COMPLIMENTARY LIVE WEBINAR

The Latest on Low- and No-Calorie Sweeteners: What You Need to Know

PRESENTED BY

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Splenda

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The Latest on Low- and No-Calorie Sweeteners: What You Need to Know awards 1.0 CPEU in accordance with the Commission on Dietetic Registration's CPEU Prior Approval Program.

Accreditation Statement

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Disclosures

Tyler Townsend, MS, RDN, LDN, has the following relevant disclosure to report: he is employed by Heartland Food Products Group, maker of Splenda® Brand Products.

Vandana Sheth, RDN, CDCES, FAND, has the following relevant disclosures to report: she is a consultant to Heartland Food Products Group, maker of Splenda® Brand Products. She is an independent contractor to Sanofi, Califia Farms and General Mills. She is a former independent contractor to Florida Orange Juice, the Tomato Wellness Council, and the Alliance for Food and Farming.

Learning Objectives

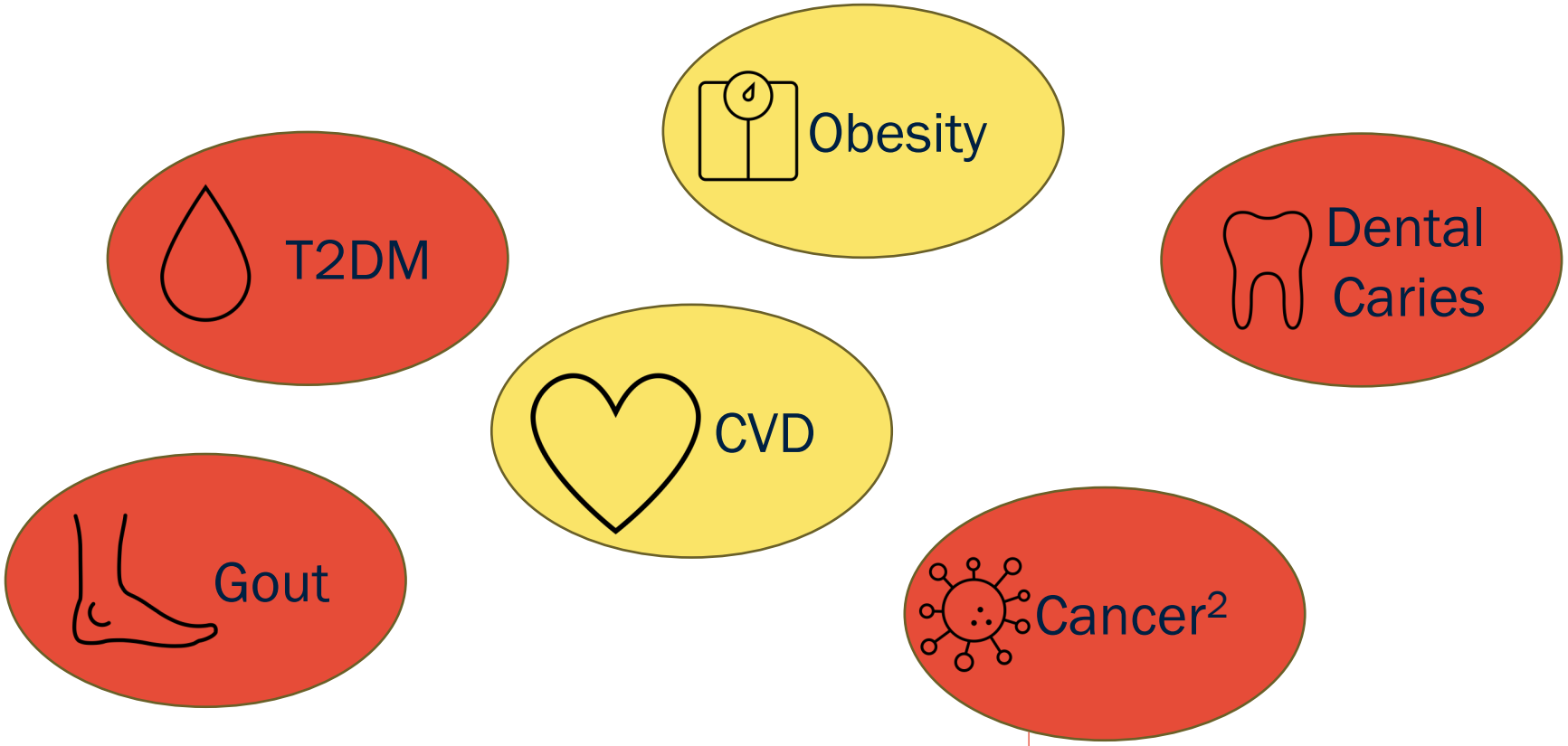
After completing this activity, nutrition professionals will better be able to:

1. Summarize why low- and no-calorie sweeteners (LNCS) are a safe and effective replacement for added sugar.
2. Explain how LNCS are regulated and differentiate between different types of LNCS.
3. Interpret the body of literature related to the safety and efficacy of LNCS.
4. Demonstrate appropriate uses of LNCS as a substitute to added sugar.

Why Does Sugar Intake Matter?

Why Does Sugar Intake Matter?

- Intake of sugar is linked to:[1,3]



Children/Young Adults and Sugar Intake

- National Survey of Children's Health (10-17 Years Old)[4]
  - 2018-2019: 15.5% have obesity
  - 2020-2021: 17% have obesity
- SSB, Obesity Rate, T2DM in Children and Adolescents[5, 6]
  - <5 Years Old: 39 million overweight or obese (2020)[7]
  - 5-19 Years Old: >340 million overweight or obese (2016)[7]
- Regular consumers of SSB between meals had 2.4-fold greater odds of being overweight[8]
- Children with obesity face 4-fold greater risk of T2DM[9]

Consumption vs. Recommendation of Added Sugar

Average Intake > Recommendation Across Lifespan[10]

Average Intake[10, 11]

266 kcal/day
67 grams/day
17 teaspoons/day

DGA Recommended Intake[10]

<10% calories/day

<200 kcal/day
<50 grams/day
<12 teaspoons/day

(based on 2000 kcal diet)

AHA Recommended Intake[12]

<6% calories/day

MEN
<150 kcal/day
<36 grams/day
<9 teaspoons/day

WOMEN
<100 kcal/day
<25 grams/day
<6 teaspoons/day

Where Does Added Sugar Intake Come From?

Beverages are the leading category of added sugar (47%)[13]

Soft Drinks (25%)
Fruit Drinks (11%)
Coffee/Tea (7%)
Sports/Energy Drinks (3%)

Snacks and sweets are next biggest contributor (31%)

Trends with Sugar and LNCS

Trends with Sugar and Low- and No- Calorie Sweeteners

- Decreased purchases of caloric sweeteners (i.e., sugar) and increased purchases of LNCS sweeteners in 2002–2018 comparison[14]
  - Non-Hispanic white population purchased 2x volume containing LNCS compared to Hispanic and non-Hispanic black population
  - Reduced purchase of saccharin and aspartame
  - Increased purchase of stevia and sucralose

- Significant reduction in SSB intake (2003–2016)[15]
  - Children: 10.9% -> 3.3%
    - Declines observed across age group, sex, family income status, and most races/ethnicities
  - Adults: 12.7% -> 9.1%
    - Significant decline in age range of 20-39 years old, most races/ethnicities, and higher-income adults

Varieties of Low- and No-Calorie Sweeteners

Sweeteners as Food Additives

Plant-Based

Others

Safety of LNCS is backed by...[52]

