Trends in Low Calorie Sweetener Consumption in the United States

Introduction to Low-Calorie Sweeteners: A Changing Landscape

The use of low-calorie sweeteners (LCS)* has changed dramatically over time.[1] In 1981, the artificial sweetener aspartame was first approved,[2] joining saccharin, as well as several sugar alcohols, as the only alternatives to added sugars (dulcin[3] and cyclamate,[4] two other artificial sweeteners, were already banned by then). Currently, CSPI has identified 19 different LCS, including six U.S. Food and Drug Administration (FDA)-approved artificial high intensity sweeteners,[5] three types of "natural" high intensity sweeteners[6] that industry has itself determined to fall into a regulatory category called "Generally Recognized As Safe" (GRAS),[7,8,9] two industry-affirmed GRAS low-calorie sugars,[10,11] and eight sugar alcohols[12] (with different regulatory statuses[13]). Current regulations allow companies to self-determine that a substance is GRAS without notifying the FDA or the public.

As a result of widespread concern and agreement about the harms of added sugars, as reflected in the Dietary Guidelines for Americans,[14] as well as the new line for added sugars on the updated Nutrition Facts label,[15] food companies and consumers may look to an array of LCS to replace added sugars.

Because their chemical structures, usage, and safety profiles differ from each other, CSPI rates the safety of different LCS differently (see our Chemical Cuisine website for more details).[16] For ease of reference, this factsheet applies the following symbols next to specific LCS to indicate the ratings CSPI applies in Chemical Cuisine: ✅ for safe, 🧈 for cut back, ⚠️ for caution, 🚸 for certain people should avoid, and ❌ for avoid.

This fact sheet summarizes what we know—and don't know—about the use and consumption of LCS in the United States and makes recommendations.

Are More Households Purchasing LCS-Containing Products?

In a word, yes. The most recent study to examine the issue[17] utilized the Nielsen Homescan Consumer Panels dataset, a large nationally representative survey in which consumers use home scanners to record their food purchases from grocery, drug, and convenience stores. Purchases from restaurants are not included. It found that the percentage of households purchasing products with only LCS (i.e., no CS) slightly but statistically significantly increased from 65.7% in 2002 to 67.2% in 2018, a change driven primarily by foods rather than beverages. This study showed larger statistically significant increases in household purchasing prevalence for products containing both CS and LCS, from 46.7% in 2002 to 74.1% in 2018, a change driven primarily by beverages.[18] Companies often blend LCS and CS in an attempt to reduce sugar but keep the same desired taste and sensory profile (e.g., texture, linger, mouthfeel).[19]

Are Households Consuming/Purchasing Larger Amounts of LCS-Containing Products?

Here, the answer is less clear, and may be changing.

* For this fact sheet, the term 'low-calorie sweetener' represents all sweet substances used as substitutes for added sugars. This includes no-, low-, and reduced-calorie sweeteners. Some sweeteners may also be referred to as high intensity, high potency, non-nutritive, artificial, sugar-free, alternative, or non-traditional sweeteners.

A 2013 study found that the volume of beverages purchased that contained only LCS increased from 2000 to 2006 and then decreased from 2006 to 2010, whereas the volume of beverages purchased that contained both LCS and CS increased gradually from 2000 to 2010.[20]

A 2020 study found that the volume of products purchased containing only LCS showed a small but statistically significant decrease (102.2 g/d in 2002 to 100.0 g/d in 2018), while the volume of products containing both LCS and CS significantly increased (10.8 to 36.2 g/day) over the same period.[21] The decrease in the volume of products purchased containing only LCS was driven by beverages; foods actually showed a statistically significant increase. The increase in the volume of products containing both LCS and CS was also reported for foods and beverages when they were analyzed separately. The volume of products purchased containing only CS significantly decreased over this period, from 436.6 to 362.4 g/day.

The same 2020 study found that non-Hispanic White people purchased twice the volume of products containing only LCS compared to Hispanic people and non-Hispanic Black people in both 2002 and 2018 in the U.S., mainly due to non-Hispanic whites having higher volume purchases of aspartame (X). Other studies also report similar findings for non-Hispanic whites.[22,23]

Multiple studies find an association between income and LCS consumption, observing a higher intake of LCS products among college graduates or higher and those in the highest tertile of income.[24,25]

What Do We Know About Consumption of LCS by Children?

