

# 2021 SWEETENER SYSTEMS

## POST-WEBINAR MAGAZINE

### Formulating with Sweet Enhancing Ingredients

#### What's Inside...

- Sweetener Choices Driven by Conflicting Goals
- Consumers' Needs in a New Era of Sugar Reduction
- Maximizing Success with High-Potency Sweeteners
- Bulking Agents from Allulose to Polyols: Maximizing Benefits
- Formulating with Whole Fruit Ingredients
- Added Sugars Declarations in Nutrition Facts Labeling
- Sweetener Systems Information & Resources

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# 2021 Sweetener Systems Premium Webinar Magazine



With a little—or more accurately a lot—of help from some friends, Global Food Forums is entering its second decade of business since its 2012 incorporation. One 10-year milestone was marked by Crawford Intellectual Property Law as it filed required documents for Global Food Forums' continued ownership of its trademark.

Over 200 speakers, an estimated 180 different sponsors and exhibitors, hard-working and talented staff, and over 3,500 in-person attendees (2013-2019) have contributed to Global Food Forums, as well. Beyond financial support, we believe their involvement in a fundamentally educational effort has made for a more efficient, beneficial and flourishing R&D effort in the food industry.

The pandemic brought a hard shift into webinars and reminded us how small the world is. One recent webinar drew registrants from 49 countries on six continents. (We need to improve our reach into Antarctica).

This magazine focuses on content presented at our 2021 Sweetener Systems Premium Webinar. It exemplifies the quality of information delivered on trends, ingredient technologies and food formulations.



The year 2022 brings back two in-person events. Please join us first for our Clean Label Conference, which includes sessions on sweeteners and salt-reduction systems, as well as the traditional focus on consumer-friendly ingredients and simplified ingredient lists (May 24-25, 2022). Secondly, our Protein Trends & Technologies Seminar will be held October 25-26, 2022. Both take place in Itasca, Illinois, a Chicago suburb northwest of O'Hare International airport. We'd love to see you there!

**Warm regards,**  
**Claudia O'Donnell & Peter Havens**  
**Co-owners, Global Food Forums, Inc.**

## Table of Contents

### **7 Sweetener Choices Driven by Conflicting Goals**

Claudia Dziuk O'Donnell, MSc, MBA, Co-owner, Global Food Forums  
*A brief introduction on global consumers and interest in sweeteners.*

### **7 Understanding Consumers' Needs in a New Era of Sugar Reduction**

Stephanie Mattucci, CFS, Associate Director, Food Science, Mintel  
*Insights into what consumers are looking for in sweeteners and how innovative ingredient solutions rise to the challenge.*

### **11 Maximizing Success with High-Potency Sweeteners**

John C. Fry, Ph.D., Director, Connect Consulting  
*Practical advice on sweetener selection, use levels, prototype assessment and mitigating sweetener defects.*

### **14 Bulking Agents from Allulose to Polyols: Maximizing their Benefits**

Melanie Goulson, MSc, President, Merlin Development  
*Technical tips on using "partners to high-intensity sweeteners," such as isomalt and allulose, to help mitigate texture and flavor issues.*

### **18 Formulating with Whole Fruit Ingredients**

Kristen Sparkman, MS, Culinologist, CuliNex, LLC  
*Advice about the benefits and challenges of formulating with forms of whole fruit sweeteners, such as from apples and prunes to berries and dates.*

### **22 Added Sugars Declarations in Nutrition Facts Labeling**

Lauren Swann, MS, RD, LDN, Concept Nutrition, Inc.  
*When it comes to naturally sweet ingredients, such as fruits and vegetables, what needs to be included as "Added Sugar" in the Nutrition Facts panel?*

### **24 Sweetener Systems Information & Resources**

*A page offering convenient links to Sweetener Systems magazines with presentation summaries, Global Food Forums webinars and future events.*

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| Oregon Fruit Products         | 13                               |
| Malt Products                 | 15                               |
| ASR                           | 17                               |
| Tree Top                      | 19                               |
| Nascent Health Sciences       | 21                               |
| Nature's Ingredients          | 23                               |
| Sweegen                       | 25                               |

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\*Food Marketing Institute. "U.S. Grocery Shopper Trends 2019."