Regulation in the United States

GRAS (Generally Recognized as Safe)

"Any substance that is intentionally added to food is a food additive, that is subject to premarket review and approval by FDA, unless the substance is generally recognized, among qualified experts, as having been adequately shown to be safe under the conditions of its intended use, or unless the use of the substance is otherwise exempted from the definition of a food additive."[16]

Food Additive

"Any substance that intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristic of any food."[16]

The FDA determines the safety of the ingredient, but a determination that an ingredient is generally recognized as safe can be made by qualified experts outside of the government [16]

Sweeteners as Food Additives

Aspartame[17]

- Discovered in 1965
- Dipeptide: phenylalanine and aspartic acid
- Not heat stable or acid stable
- FDA Approved 1974[18, 19]

Saccharin[17, 20]

- Discovered in 1879
- FDA regulated in 1977
- Heat Stable

Sucralose[21]

- Discovered in 1976 (accidentally)
- FDA Approved: 1998
- Made from Sucrose
  - Selective process to replace 3 -OH groups with Cl
- Heat stable

Common Concerns

- Gut Health[22,23]
- Glucose Metabolism[24]
- Toxicity/ Cancer

Plant Based Sweeteners

Stevia

Process

- Harvest
- Dry
- Steep
- Extract
- Crystallize

- Steviol Glycosides Common in US
  - Reb A
  - Reb D (no bitter aftertaste)
- GRAS: 2008

Monk Fruit

- Native plant to Southern China
- Process
  - Crushed
  - Mixed with hot water
  - Filtered
  - Spray Dried
- GRAS: 2010

Others

Sugar Alcohols

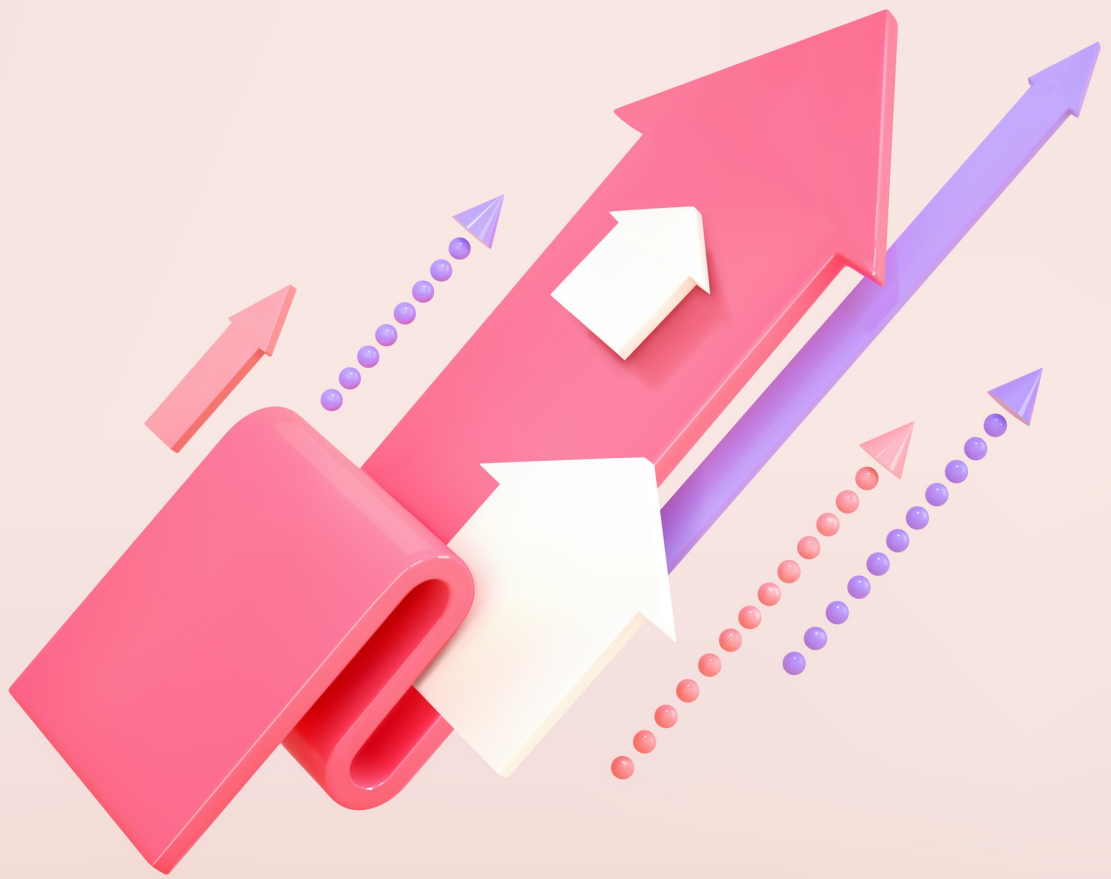
- Examples: Sorbitol, Mannitol, Xylitol, Erythritol
- Sweetness varies from 25%-100% as sweet as sugar
- Sugar alcohols do not react with plaque bacteria in mouth/oral hygiene[25, 26]
- Uses: sugar-free candies, cookies, chewing gum, protein bars
    - Creates cooling sensation

Rare Sugars[18]

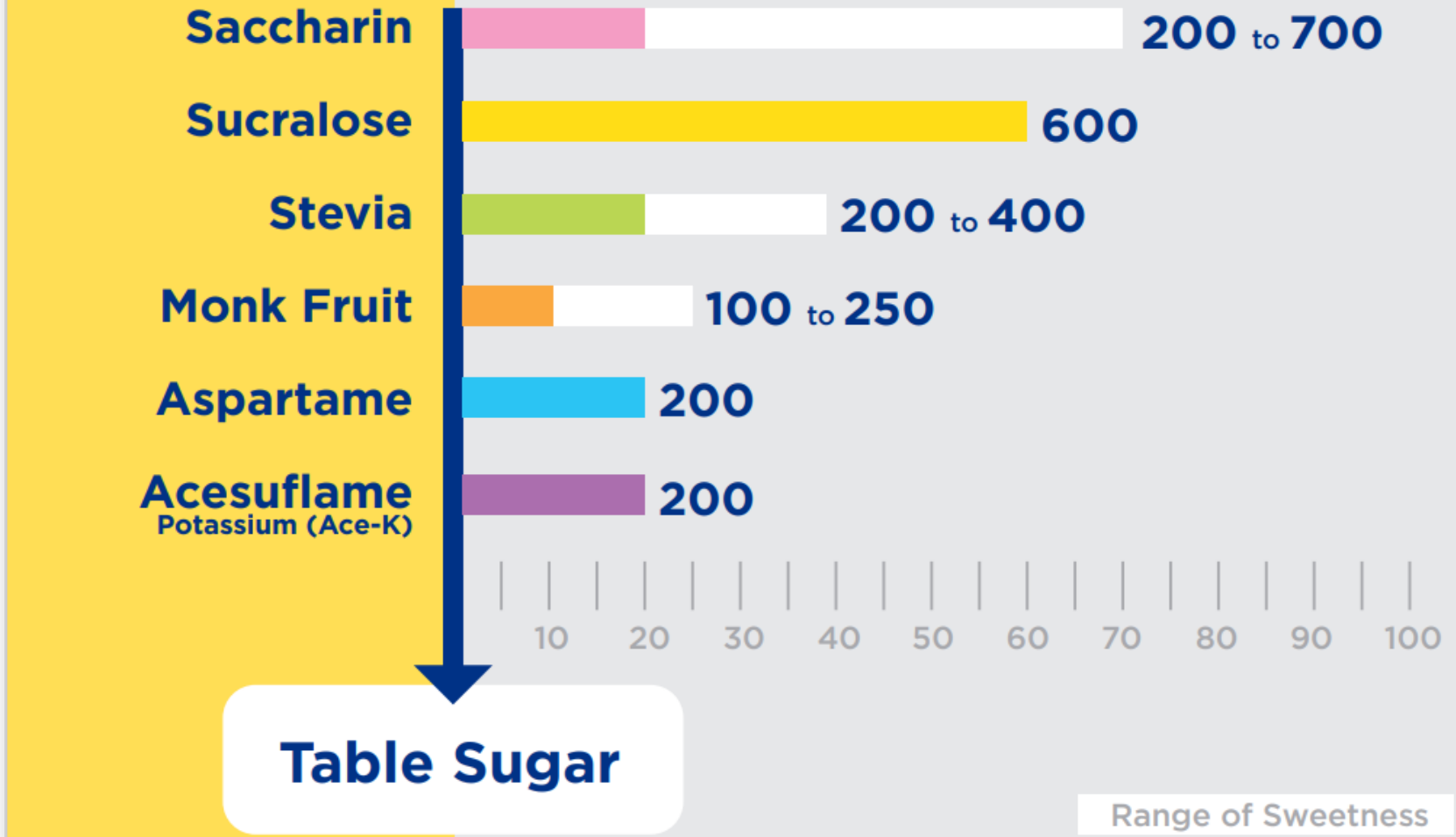
- Examples: Allulose, tagatose, isomaltulose
- Metabolized differently than traditional sugars due to different chemical makeup, but meet the chemical definition of sugar
- Rare sugars found to offer both short- and long-term benefits[27]
    - Glycemic control
    - Weight loss

