ADM®

Sweet Stability

Sugar Alternatives and Blood Sugar Control

Emerging Trends in Glycemic Regulation

The last three years have brought a heightened focus to personal health and well-being. As a result, consumers are becoming more proactive regarding their physical fitness, nutrition and supplement use in order to support their overall health and reach their individual goals. These behavioral shifts have led to consumers pursuing contemporary solutions that can easily be worked into their busy lifestyles.

For many consumers, the increased availability of personal health monitoring devices has increased interest in how diet and lifestyle modifications can affect day-to-day measurements related to various markers of health and well-being.

Blood sugar monitoring has expanded beyond those with medical conditions like diabetes to everyday, health-aware consumers interested to learn more about their individual body's responses to diet and lifestyle choices. This includes everyone from active lifestyle consumers to those adhering to low-carbohydrate diets. Interest in the over-arching topic of metabolic health, which includes blood sugar control, has grown tremendously among the U.S. public. Further, social media influencers have become increasingly popular among those exploring these new frontiers of personalized nutrition and lifestyle programs, amassing large followings of health-curious, tech-forward consumers.

Supporting blood glucose levels has been a familiar concept to those for whom it is medically necessary, but as the prevalence of diabetes and prediabetes has increased, so has awareness of methods to monitor and manage blood glucose among the general public.

While advances in technology have increased accessibility and ease of monitoring, there remains a tremendous opportunity for development of food products, beverages and dietary supplements that support the growing interest in tailored nutrition solutions to positively affect metabolic health, and specifically markers related to blood glucose control.

This is where ADM nutrition science and ingredient experts can support brands—through development of tailored products that provide future-forward solutions that meet the needs of consumers.

Consumer Behavior Surrounding Blood Sugar

ADM conducted an Outside Voice℠ proprietary research study[1] of U.S. adults to gauge current blood glucose maintenance, as well as measure their awareness and behaviors regarding nutrition and wellness-related lifestyle habits.

When comparing concerns on blood sugar control, wellness areas of focus like sleep quality, stress, and weight control are more prevalent among the general population. **Still, 57% of U.S. adults surveyed claim they are taking specific actions to manage their blood sugar, and 40% monitor their blood glucose levels outside of routine doctor visits with at-home devices.** The research suggests that young adults (25-34) and early middle age (35-44) have the most interest in their blood sugar levels and also are the largest users of at-home devices like finger stick tests and continuous glucose monitors. Furthermore, 65% of these individuals using at-home devices only began testing in this way within the last three years—suggesting the pandemic and increased media attention may correlate to consumers taking action.

Blood Glucose Monitoring:

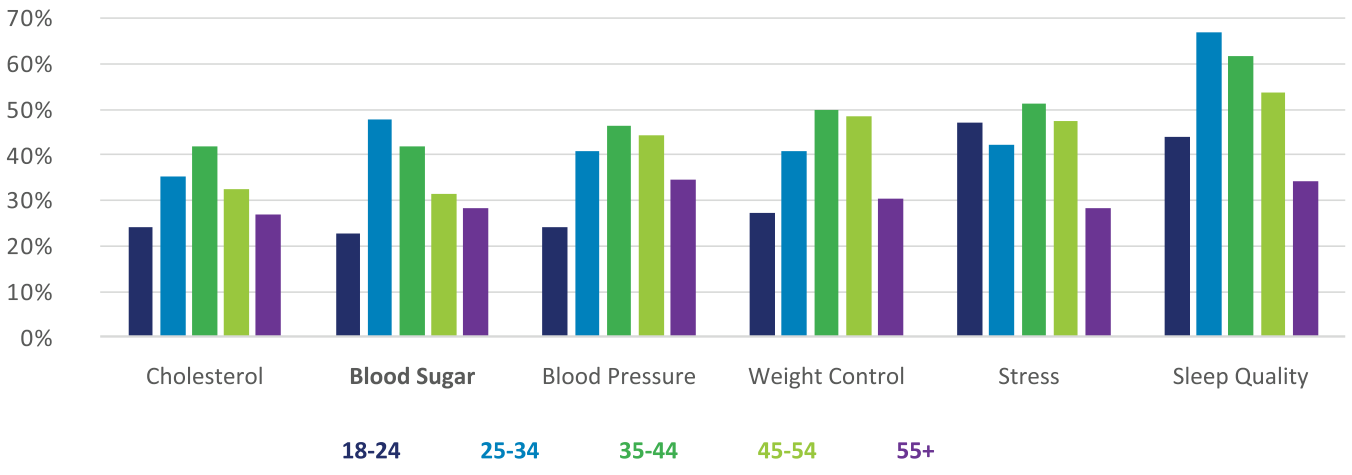
25% I don't monitor my blood glucose level