As the American Academy of Pediatrics notes, children tend to consume more LCS per pound of body weight than adults, and the long-term safety of LCS in childhood has not been assessed in humans.[26] The 2018 American Heart Association Scientific Advisory states, "it is prudent to advise against prolonged consumption of LCS beverages by children."[27] Based on the available evidence, which is relatively limited, CSPI advises that children avoid LCS.

Between 2003 and 2010, children ages 2-18 significantly increased their consumption of LCS beverages, from 42.7 to 76.8 mL/day (and significantly decreased their consumption of CS-only beverages, from 616.2 to 460.0 mL/day), according to a 2013 study.[28] A 2020 study found that households with (and those without) children purchased significantly more products containing LCS in 2018 compared to 2002. This included both products containing only LCS (62.4% in 2002 to 66.8% in 2018 for households with children) and those containing both LCS and CS (58.1% in 2002 to 83.6% in 2018 for households with children).[29]

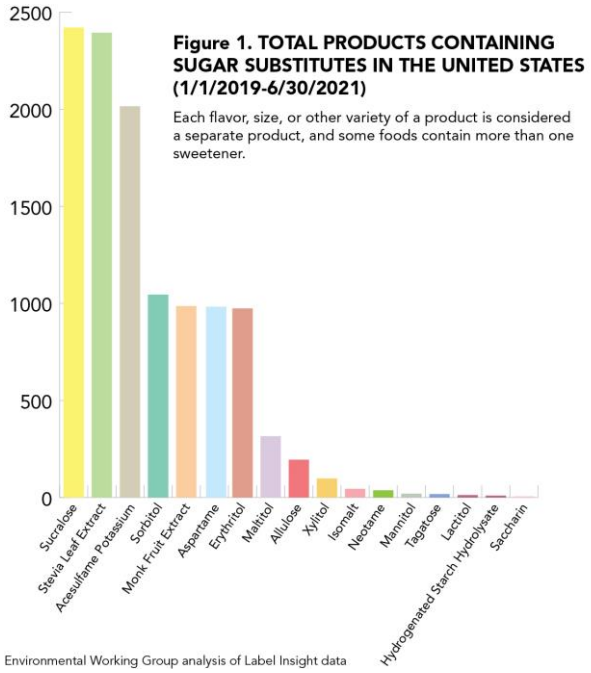
A 2017 study estimated that, of those children who consumed LCS, 80% did so daily.[30]

But, in 2018, households with children purchased less than half the volume of products containing only LCS compared to households without children (46.3 vs. 125.9 g/day), according to a 2020 study. Similarly, households with children purchased a much smaller volume of products containing both LCS and caloric sweeteners compared to households without children (26.3 vs. 40.9 g/day). (Households with children also purchased a considerably lower volume of products containing only caloric sweeteners compared to households without children (259 vs. 412 g/day).)[31]

What Do We Know About Consumption of LCS by Pregnant Women?

A study that collected data from pregnant women aged 20-39 who participated in the National Health and Nutrition Examination Survey (NHANES) from 1999-2000 through 2013-2014 reported that the prevalence of LCS consumption among these women increased by approximately 50% in that timeframe (from 16 to 24%).[32]

Which LCS are Most Prevalent in the U.S.?