Sweetness Effect

Compared to sugar (sucrose), how sweet are low- and no-calorie sweeteners?



Sweetness Intensity of Sweeteners Compared to Table Sugar



Adapted from: U.S. Food & Drug Administration. (2023, July 14). Sweetness Intensity of Sweeteners Compared to Table Sugar [PDF]. Retrieved from https://www.fda.gov/food/food-additives-petitions/aspartame-and-other-sweeteners-food

How Much is Too Much?

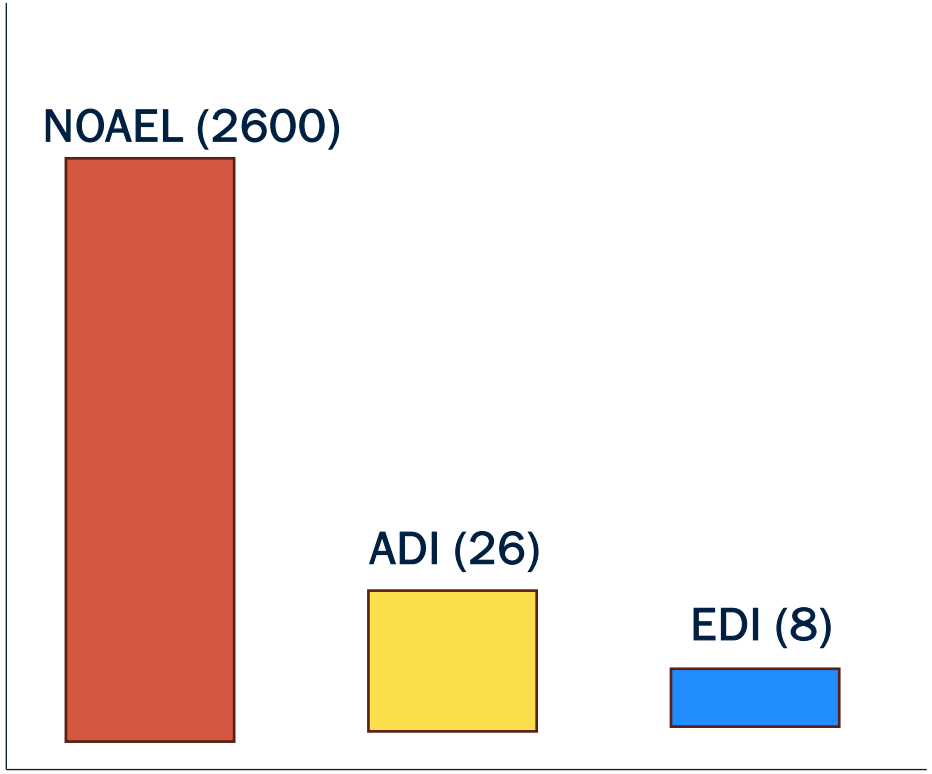
How much LNCS can a person safely consume to stay within the Acceptable Daily Intake (ADI Level)?

Acceptable Daily Intake (ADI)

- What is it?[28]
  - The amount of an approved food additive that can be consumed daily in the diet, over a lifetime, without appreciable health risks.
  - Expressed as mg/kg bw/day
- Who is involved?[28]
  - International level
    - JECFA/FAO/WHO
  - United States
    - FDA
- How does it happen?[28]

LNCS are some of the most thoroughly researched ingredients in the world[55]

Putting it in perspective…



NOAEL = No observed adverse effect level

ADI = Acceptable Daily Intake

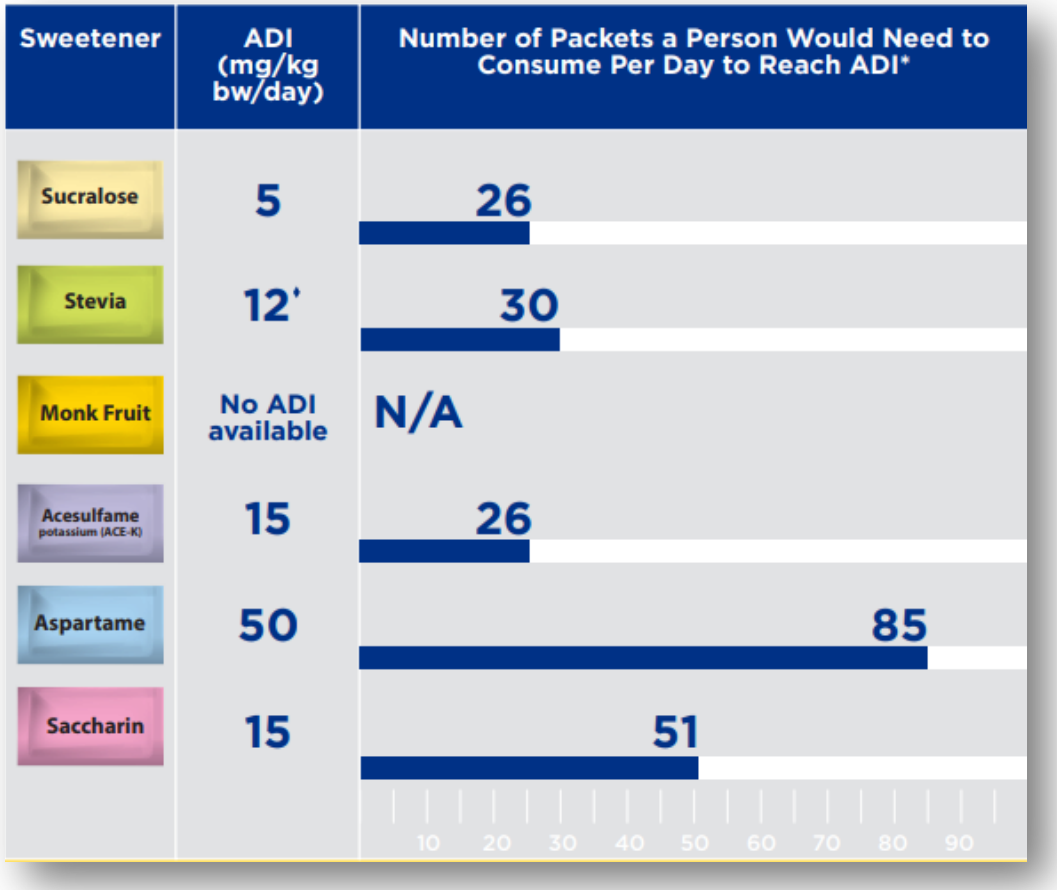
EDI = Estimated Daily Intake

NOAEL / 100 = ADI

SUCRALOSE

NOAEL = 2600 Packets
ADI = 26 Packets
EDI = 8 Packets

Safe Levels of Sweeteners



Acceptable Daily Intake (ADI)

The Acceptable Daily Intake (ADI) is the amount of a sweetener considered safe to consume each day over the course of a person's lifetime.