35% I only have it tested as part of my routine physical exams

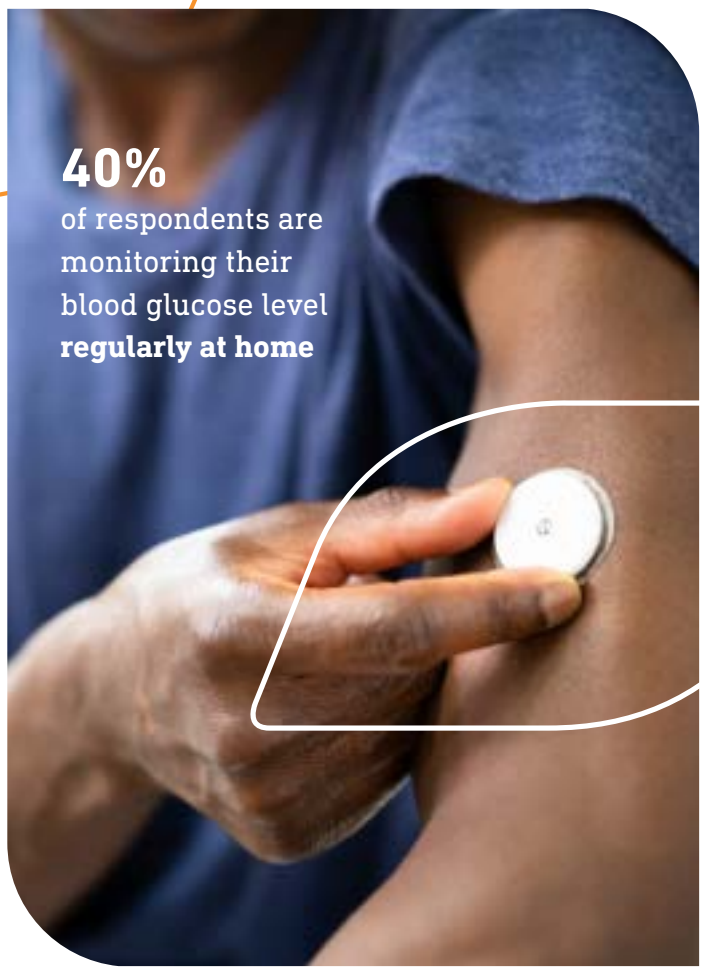
23% I monitor it myself using commercially available devices like a finger stick test

17% I monitor it myself using commercially available continuous glucose monitor

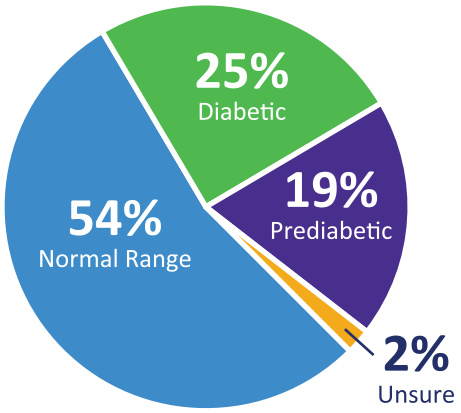
How concerned are you personally about the following health and wellness areas?[1]



[1] ADM Outside Voice℠ Sugar Reduction & Blood Sugar Control, April 2023
N=502 (U.S. adults aged 18 +; weighted to U.S. Census)