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## Sweetener Choices Driven by Conflicting Goals

“A SPOONFUL OF SUGAR helps the medicine go down.” This often-used quote, taken from the lyrics of a popular song from the 1964 movie *Mary Poppins*, speaks to a fundamental truth. Sweetness is desirable. In food, beverage and nutritional product formulations, adding ingredients that increase the perception of sweetness has been a common and effective way to address a multitude of flavor and taste issues.

Fast forward to a world of increasing numbers of overweight humans and the related health conditions that accompany that condition. Additionally, better informed consumers link food choices with health. And, occasional, over-reliance on sweeteners as formulation tools has produced a food industry transfixed on sweetener use. It has also produced a growing number of sweetener options.

A HealthFocus® International’s 2020 Global Topic Report titled “Sweetener Solutions: A Path Forward,” based on a 22-country survey on six continents, noted three macro conflicting food and beverage trends. “The overall result is consumer confusion and dissatisfaction with current sweetener options, which are significantly changing shopper behaviors,” says Julie Johnson, General Manager, HealthFocus. This confusion creates challenging market dynamics for sweeteners based on a consumer’s primary driver, which is then influenced by other motivations and influencers.

Attributes of the “clean” trend involve short, clear ingredient lists, real ingredients, no additives or preservatives, no GMO and a transparent supply chain. Hallmarks of the trend toward increased consumer interest in “carbohydrate intake” include calories, weight for health, weight for other reasons and healthy energy. The third trend, “pleasure,” contains the aspects of eating without guilt and enjoyment of simple pleasures in life. “And, if these are a bit sinful in caloric content or fat, this is a victimless crime,” notes the report.

HealthFocus’s “Sweetener Solutions” report goes on to say that consumers rank sugar reduction as the primary way to make processed foods and beverages healthier. The strategy outranks eating clean (e.g., less artificial, non-GMO); removing negatives (e.g., salt or fat reduction); and adding positives (e.g., fortification).

Shoppers do not trust most sweetener options. They continue to search for acceptable sweetener choices, notes Johnson. However, certain natural sweeteners have strong health halos and stand out as significantly better options. For example, 80% of respondents to this global survey say honey is a “good” sweetener, 61% say that of fruit juices and 42% for maple syrup. Some 41% of those surveyed found coconut palm sugar “good;” 32% said so for stevia.



Consumer sweetener choices are influenced by three macro conflicting food and beverage trends that can be simply labeled as “clean,” “carbohydrate intake” and “pleasure.”

When it comes to sugar, the goal is cutting back and not completely avoiding it. Since 2014, sugar concern is up 15 points, and artificial sweetener concern is up 12 points. But overall, those concerns may be moderating.

When asked, “In the past two years have you increased or decreased your use of (with the survey specifically mentioning ‘sugar’ or ‘artificial sweeteners’),” the overall usage is rising, with a 26-point decline in those rejecting artificial sweeteners since 2008. When it comes to sugar, the goal is to cut back but not avoid it altogether. For example, 50% of respondents said they did not use artificial sweeteners in 2008; that declined to only 24% saying so in 2020. Similarly, 7% said they didn’t use sucrose in 2008, falling to only 3% saying so in 2020.

## A New Era of Sugar Reduction

CONSUMERS ARE DEVOTING more time and energy to health and wellness. The interest has taken on even more relevance since the outbreak of COVID-19. More opportunities for sugar reduction and sweetener innovation in foods and beverages have resulted. This concept forms the core of the presentation titled “Understanding Consumers’ Needs in a New Era of Sugar Reduction,” given by Stephanie Mattucci, CFS, Associate Director, Food Science, Mintel, for Global Food Forums’ 2021 Premium Sweetener Systems Webinar.