The ADI is established by taking the highest experimental dose that is without adverse effects, known as the No Observed Adverse Effect Level (NOAEL), and dividing it by a safety factor of 100.

* Based on a 68 kg (150 pound) person

♦ Based on high-purity stevia extracts[29]

Adapted from: US. Food & Drug Administration. (2023, July 14). Safe Levels of Sweeteners [PDF]. Retrieved from fda.gov/food/food-additives-petitions/aspartame-and-other-sweeteners-food

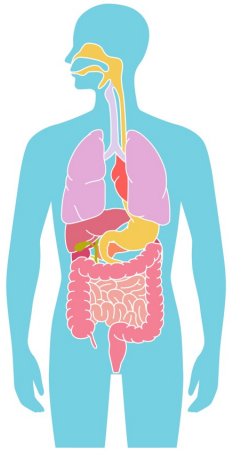
Research of LNCS

Research of Low- and No- Calorie Sweeteners

- **Cardiometabolic Health**
  - LNCS were not associated with cardiometabolic harm and research provides some indication that LNCS may be associated with cardiometabolic benefit in the intended substitution for SSB[30]

- **Glycemic Management and Diabetes**
  - No statistically significant associations of diet soda or LNCS consumption with fasting insulin, fasting glucose, or incident diabetes[31]

- **Gut Health/Microbiome[22, 23]**
  - No relation to LNCS consumption and adverse impacts on gut microbiome



Research of Low- and No- Calorie Sweeteners (con't)

- **Hunger/Appetite**[32, 33]
  - Appetite is subjective
  - Effects of potential increase in appetite does not translate to changes in food intake[32]
  - LNCS do not protect consumers from craving-induced increases in energy; however, frequent consumers of LNCS beverages consumed fewer calories overall and participants perceived more control over their food intake and felt less guilty[33]

- **Weight Management and Energy Intake**
  - Evidence supports the use of LNCSB as an alternative replacement strategy for SSB over the moderate term in adults with overweight or obesity[34]
  - Consumption of LNCS instead of added sugars decreases body weight and achieves this by decreasing daily energy intake in adults and children at a healthy weight, or with overweight or obesity[37]
  - Participants using LNCS showed significant weight/BMI differences that favored the use of LNCS compared to nonusers[35]

- **Cancer Risk**
  - Analyses failed to show any associations between LCS use and cancer mortality[36]

Sifting the Science versus the Headlines

World Health Organization – May 15, 2023

What the Headline Said: "World Health Organization advises not to use non-sugar sweeteners for weight control in newly released guideline"[38]

What the WHO Guidance Said:

- "WHO suggests that non-sugar sweeteners not be used as a means of achieving weight control or reducing the risk of noncommunicable diseases (**conditional recommendation**)."
- "The recommendation is based on evidence of **low certainty** overall, from a systematic review that assessed the health effects of higher compared with lower intake of NSS."
- "Because the link observed in **the evidence between NSS and disease outcomes might be confounded** by baseline characteristics of study participants and complicated patterns of NSS use, the recommendation has been assessed as **conditional**."
- "Because assessing the effects of NSS use in individuals with diabetes was beyond the scope of this guideline, studies specifically assessing **the effects on individuals with pre-existing diabetes or including only such individuals were not included** in the review."
- "The guidance **in this guideline is not based on toxicological assessments of the safety of individual non-sugar sweeteners** and is therefore not intended to update or replace guidance on safe or maximal levels of intake established by the Joint Food and Agriculture Organization of the United Nations (FAO)/WHO Expert Committee on Food Additives (JECFA) or other authoritative bodies."

Responses to WHO Article

- The WHO could only conclude a *conditional* recommendation[39, 40]
  - Evidence supporting the recommendation is considered less certain

- The WHO Guideline was not a safety assessment of the LNCS category
  - LNCS are safe and have been extensively researched and approved by safety bodies around the world such as JECFA, the US FDA, and EFSA[39]

International Agency for Research on Cancer (IARC): Aspartame Hazard and Risk Assessment Results Released[41]

What the Headline Said: "Aspartame Hazard and Risk Assessment Results Released"

What the IARC Guidance Said:

- IARC classified aspartame as **possibly carcinogenic** to humans (Group 2B) on the basis **of limited evidence** for cancer in humans
- There was also **limited evidence** in cancer for experimental animals and **limited evidence** related to the possible mechanisms for causing cancer
- After reviewing the available scientific literature, **both evaluations noted limitation in the available evidence for cancer** (and other health effects)
- The strength of evidence classification in Group 2B is generally used either when **there is limited, but not convincing evidence**, for cancer in humans or convincing evidence for experimental animals, but not both

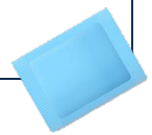
International Agency for Research on Cancer (IARC)

Classification of Carcinogens[42]

Group 1: Carcinogenic to humans
Examples: Alcoholic beverages, UV Radiation

Group 2A: Probably Carcinogenic to humans
Examples: Frying (emissions from high-temperature), night shift work, red meat (consumption of)

Group 2B: Possibly Carcinogenic to humans
Example: Aspartame



Group 3: Not classifiable as to its carcinogenicity to humans

Sucralose-6-Acetate (S6A)

What the Headline Said: “Chemical Found in Sucralose Damages DNA”

What the Article Said:

- “S6A is an intermediate and impurity in the manufacture of sucralose, and recent commercial sucralose samples were found to contain up to 0.67% S6A.”[43]
- S6A is produced in the gut after sucralose ingestion[53]
- “S6A significantly increases the expression of genes associated with inflammation, oxidative stress and cancer.”[43]

Response to Sucralose-6-Acetate Study

- Sucralose is approved globally for use in foods and beverages
- Safety is backed by…[44]
  - US FDA
  - European Food Safety Authority (EFSA)
  - Health Canada
  - Food Standards Australia and New Zealand (FSANZ)

- Findings from a study assessing key characteristics of carcinogens agree with previous reviews reporting that sucralose is not carcinogenic.[45]
- There is no published study demonstrating S6A is formed when humans consume sucralose.