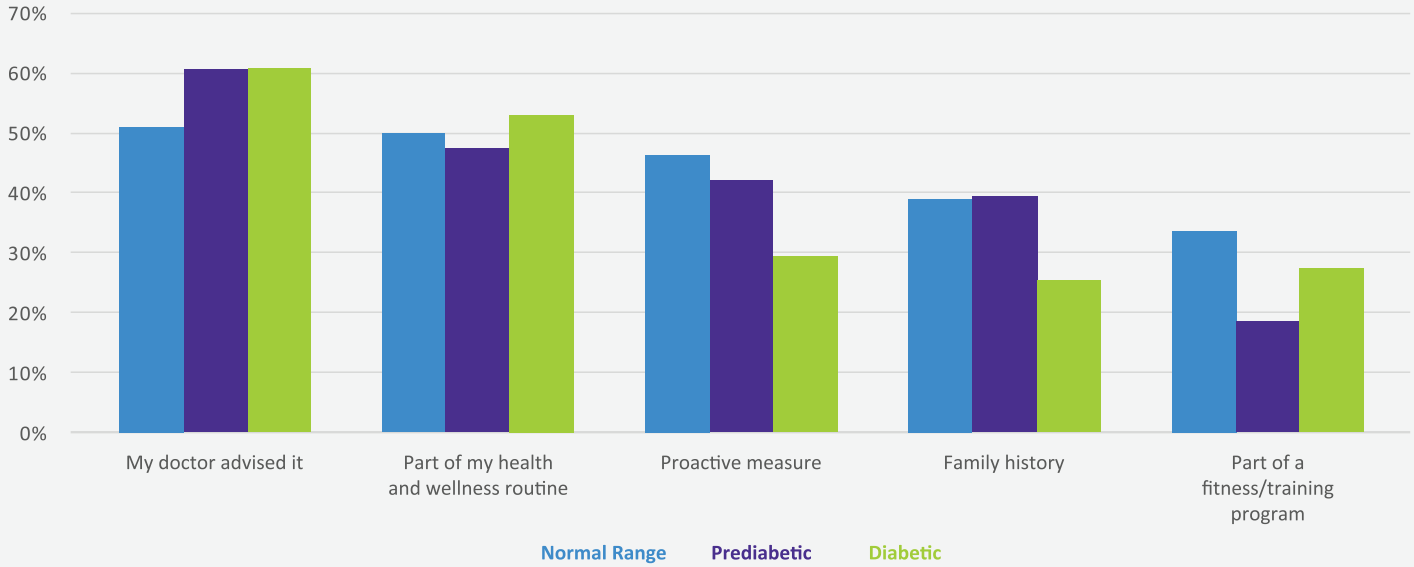


How would you describe your current blood glucose level?[1]
users of at-home monitors

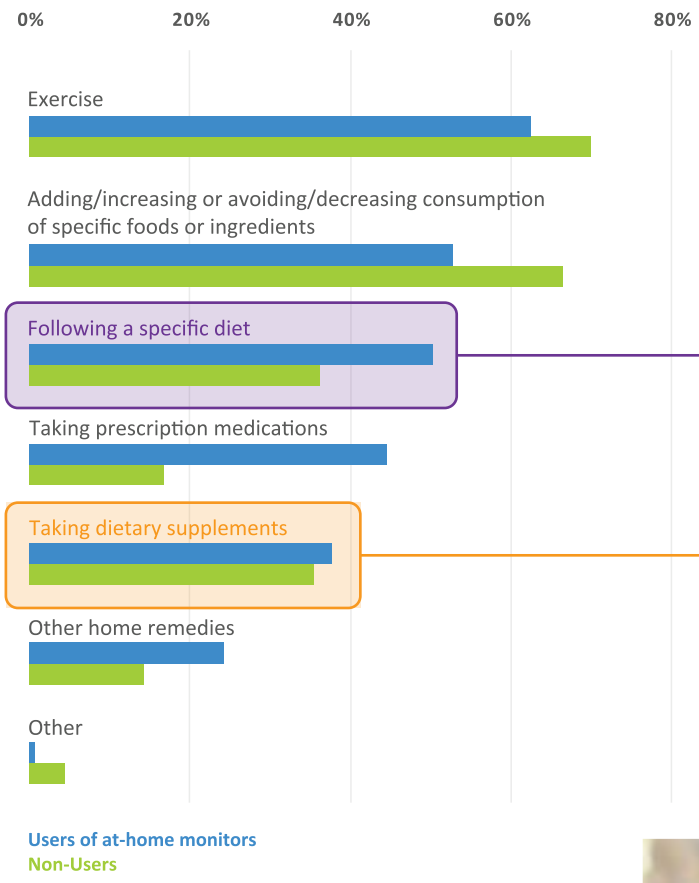


54% of users who monitor their blood glucose level with at-home devices **have normal blood sugar range**

