines to discuss such matters."

Recent reporting based on internal industry documents reveals how beverage companies such as Coca-Cola also pay third party messengers, including doctors and scientists, to promote their products and shift the blame when science ties their products to serious health problems.

See reporting by Anahad O'Connor in the *New York Times*, Candice Choi in the *Associated Press*, and findings from the USRTK investigation about sugar industry propaganda and lobbying campaigns.

News articles about soda industry PR campaigns:

- “Coca-Cola’s Secret Influence on Medical and Science Journalists,” by Paul Thacker, *BMJ* (4.5.2017) and author’s note
- “If Soda Companies Don’t Want to Be Treated Like Tobacco Companies, They Need To Stop Acting Like Them,” by Patrick Mustain, *Scientific American* (10.19.2016)
- “Critic of artificial sweeteners pilloried by industry-backed scientists,” by Chris Young, *Center for Public Integrity* (8.6.2014)

Overview news stories about aspartame:

- “The Story of How Fake Sugar Got Approved is Scary As Hell; It Involves Donald Rumsfeld,” by Kristin Wartman Lawless, *Vice* (4.19.2017)
- “The Lowdown on Sweet?” by Melanie Warner, *New York Times* (2.12.2006)
- “NutraSweet Controversy Swirls” by Gregory Gordon, *UPI series* (10.1987)

USRTK Fact Sheets

- Journalists Fail to Reveal Sources Funded by Coca-Cola
- The International Life Science Institute (ILSI) is a Food Industry Lobby Group
- The International Food Information Council (IFIC): How Big Food Spins Bad News
- Trevor Butterworth Spins Science for Industry
- Why You Can’t Trust the American Council on Science and Health

Reports on Front Groups and PR Campaigns

- Friends of the Earth: *Spinning Food: How Food Industry Front Groups are Spinning the Story of Food*
- Center for Food Safety: *Guide to Food Industry Front Groups*

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☰ Sweeteners ➡ AminoSweet, aspartame, brain tumors, Burson-Marsteller, cancer, cardiovascular, Coca-Cola, Donald Rumsfeld, Equal, FDA, Food and Drug Administration, G.D. Searle, Gregory Gordon, headaches, Monsanto, NutraSweet, seizures, stroke, Sugar Twin, tobacco companies



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