"The collective evidence supports that sucralose is non-carcinogenic, based on carcinogenicity studies that comply with regulatory standards for appropriate design and conduct and no evidence of genotoxicity."[44]

The Artificial Sweetener Erythritol and Cardiovascular Event Risk[46]

What the Headline Said: "Elevated levels of erythritol and several related artificial sweeteners were associated with the risk for cardiovascular events"

What the Article Said:

- ***Initial study:*** *looked for compounds in blood whose levels were linked to future cardiac risk and tracked adverse cardiovascular events for 3 years*
- *Elevated levels of erythritol were* ***associated*** *with the risk for cardiovascular events*
- ***In-vitro study:*** *exposed human platelets to erythritol, which increased platelets' sensitivity to blood clotting signals*
- ***Animal study:*** *increasing blood erythritol levels sped up blood clot formation and artery blockage in mice*
- *Measured erythritol levels in 8 volunteers* ***after*** *drinking a beverage sweetened with erythritol*

Response to Erythritol Study

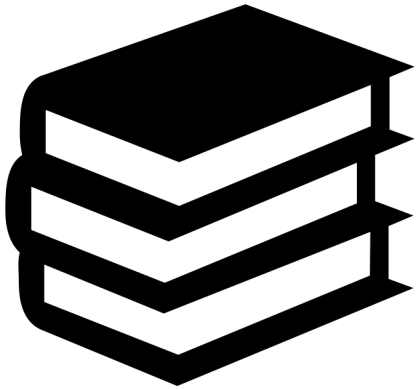
- Authors only included those at risk for adverse cardiovascular events[47]
- Does not establish **dietary** erythritol as a causal agent for CVD risk[47]
- No intervention on diet, physical activity, or other factors that impact cardiovascular disease risk[47]
- Erythritol dose in human feeding studies atypical[47]
  - 3x the max amount found in beverages
  - Plasma levels of erythritol only measured once
- Erythritol is approved for use in over 60 countries[48]
- Humans *produce excess erythritol* under oxidative stress[47, 49]

Academic Bias Against LNCS[50]

Proposing mechanism without relevance

Negative interpretations of LNCS largely rely on selectively emphasizing lower quality research

Reverse Causality



Reprise hypotheses of adverse effects without acknowledgements of where hypotheses of adverse effects have been tested and rejected

Reading Beyond the Headlines...

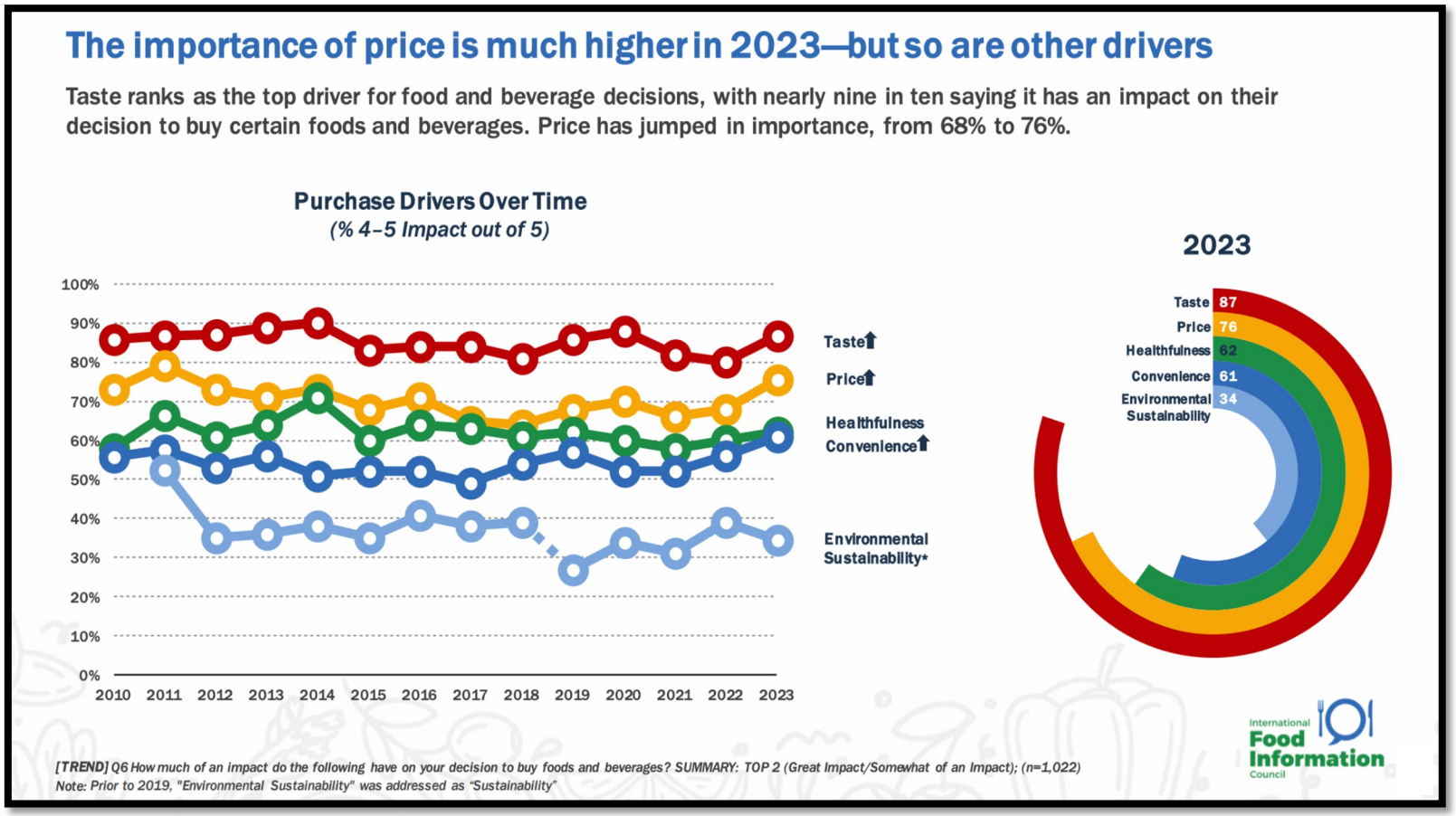
What You Heard...	How to Address Your Clients
 "Sucralose damages DNA and increases cancer risk."	Sucralose does not change your DNA or cause cancer. Health and safety experts around the world have reviewed 30+ years of scientific data on sucralose and have determined that it is safe.
 "Erythritol is linked to heart attack and stroke."	Erythritol does not cause heart attack or stroke. People who have had a heart attack or stroke are more likely to naturally make erythritol inside their bodies. This does NOT mean that eating erythritol will cause you to have a heart attack or stroke. Erythritol is used around the world by more than 60 countries and has been determined safe.
 "The WHO says not to use low- and no-calorie sweeteners."	The WHO did NOT say to avoid LNCS because they are unsafe. They gave a conditional recommendation to avoid using LNCS for weight control and reducing risk of chronic diseases, which was based on low certainty of evidence. This means they were less than certain of the outcome using their guidance
 "Low- and no-calorie sweeteners alter gut bacteria."	Low- and no-calorie sweeteners do not negatively impact your gut. Your gut bacteria changes all the time due to many different factors, like sleep, medications, and your overall diet.
 "Eating low- and no-calorie sweeteners makes you crave sweets more."	Low- and no-calorie sweeteners do not make you crave sweets more. In fact, low- and no-calorie sweeteners can help you get the sweet taste you desire without the excess calories and carbs, which can help with weight and blood sugar management.
 "Low- and no-calorie sweeteners raise your blood sugar."	Low- and no-calorie sweeteners do not rase blood sugar levels. Eating low- and no-calorie sweeteners in place of added sugars can help you avoid blood sugar spikes, which can help with reducing your risk for diabetes or diabetes complications.