Why do you monitor your blood glucose level at home?[1]
users of at-home monitors



Actions Consumers are Taking to Manage Blood Glucose Level[1]



In addition to monitoring devices, a majority rely on conscientious consumption of foods, beverages and ingredients that support their goals. In particular, **44% believe diet and nutrition are the most important variables in managing their blood sugar.**

40% of users and **34%** of non-users are following **low-carb diets**

68% of users are taking a **fiber supplement**

Top 5 Categories trying to add or increase

74% Vegetables
70% Low-sugar products
64% Fruits and berries
66% High-fiber products
60% High-protein products

Top 5 Categories trying to avoid or decrease

73% Sweets and desserts
69% Sugary beverages
66% Fast food
56% Ultra-processed foods
50% Carbohydrate, grains

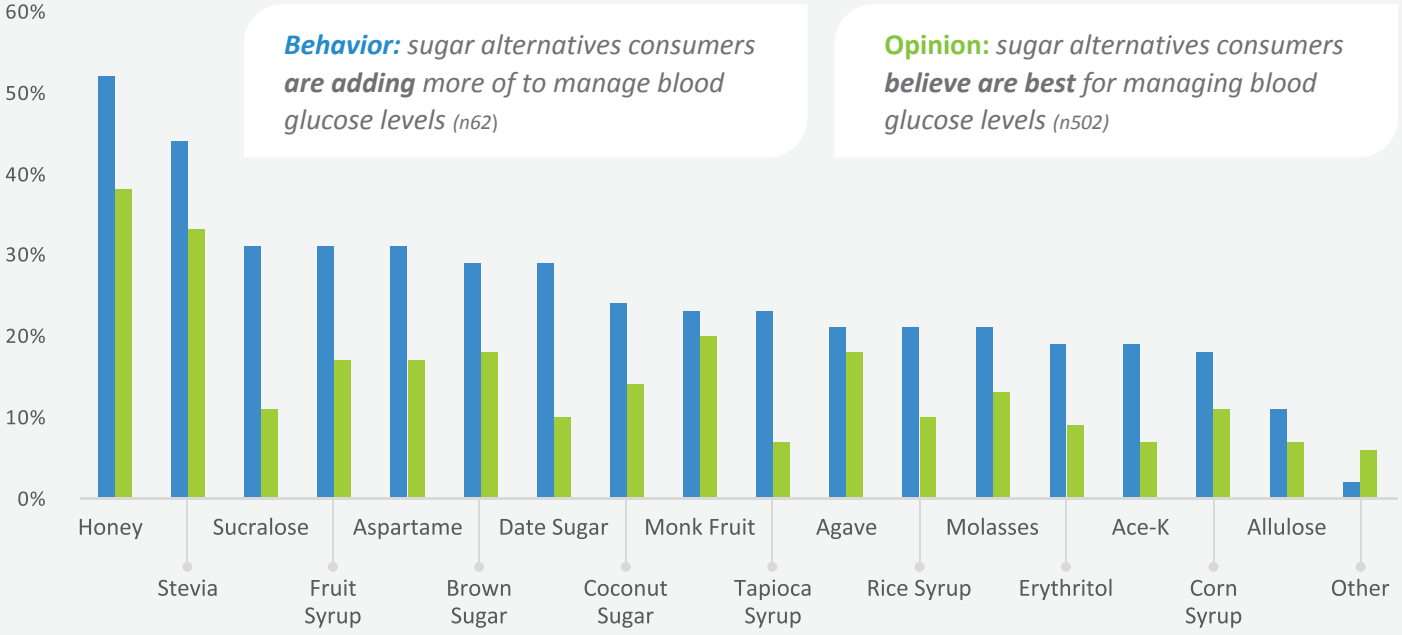
Consumers are deliberate about the products they are limiting and adding to their routines, with **84% claiming they are actively avoiding or limiting sugar in their diets**. However, these consumers don't want to compromise on taste, and sweet permissible indulgences remain important parts of balanced consumption patterns. **Thus, 37% of consumers are more actively seeking out sugar alternatives that can help them meet their goals.**

When comparing sweetening ingredients that our study population believes are best for blood glucose management with the ingredients that a subset are actively adding to support blood glucose levels, we see some differences. This suggests an opportunity to increase consumer awareness and create educational content that communicates the potential of sugar alternatives to positively support consumers' goals.