✔=safe ◢ = cut back ⚠ = caution
⚠ = certain people should avoid ✘ = avoid

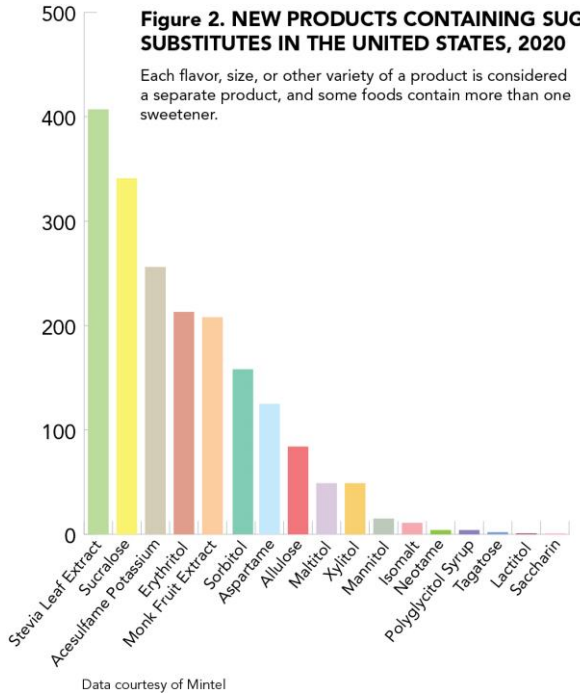
Sucralose (✘) and stevia leaf extracts (✔) are now used in more products than any other LCS, with acesulfame potassium (✘) not far behind, according to an Environmental Working Group analysis of Label Insight data (*see Figure 1*). Sorbitol (◢), monk fruit extract (⚠), aspartame (✘), and erythritol (✔) also appear in many products. Other sweeteners are much more rarely used.

Aspartame (✘) used to have the largest share of the market overall, but that share declined as the consumption of diet soda declined and other LCS gained market share.[33] Aspartame (✘) is the LCS of most concern to the Center for Science in the Public Interest (CSPI) because of compelling evidence that it causes cancer and is a potent carcinogen.[34]

Which LCS are Increasing in Popularity, and Which are Decreasing?

Most relevant studies on LCS trends do not analyze specific LCS. A 2020 study is the only recent study to do so.[35] It reported a statistically significant decrease between 2002 and 2018 in the prevalence of households purchasing products containing aspartame (✘), down from 60.0% to 49.4% and a statistically significant increase in the prevalence of those purchasing the stevia leaf extract rebaudioside A (✔), up from only 0.1% to 25.9%, and in sucralose (✘), from 38.7% to 71.0%. Similarly, comparing 2002 and 2018, there were statistically significant decreases in the volume of products purchased containing aspartame (94.7 to 80.0 g/day) and statistically significant increases in the volume of products containing rebaudioside A (0.0 to 7.6 g/day) and sucralose (15.4 to 49.4 g/day).

Another way to assess which LCS are increasing in popularity is to look at the percent of new products containing specific LCS. Doing that, we see that stevia leaf extracts (✔) may be poised to overtake sucralose (✘) as the most popular LCS, given that they are used in more new products than any other LCS (*see Figure*



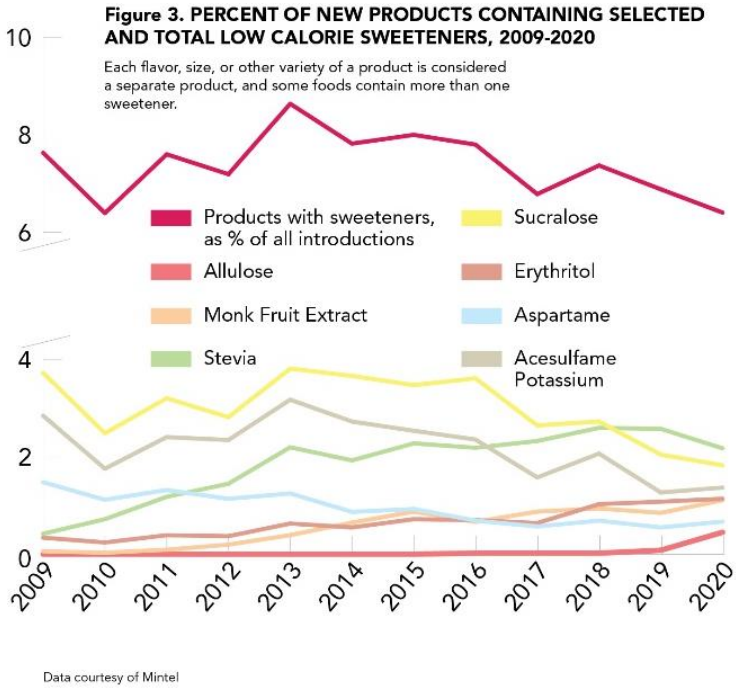
2), according to data provided courtesy of Mintel. Sucralose (❌), acesulfame potassium (❌), erythritol (✅), and monk fruit extract (⚠️) are also commonly used LCS In new products, followed by sorbitol (🔑), aspartame (❌), and allulose (⚠️).