Vandana Sheth

RDN, CDCES, FAND

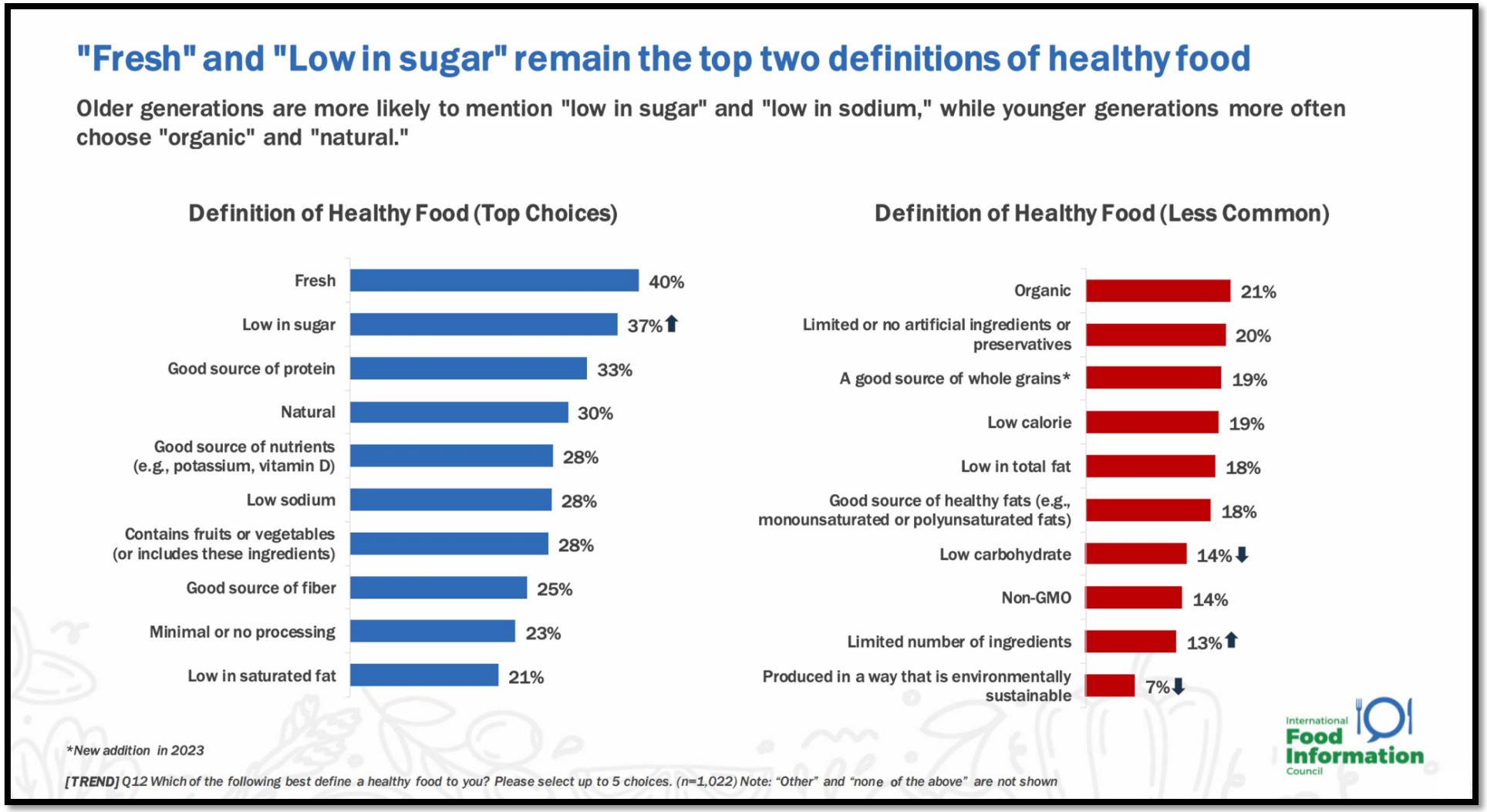
Applications

- Strategies to help your clients incorporate LNCS
- IFIC data on what drives eating behaviors
  - Taste
  - Cost



International Food Information Council. 2023 Food & Health Survey. 23 May 2023. https://foodinsight.org/2023-foodhealth-survey/

Applications

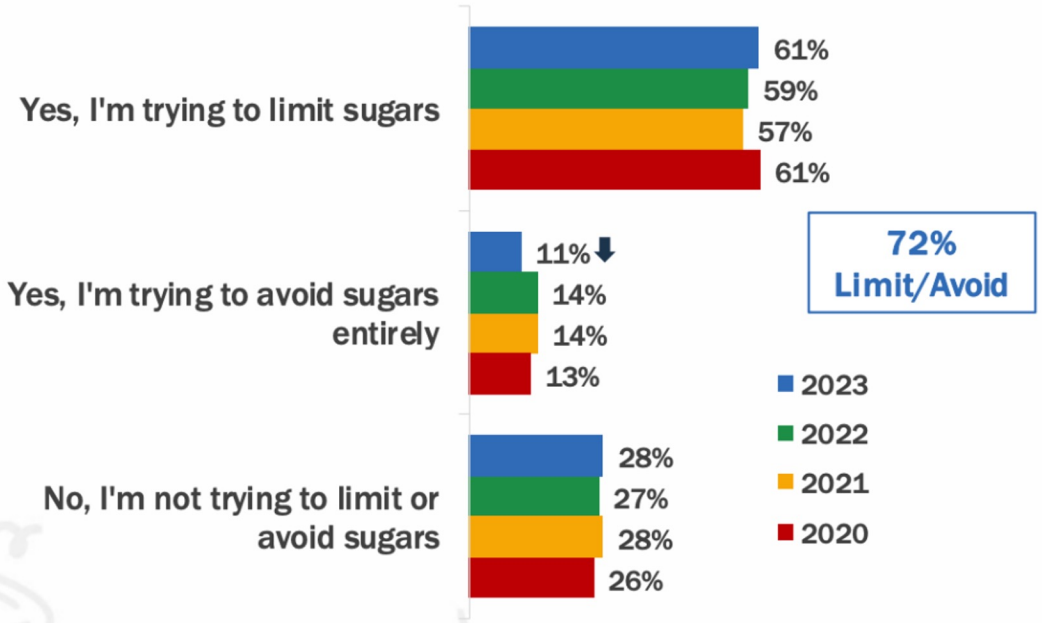


International Food Information Council. 2023 Food & Health Survey. 23 May 2023. https://foodinsight.org/2023-foodhealth-survey/

Percentage of those trying to limit or avoid sugars is relatively consistent with last year

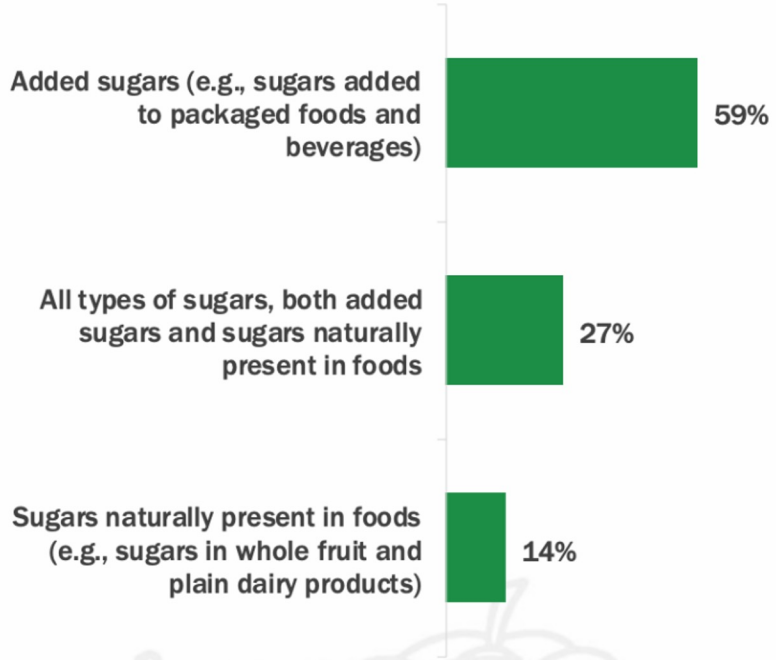
While added sugars are the most common type to avoid, three in ten say they are avoiding all types of sugars.