37% of consumers claim they are trying to **add more sugar alternatives to their diet**

84% of consumers claim they are **avoiding or decreasing consumption of sugar** to manage blood glucose

Consumers: Behavior vs. Perception on Sugar Alternatives[1]



Tailored Products to Support Blood Sugar Control

It is widely accepted that the primary factor contributing to dysregulation of blood glucose is excessive energy and carbohydrate intake. Emerging research suggests that managing glycemic variability, a measure of fluctuations in blood glucose levels, may offer additional advantages beyond those achieved by simply reducing energy intake and carbohydrate consumption.

Glycemic variability has been independently linked to a variety of adverse health outcomes[2,3]. One effective way to reduce overall daily glycemic variability is to limit glucose excursions during meals. Research has shown that higher post-meal peak glucose levels are associated with a range of negative health parameters. Notably, changes in post-meal glucose control often precede alterations in measures of fasting blood glucose[4] further emphasizing the importance of addressing the dietary aspect of glucose management.

Introducing low- and no- calorie sweeteners into the formulations of food products addresses both of these nutritional concerns.

By replacing carbohydrates with specialty sweeteners, we can simultaneously reduce total energy per serving as well as the carbohydrate composition of the product, which can help to minimize post-meal glucose excursions.

There aren't enough food & beverage options to help me maintain healthy blood glucose level.

44% Agree

I often experiment with new ingredients to determine which can be better for maintaining healthy blood glucose levels.

50% Agree

Taste is always an issue in products that are designed to help maintain healthy blood glucose levels.

52% Agree

Navigating the Complex World of Glycemia

It's natural for blood glucose levels to increase after consumption of a meal, and as a normal part of human physiology, these temporary increases are not cause for alarm. However, the duration and magnitude of blood glucose elevation following a meal can vary, and this post-meal blood glucose response can be influenced by many factors, including overall diet patterns and food composition, as well as exercise, everyday stress, sleep patterns, medications and more. While the primary factor driving glycemic responses is meal composition, these other factors can contribute to overall glucose regulation in meaningful ways[5].

To make informed decisions about nutrition and also the meals, products and ingredients most appropriate to support healthy blood glucose control, it's important to understand the key differences between glycemic index, glycemic load and glycemic response.

Illustrative Comparison of Glycemic Load & Glycemic Index Values[6]

Low Glycemic Load (10 or under)		
Product Test Portion (g)	**Glycemic Load**	**Glycemic Index**
Cashews (98g)	1	22 ± 5
Milk, Full-fat (NS)	4	41 ± 2
Chickpeas: canned, drained (131.6g)	5	35 ± 3
Apple, raw (182g)	6	39 ± 5
Watermelon, raw (332.9g)	8	50 ± 6
Bran Cereal (106g)	8	38

Medium Glycemic Load (11-19)		
Product Test Portion (g)	**Glycemic Load**	**Glycemic Index**
Dark Chocolate (91.9g)	11	44 ± 5
Pomegranate Juice (313.2g)	11	53 ± 3
English Muffin (141.6g)	12	77 ± 7
Sweet Corn: canned, drained (270g)	12	60
Instant Oats (88.2g)	15	76 ± 4
Meal Replacement Beverage (141g)	17	56 ± 1

High Glycemic Load (20+)		
Product Test Portion (g)	**Glycemic Load**	**Glycemic Index**
White Flour Spaghetti: cooked (71g)	20	51 ± 9
Pretzel Snacks (NS)	21	83 ± 9
Quinoa: white, cooked (74.4g)	23	50 ± 6
Protein Bar (67g)	25	101 ± 12
Gingerbread (68.2g)	26	88 ± 5
Jasmine White Rice: cooked (68.8g)	48	106 ± 13

Reference food: Glucose = 100
Glycemic Index Data are means ± SEM

Glycemic Index (GI)

The glycemic index (GI) is an internationally recognized standard that describes the **ability of a food's digestible carbohydrates to affect the concentration of glucose in the bloodstream.** The GI is considered a measure of carbohydrate quality based on a scale of 0 to 100 when compared to a reference food—either glucose or white bread (GI=100). The scale ranks foods according to the rate at which they raise blood glucose after consumption and values are unique to variables such as ripeness, fiber content, processing methods and more.