Renewed interest in health has consumers looking at diet to support their physical health, as well as their immune and mental

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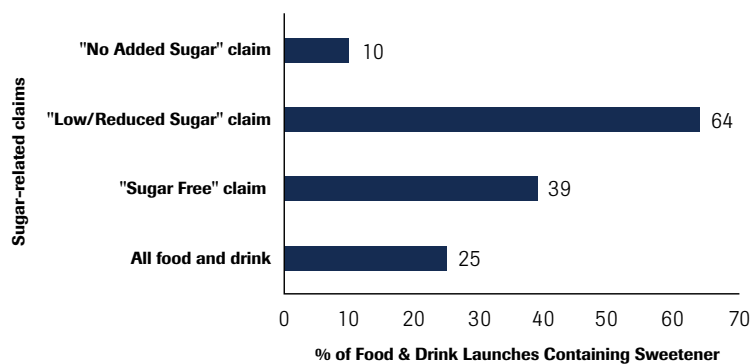


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## Share of Food & Drink Launches Containing Sweetener Ingredient by Claim, 2016-2020



SOURCE: MINTEL GLOBAL NEW PRODUCTS DATABASE (GNPD)/ 2021 SWEETENER SYSTEMS PREMIUM WEBINAR

Given the rise in sugar-related claims, “I think there’s more opportunity for ingredient transparency, especially when it comes to sweeteners being used or not used—following in the footsteps of various clean label trends,” expressed Stephanie Mattucci, Mintel.

health. The percentages of those interested in these facets of health are quite high, according to the results of a Mintel 2020 survey of U.S. internet users aged 18+. Some 78% of U.S. adults were in favor of eating healthy in support of their emotional wellbeing; 86% of U.S. adults favor healthy eating as a means of supporting physical wellbeing—with the same percent saying the same for a strong immune system.

When asked what factors are essential when choosing healthy foods and beverages, half of the consumers agreed that “low/no sugar” was important, second only to the 66% of consumers who said “fresh” was important. “Sugar has overtaken other components as the most concerning factor in foods and beverages,” stated Mattucci.

Mintel compared the importance of various health factors due to the pandemic, revealing that low sugar is 30% more important since the outbreak of the pandemic. However, while consumers seek less sugar, are other sweeteners an acceptable alternative? The answer to this question is as follows, as measured by a Mintel survey of U.S. consumers:

- 30% check food labels for sweetener content; 25% avoid items with sweeteners
- 79% think some sweeteners should be avoided more than others
- 69% think artificial sweeteners are bad for your health

Looking at sweetener use from 2016-2020, sucralose, acesulfame-K and aspartame have been the most widely used sweeteners in product launches; however, each has been on the decline, globally. Erythritol and monk fruit are on the rise, although still used to a lesser extent

than some other sweeteners out there, noted Mattucci. In the U.S., allulose, monk fruit and erythritol were the fastest growing sweeteners during that same period.

## CONSUMER EMBOLDENED SWEETENER INNOVATION

Dietary choices such as Keto and other low-carb options are driving sweetener innovation. In the past five years, over 60% of U.S. food and beverage launches containing allulose mentioned Keto on the package, according to Mintel Global New Products Database (GNPD). “Keto and other diets are helping to drive the conversation about sweeteners, which emboldens consumers to take control of how much sugar they’re consuming,” suggested Mattucci.

“This increases the education base and fosters questions regarding sweeteners, both at home and retail,” she added.

Some food and drink manufacturers are becoming aware of the fact that consumers might want more options and flexibility when it comes to sweetening their foods. Mattucci asked, as food product developers, marketing experts and food producers, “How often do we take a step back and ask if the benchmark is at the right level of sweetness?”

One innovative product—RifRaf Ricotta Cups®—perhaps provides an answer to the above question by giving consumers flexibility, not only in the choice of flavor based on sweetness preference, but the ability to adjust that level of sweetness depending on how much of the side cup of honey or other condiment is used. Each cup has a scale ranging from sweet to savory, with an indicator as to where that flavor resides on the scale.