Trying To Limit/Avoid Sugars



Types of Sugar Being Limited/Avoided

(Of Those Limiting/Avoiding Sugar)



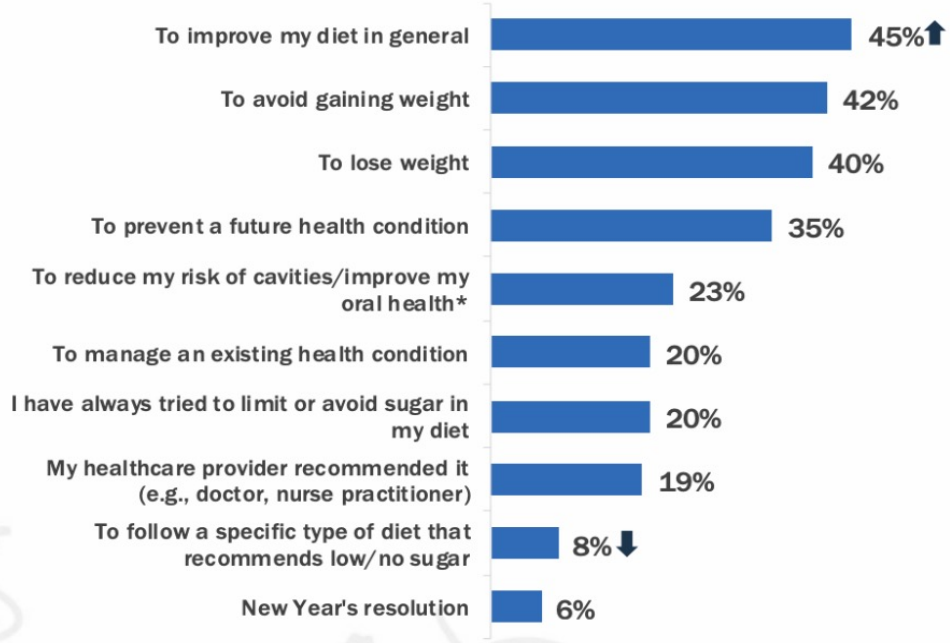
[TREND] Q40 Are you trying to limit or avoid sugars in your diet? (n=1,022) / Q40A What type of sugars are you trying to limit or avoid? Filter: Tries to limit or avoid sugars: (n=725)

International Food Information Council

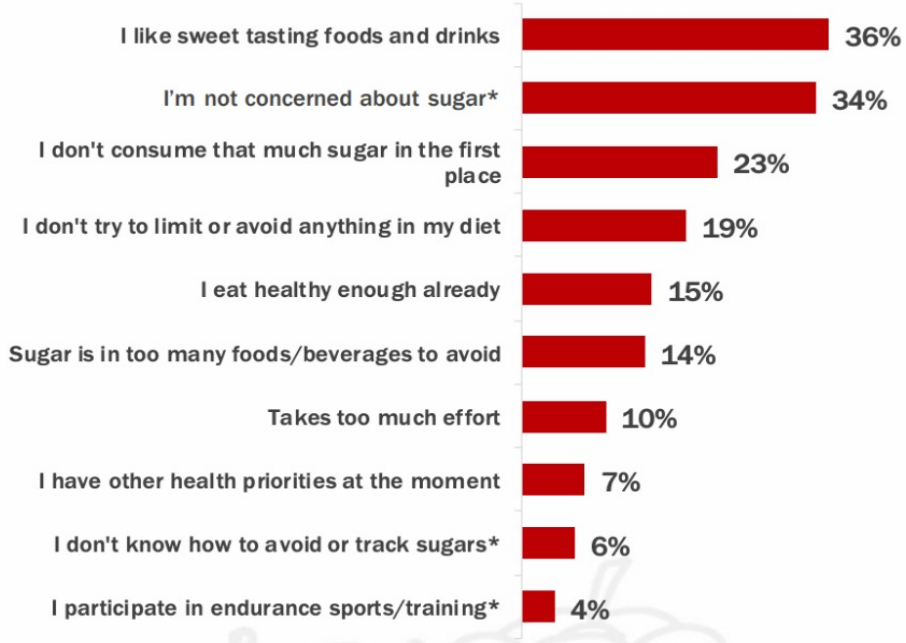
More consumers say they are limiting sugars to improve their diet in general

And more than a third say they do NOT limit sugars because they like the taste and aren't concerned about their sugar intake.

Reasons for Limiting/Avoiding Sugars
(Of Those Who Limit/Avoid Sugars)



Reasons for NOT Limiting/Avoiding Sugars
(Of Those Who Do Not Limit/Avoid Sugars)

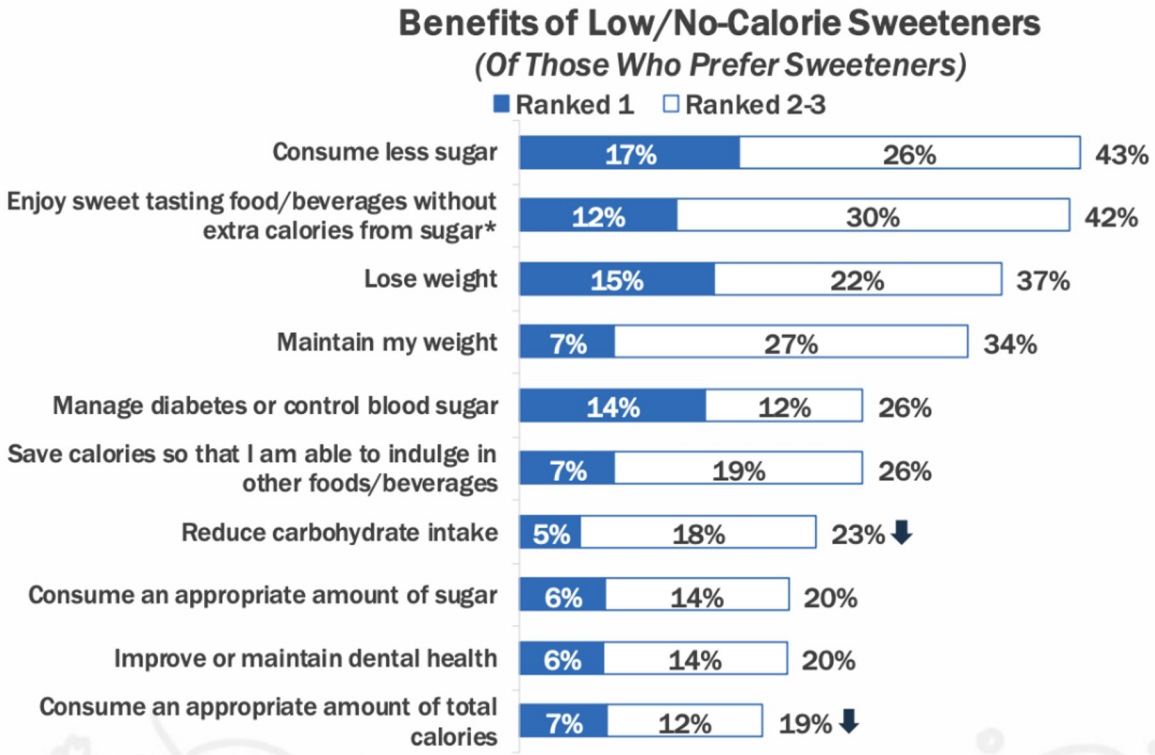


**New addition in 2023; [TREND] Q40B Why did you start trying to limit or avoid sugar in your diet? (Select all that apply.) Filter: Tries to limit or avoid sugars: (n=725) / [TREND] Q40C Which of the following are reasons why you do not try to limit or avoid sugar in your diet? (Select all that apply.) Filter: Does not try to limit or avoid sugars: (n=297); Note: "Other" and "not sure" are not shown*