- Foods with a high GI are those with GI values of ≥70, which means they are digested, absorbed and metabolized quickly.
- Foods with a low GI are those with GI values ≤55 and are digested, absorbed and metabolized more slowly and have less of an impact on circulating blood glucose level.

Glycemic Load (GL)

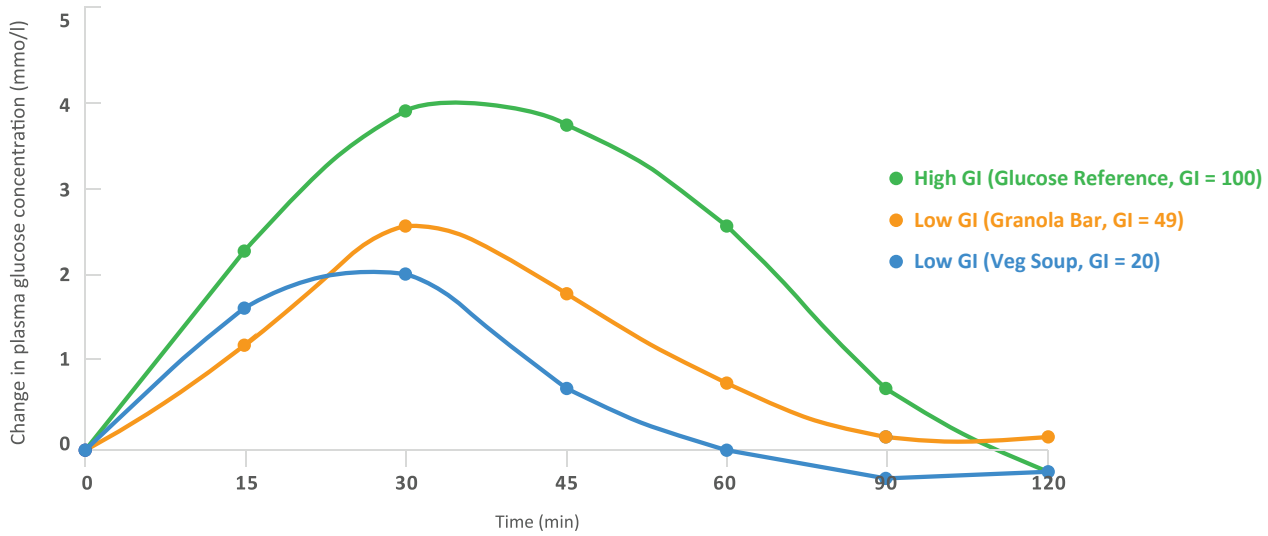
Glycemic load (GL) measures the **actual amount of digestible carbohydrates provided by one serving of food multiplied by its GI value**. By considering the number of digestible carbohydrates supplied by a serving of a food along with its GI value, the GL value can provide a more accurate assessment of how a particular food affects blood sugar levels.

For example, if a food has a glycemic index of 38 and provides 15 grams of carbohydrates per serving, one serving would have a glycemic load of 5.7. A glycemic load of 1 to 10 is considered "low," 11 to 19 is "medium" and ≥20 is "high."

Glycemic Response (GR)

The concept of glycemic response (GR) refers to the **post-meal change in blood glucose concentration following consumption**. It includes the digestion, absorption and metabolism of the food or meal.

Blood Glucose Response (GR) Curves for High and Low GI Foods[7]



What Does This Mean For Consumers?