RifRaf Ricotta Cups give consumers the ability to adjust sweetness level by how much of the side cup of honey or other condiment is used. Each cup has a scale ranging from sweet to savory, with an indicator as to where that flavor resides on the scale.



## Raising the bar on sugar replacement. Natural taste and texture, healthier recipe.

Nowadays, sugar is a hot topic in the industry and consumer households. On a global scale, almost 50% of consumers browses food labels for sugar content. Sugar-rich foods, however, often slip into our diet in the shape of indulgent or convenient treats. BENEÓ's ingredients offer new ways to replace sugar and add nutritional benefits without compromising on taste and texture.

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As a result of the pandemic, consumers have spent more time at home eager to improve their cooking and baking skills. Some three-quarters of U.S. consumers want to improve these skills, “which is where at-home innovation can come in with sweeteners,” emphasized Mattucci.

A few brands have launched allulose for home use touting its Keto-friendly property. Other brands, such as Purecane™, provide not only a single serving (one teaspoon of sugar-equivalent packets of sweetener blend containing erythritol and fermented sugarcane Reb M) but bulk sweetener blends, as well. One bulk formula is a one-to-one replacement for sugar made from erythritol, soluble fiber, fermented sugarcane and Reb M; the other is a brown sugar replacement blend containing erythritol, natural flavor, fruit juice color, sugarcane and Reb M.

Tagatose, another low-carb, low-calorie sweetener, is now available for commercial use. However, its supply is still somewhat limited. “It’s pretty niche, yet. The jury is out on [tagatose] in terms of consumer awareness and perspective,” said Mattucci.

### BETTER-FOR-YOU SWEETENERS

Food product developers are exploring ways in which sweeteners can do more than merely function as a sugar equivalent with fewer calories and fewer carbs while delivering on taste. This isn’t remarkable, given that 56% of U.S. adults agree sweeteners that provide other nutritional benefits appeal to them. One means of enhancing a sweetener’s functionality is by combining it with dietary fiber, such as polydextrose, inulin, malto-oligosaccharides and fructooligosaccharides (FOS), among others.

When consumers indicate they want to know more about alternative sweeteners, Mattucci suggested they’re aligning with the clean label movement, in that they want to know what ingredients are being used. This is particularly important with those following low-carb diets, such as Keto, where an ingredient like maltodextrin is considered not Keto-friendly.

“Prebiotic fibers can replace traditional fillers (e.g., maltodextrin). Mintel patent research shows that recent activity illustrates several functional applications for prebiotics and other dietary fibers, such as enhancing flavor or improving taste or texture,” said Mattucci. Vital Proteins Beauty Collagen Dietary Supplement is a powdered drink mix that uses agave inulin, presumably as a bulking agent or carrier. The low-sugar product only has 1g of total sugars and 3g of carbohydrates per serving (U.S.).

**Sweetener selection is a process that involves numerous steps and considerations.**

Overall, consumers’ quest for a more healthful lifestyle has put more pressure on food and beverage manufacturers to address the sugar content in their products. Better-for-you foods deliver on consumers’ goals for health and wellness. More highly educated consumers are being given opportunities to experiment with sweeteners at home, thereby giving them a stake in their future. “Giving consumers agency of their sugar intake can build powerful brand ambassadors,” concluded Mattucci.