Between 2009 and 2020, and especially since 2013, there appears to be a slightly downward trend in the percent of new products containing any LCS, and in a number of specific LCS, (e.g., sucralose (❌, acesulfame potassium (❌)), but there seems to be a slightly upward trend for erythritol (✅), monk fruit extract (⚠️), and very recently (since 2019), for allulose (⚠️) (*see Figure 3*).

The increase after 2019 in the percent of new products containing allulose (⚠️), a sugar that has only 10% of the calories as traditional sugar and causes only negligible increases in blood sugar and insulin levels, coincides with FDA's 2019 draft guidance, finalized in 2020, advising manufacturers that they would not have to include allulose (⚠️) in the lines for "Total Sugars" and "Added Sugars" on Nutrition Facts labels.[36] While CSPI agrees with FDA's guidance, we have urged the FDA to require labels to warn consumers that "excess consumption of allulose may cause diarrhea or other adverse gastrointestinal effects."[37]

Knowledge of Trends is Limited by Data Availability

- FDA lacks data on the amounts of food additives, including LCS, used in the U.S. FDA does not require companies to report the amounts of food additives in general, including LCS, produced or used.
- The U.S. Department of Agriculture has not published any recent data on use of LCS; the most recent information was published in 2012.[38,39]
- The published literature may not reflect the most current trends in purchasing and consumption of LCS. For example, two studies published in 2018 utilize NHANES data up to 2012.[40,41] Studies published in 2012 and



2015 utilize NHANES data up to 2008.[42,43].

- Studies frequently fail to differentiate between different LCS, instead aggregating LCS into a single group.
- Most purchasing volume studies do not reflect foods and beverages purchased or consumed in restaurants. Others rely on self-reported dietary recall data (like that collected through NHANES) which may not report intake accurately and are inherently limited in precision.[44]
- The data needed to conduct exposure assessments on LCS is lacking.
- Only a few studies examine trends in the consumption of LCS by populations of concern, such as children or pregnant and nursing women.
- Some manufacturers do not explicitly disclose the use of LCS, including erythritol,[45] (✅) stevia leaf extracts[46] (✅), and monk fruit extract[47] (⚠️) on food labels, instead including them under the term 'natural flavors.'

Recommendations

- FDA should require all LCS to be affirmatively disclosed in the list of ingredients on the food label, and not permit LCS to be included under the terms "natural flavors" or "artificial flavors." Until then, food and beverage manufacturers should not include LCS under "natural flavors" or artificial flavors."
- Congress should ensure that FDA has the authority to collect data on the production and use of LCS and other food additives. Meanwhile, food and beverage manufacturers should voluntarily disclose the amounts of different LCS used in their products in a public database.
- Congress should fund a National Academies of Sciences, Engineering, and Medicine (NASEM) study that examines key changes in exposure to specific LCS among children and adults, reviews the scientific evidence regarding LCS safety for children, and develops recommendations to protect children and other consumers
- FDA should conduct an exposure assessment on LCS for the U.S. population, for children in different age groups, and for pregnant women.
- Food and beverage manufacturers as well as consumers should especially avoid the use of aspartame (❌) because of compelling evidence that it causes cancer, and should favor safer LCS such as erythritol (✅), stevia leaf extract (✅), and advantame (✅).
- FDA should require disclosure of information on the label that overconsumption of certain sweeteners (sugar alcohols, allulose (🔼)) may cause gastrointestinal distress. This is especially pressing in light of current trends showing an increase in the use of allulose, and the widespread use of chemically related sugar alcohols. In the interim, food and beverage manufacturers should voluntarily disclose this information.

For more information, please contact the Center for Science in the Public Interest at policy@cspinet.org.

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[4] 21CFR189.135.
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[6] (The three types are (1) certain purified extracts (containing steviol glycosides) obtained from the leaves of the stevia plant (*Stevia rebaudiana*), such as Rebaudioside A (Reb A), Stevioside, Rebaudioside D); (2) extracts (containing mogrosides) obtained from monk fruit (Luo Han Guo, or *Siraitia grosvenorii* Swingle fruit); and (3) thaumatin, obtained from the katemfe fruit.)

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