- Observational studies consistently show associations between long-term (chronic) consumption of high GI foods and increased risk for non-communicable (chronic) diseases, including type 2 diabetes and cardiovascular diseases.
- Reducing the diet's glycemic load (GL) may help with glycemic control or limit severe increases in circulating blood glucose.
- Lowering the GL can be achieved by several means, including increased consumption of whole grains, legumes, nuts, seeds, non-starchy vegetables, as well as non-nutritive or low-glycemic sweeteners.

Tools for Sweet Success

The Contribution of Sweeteners towards Glycemic Index

While consumers actively seek foods and beverages to meet specific wellness needs, they are also more frequently reading labels and monitoring intake to avoid or add specific ingredients. Despite increasing awareness of sugar alternatives to support blood sugar control, not all sugars and sweeteners are universally recognized or understood. There are a variety of options on the market that can replace sweetness to lower calories and sugars in a beverage or food, and consumer education of these varies.

The glycemic index of a sugar or sweetener can dictate blood glucose impact after consumption. Sugar alternatives such as high-potency sweeteners are low glycemic (<55) sweeteners that can minimize impact on blood glucose levels. Sweeteners with higher glucose in their composition have a higher GI value and are less supportive in managing blood sugar.

Comparison of Sugars & Sweeteners Glycemic Index Values[6]

High Glycemic Index (71 or more)	Glycemic Index
Glucose	100 (baseline)
Medium Glycemic Index (56-70)	
Sucrose (Sugar)	68 ± 5
Honey	63 ± 7
Low Glycemic Index (55 or less)	
Fruit Syrup	39 ± 4
Fructose (Crystalline)	17 ± 5
Agave Syrup	13 ± 2
Sorbitol	9
Erythritol	<1
Stevia	ni
Sucralose	ni
Monk Fruit	ni
Allulose	nd

ni = no impact due to low ppm usage
nd = do not have sufficient data

With so many options available on the market, it helps to think of alternatives across 4 categories.

+ Foundational: Traditional sugars and bulk sweeteners have varying glycemic index values depending on their makeup of glucose, fructose and sucrose ratios. These ingredients are caloric and are generally best in moderation for consumers focused on blood sugar.

+ Food-associated: Nutritive sweeteners like honey, agave or molasses also have wide variability in their glycemic measurements based on the nutrient makeup of each source. Honey from one supplier can test and perform differently from the next. Some food-associated sweeteners like fruit syrup and agave have a lower glycemic index which supports more stable blood glucose.

+ Branded: Generally, sweeteners consumers recognize from brands are high-potency sweeteners like stevia and sucralose, which are both familiar to consumers and sought-after for being effective for managing blood sugar.

+ Unfamiliar: There are a variety of lesser-known sweetening ingredients due to the rapid innovation surrounding sugar reduction that are used in the foods and beverages we enjoy. Novel plant-based ingredients like monk fruit and allulose can also aid blood glucose support by achieving sweetness with reductions in calories and carbohydrates.

Industry-Leading Sweetening Ingenuity

SweetRight® ADM's portfolio of specialty sweetening offerings that go beyond sweetness—addressing friendly labels, calorie reduction and health & wellness trends.

Fruit Up® delivers proprietary natural sweetness extracted from fruit with no additives, chemicals or enzymes from a blend of carob and apples, providing excellent clean label and low-glycemic functionality.

Sweetness Without Compromise

Better-for-you doesn't mean bland. We help you deliver delicious health-forward nutrition in delightful indulgences, with truly innovative solutions that give you an edge in today's dynamic marketplace.

ADM is your nutrition and sugar reduction innovation leader.

SOURCES

[1] ADM Outside Voice℠ Sugar Reduction & Blood Sugar Control, April 2023

[2] Chen, J; *et al.* (2022) *Diabetes Res Clin Pract.* 192: 110085

[3] Gorst, C; *et al.* (2015) *Diabetes Care.* 38(12):2354-2369

[4] Monnier, L; *et al.* (2007) *Diabetes Care.* 30(2): 263-9

[5] Berry, SE; *et al.* (2020) Nature Med. 26, 964-973

[6] Adapted from: Atkinson, FS; *et al.* (2021) *Am J Clin Nutr.* 114(5): 1625-1632

[7] Adapted from: Sadler, M (2011) ILSI Europe

Let's collaborate for a sweeter tomorrow

800-257-5743 | sugarreduction@adm.com