International Food Information Council

The most common benefits cited for using low/no-calorie sweeteners are reducing sugar intake and enjoying sweet-tasting products without the added calories

More than a third also say it helps them lose or maintain weight.



*New addition in 2023

[TREND] Q42A Which of the following, if any, do you believe consuming low/no-calorie sweeteners helps you do? (Rank your top 3 choices, with 1=Top Choice.) Filter: Prefers low/no calorie sweeteners: (n=235); Note: "Other" and "none of the above" are not shown

International Food Information Council

5 Ways to Reduce Added Sugars

Limit consumption of:

- Sugar-sweetened beverages (SSBs)
- Coffee/Tea
- Condiments
- Breakfast
- Baked goods

Case Study

Client: Vakil

- 70-year-old Indian American client who was newly diagnosed with DM
- Used to love drinking multiple cups of chai (sugar sweetened Indian tea) every day
- Stopped because he did not like drinking it unsweetened; he was worried about his blood sugar

Our Strategy

- Provide him with a way to enjoy his chai without spiking his blood sugar
- Introduced various low sugar sweetener options
- Discusses pros and cons, and safety
- Sucralose, allulose, stevia, monk fruit
- He chose to go with sucralose packets

Results:

- He loved having his chai without spiking his BG
- His A1C went from 6.8% to 6% and he lost 15 lbs. in 3 months

Case Study

Client: Noah

- 55-year-old Engineer
- Sweet tooth
- Went from prediabetes to diabetes
- Only eating salads and feeling hungry, tired, and scared

Our Strategy

- Simple action plan
- Educate on the Plate Method
- Focus on veggies + protein + carbs
- For his sweet cravings and to help with hydration (since he did not like the taste of water), incorporate beverages sweetened with LCS

Results:

- Feeling more confident
- BG more stable
- Not hungry all the time

Case Study

Client: Erin

- 65-year-old overweight client struggling with DM for a long time
- Loves to bake and entertain, especially with family
- She also enjoyed playing golf but kept having many high and low blood sugar levels

Our Strategy

- Discussed the variety of LCS and how to use them when baking to cut down on added sugars
- Shakes as an option to help her maintain her BG while staying active on the golf course

Results:

- She is enjoying baking again while also avoiding BG spikes
- Shakes have significantly improved her energy on the golf course
- She’s not experiencing any lows

Qualities of the Different Low-Calorie Sweeteners

Sucralose

- No-calorie sweetener
- Derived from sugar
- 600 times sweeter than sugar[21]
- Keeps its sweetness and is stable in a wide range of conditions[21]
- Works for baked goods as well as frozen desserts
- Available forms: packets, pouches, liquid, baking blends

Qualities of the Different Low-Calorie Sweeteners

Allulose

- Naturally occurring sugar (plant foods) in small amounts
- Commercially produced from corn or fructose
- Low in calories: 70% as sweet as sucrose and only 10% calories[51]
- Rapidly absorbed and excreted from the body[51]
- Does not increase blood glucose or bacteria in the mouth leading to cavities[51]
- Available forms: granular, liquid, and packets

Qualities of the Different Low-Calorie Sweeteners

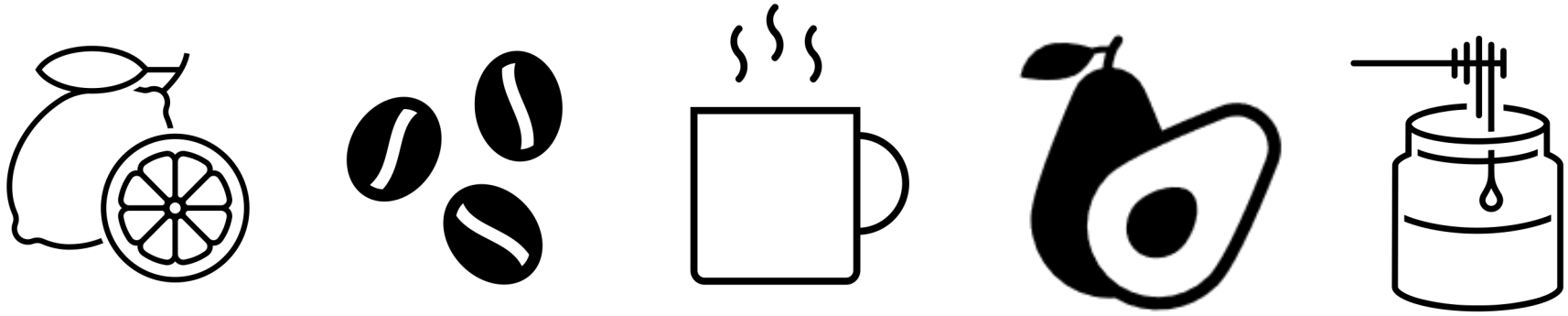
Stevia

- Comes from the leaves of the stevia plant
- 200-350 times sweeter than sugar[18]
- Retains sweetness at high temperatures
- Available forms: Packets, pouches, jars, liquid

Qualities of the Different Low-Calorie Sweeteners

Monk Fruit

- No calorie sweetener
- 100-250 times sweeter than sugar[18]
- Retain sweetness at high temperatures
- Available forms: Packets, pouches, jars, liquid



Recipes

My Favorite Ways to Incorporate Low- & No-Calorie Sweeteners

Masala Chai

Sucralose

Water

Milk (of choice)

Black tea

Chai spice mix

- Cardamom
- Nutmeg
- Cloves
- Cinnamon

Hot “Honey” Sauce

Sucralose Multi-Use Syrup

Garlic

Hot sauce

Olive oil

Onion powder

Cayenne

Sea salt

Almond Fudge Badam Halwa

Sucralose

Almond flour

Milk

Cardamom

Ghee

Vegetable Chili

Stevia Packets

Olive oil

Onion

Bell pepper

Garlic

Zucchini

Chili powder

Oregano

Cumin

Chipotle chili powder

Black beans

Tomato sauce

Diced tomatoes

Salt

Black pepper

Putting It Into Practice

- Added sugar intake exceeds the recommendations in the US and sugar intake negatively impacts health
- There are a variety of LNCS categorized by sweeteners as food additives, plant-based, and others
- LNCS are put through a rigorous approval process and only approved when there is strong evidence of no safety concerns
- Acceptable Daily Intake (ADI): the amount of a sweetener considered safe to consume each day over the course of a person's lifetime
- LNCS are an easy, effective, and safe replacement for products with added sugar

Thank you!

Questions?

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