Understanding Sweeteners

A variety of different carbohydrates are commonly used to sweeten foods, such as sucrose, fructose, glucose, maltose, isomaltulose, and fructooligosaccharide (FOS). Some of these sweeteners are naturally occurring (such as honey and molasses), whereas others are available in highly processed formulations (high fructose corn syrup.) In addition to the nutritive sweeteners, there are also noncaloric (artificial) sweeteners, sugar alcohols, and stevia. It is difficult for patients to discern which sweetener is best for their health, and this is particularly important for those with diabetes, who are encouraged to decrease their carbohydrate intake. This Integrative Health tool will help clinicians offer evidence-informed advice regarding choosing the best sweetener for a given patient.

Sweeteners and Glycemic Index

Like all other foods, the glycemic index (GI) of sweeteners is a function of the type and quantity of their carbohydrate content as well as the presence of other substances (such as soluble fiber) which can slow absorption. Glucose has a GI of 100, fructose has a GI of 25 and sucrose—which is a blend of the previous two—has a GI of 65. Most natural sweeteners are a combination of these three carbohydrates.

Sweeteners containing higher levels of fructose tend to have a lower GI. Research has shown fructose (versus glucose or sucrose) leads to lower two-hour postprandial serum glucose concentrations in diabetic and nondiabetic subjects.[1] Another study showed substitution of dietary fructose for other carbohydrates produced a 13% reduction in mean plasma glucose in a study of type 1 and type 2 diabetic subjects.[2] GI of common sweeteners are listed in Table 1. More information on GI is available in the "Glycemic Index" tool.

Table 1. Glycemic Index of Common Sweeteners

Sweetener	Glycemic Index
Maltodextrin	110
Corn Syrup	75
Glucose	100
Lactose	45
Sucrose	65
Molasses	55

Sweetener	Glycemic Index
Maple Syrup	54
Mannitol	2
Honey	50
Sorghum	50
Brown Rice Syrup	25
Xylitol	12
Agave Syrup	11
Table Sugar	80
HF Corn Syrup	87
Stevia	<1

Fructose

While a 2018 review concluded that small doses of fructose may improve glycemic control over time,[3] there is still concern that a diet high in fructose leads to worsening hypertriglyceridemia and obesity, and it may contribute to the development of type 2 diabetes. In contrast to glucose, which can be used easily by all cells of the body, fructose must be metabolized by the liver. In large quantities, fructose may be toxic to the liver, contributing to fatty liver, insulin resistance, and uric acid production, the latter of which has been linked to high blood pressure, kidney stones, and gout. Fructose also stimulates insulin secretion less than glucose-containing carbohydrates. Insulin is necessary for leptin release; leptin is a hormone that inhibits appetite. Lower insulin and leptin levels after fructose ingestion inhibit appetite less than consumption of other carbohydrates and may lead to increased energy intake and more obesity.[2]

These concerns were widely popularized by Dr. Robert Lustig in his book *Fat Chance*[4] and the online lecture, "Sugar: The Bitter Truth," a video produced by the University of California's Osher Integrative Medical Center. In light of this growing body of evidence, it seems prudent to counsel patients to use high fructose-containing sweeteners modestly even though they have a low GI and to encourage patients to eat whole fruits with fiber instead of fruit juice, because the fiber slows absorption.

Artificial Sweeteners

Artificial sweeteners add sweetness with minimal calories in two ways. First, they are hundreds to thousands of times sweeter than sugar, so only a small amount is needed to have sweetness equal to that of sugar. Second, because the body doesn't fully absorb them, it also doesn't fully absorb the few calories they do contain, so they have a GI of 0 or 1. A 2018 review and meta-analysis of nonnutritive sweeteners concluded that their consumption was not found to elevate blood glucose levels, though more studies are necessary to determine the effects of chronic artificial sweetener consumption.[5]

Despite tremendous interest in artificial sweeteners as a potential tool to prevent obesity and minimize hyperglycemia in diabetics, there is little evidence available to support their having health benefits. While some studies show decreased caloric intake and modest short-term weight loss with artificial sweeteners, there is no substantive evidence to support clinically meaningful long-term benefits for diabetic patients.[1]

The safety of artificial sweeteners has been controversial for some time. Many users report digestive issues, migraine headaches, and skin rashes. Most studies on artificial sweeteners—those attesting to its safety and those warning of dangers—have been done in animals. There is no high-level human data proving artificial sweeteners are harmful, nor is there human data proving safety. The precautionary principle would advise against use of artificial sweeteners until more safety data is available.

Sugar Alcohols

Sugar alcohols can also be used as sweetener additives and provide less calories per gram than other sweeteners. Erythritol, xylitol, and other sugar alcohols have been used for decades to sweeten chewing gum, candy, fruit spreads, toothpaste, cough syrup, and other products. However, because sugar alcohols are not absorbed, they can cause gastrointestinal symptoms in some individuals due to incomplete absorption in the small intestine.

Stevia

The plant species *Stevia rebaudiana* has gained attention as a natural sugar substitute. The stevia plant has a long history of use as a sweetener in South America. It has zero calories, its GI is 0, and it is 200-300 times sweeter than sugar. Stevia appears to be safe, though extensive research is lacking and some believe this product was approved by the FDA prematurely.

Recommendations

- Discuss sweeteners and glycemic index when counseling patients on nutrition and glycemic control
- Recommend small amounts of low GI sweeteners, keeping in mind that the safety of artificial sweeteners, sugar alcohols, and Stevia has not been firmly established
- Counsel patients that fruit nutrients are best consumed as a whole fruit, not as fruit juice

Resource Links

- Glycemic Index: https://www.fammed.wisc.edu/files/webfm-uploads/documents/outreach/im/tool-glycemic-index.pdf
- Sugar: The Bitter Truth: https://uctv.tv/shows/Sugar-The-Bitter-Truth-16717

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