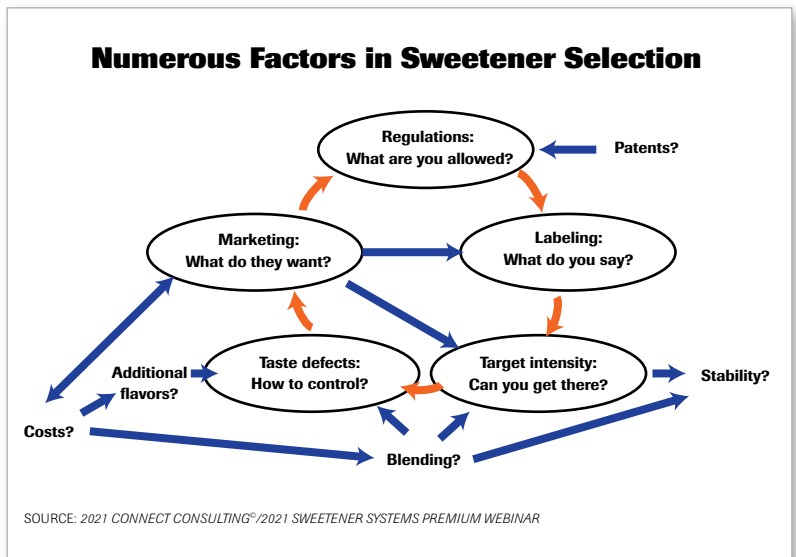
*“Stephanie Mattucci, CFS, Associate Director, Food Science, Mintel, “Understanding Consumers’ Needs in a New Era of Sugar Reduction.” To learn more about Mintel and how it can help you you’re your business, visit [mintel.com](http://mintel.com).*

*[To access the video and PowerPoint of this presentation, see <https://sweeteners.globalfoodforums.com/sweetener-systems-rd-academy/webinar-new-era-sugar-reduction-presentation/> or <https://bit.ly/355Cv42> ]*

## Formulation Advice: How to Use High-Potency Sweeteners

**FOOD FORMULATORS NEED** to avoid some common formulation challenges to achieve maximum success with high-potency sweeteners. One of the first concerns for food formulators is to assess prototypes fairly.

For example, human variability in tasting is an issue. A typical population of consumers has a wide range of responses in their ability to identify the sweeter of two solutions in a taste test, varying as much as plus or minus 20%. If only a few individuals are involved in product development, perhaps the formulator is not an ideal taster.



“When using only one or two product developers in the lab, it is important to test every key step in the development process with a properly constituted taste panel.” So advised John C. Fry, Ph.D., Director, Connect Consulting, in his presentation titled “Maximizing Success with High-Potency Sweeteners,” given at Global Food Forums’ 2021 Sweetener Systems Premium Webinar.

The second issue is tasting an adequate sample size. Temporal dynamics are typically different for high-potency sweeteners vs. sucrose. For example, Reb A reaches a peak intensity later than sucrose and has higher sweetness intensity as it decays. In other words, there is a lasting quality to its sweetness. This late onset of the peak can be very extreme. For example, the protein sweetener thaumatin has an even later peak and occurs when the sweetness for sucrose has already disappeared. Consequently, one sip of a beverage does not necessarily indicate the consumer’s impression and might result in overdosing with the sweetener. Fry suggests that the minimum sample size for a taste panel might be at least 50ml (about two ounces).

Sweetener selection is a complicated process that involves many steps and groups within a company. Often the process starts with marketing’s goals. A next step might be to consider regulatory and patent issues. Other steps involve reviewing labeling claims; achieving target intensity; dealing with flavor defects; and analyzing potential cost issues. The prototype then might be sent back to marketing for consideration, possibly back through some of the steps. (See chart “Numerous Factors in Sweetener Selection.”)

## DETERMINING HOW MUCH SWEETENER TO USE

The first step in deciding on how much sweetener to use is to review a sweetener’s concentration-response curve. All high-potency sweeteners have concentration-response curves that tend to plateau at a given sweetness level. In this area, increasing the percent of the sweetener in a formula does not increase the perception of sweetness. A standard rule of thumb is not to formulate with a high-potency sweetener in its plateau region, because this is the least cost-effective and carries the most risk for side-tastes. There also may be legal considerations, particularly in the EU, where every high-potency sweetener has a prescribed legal maximum amount for every application.

Concentration-response curves supplied by the manufacturer should be considered as only a guide. Temperature and pH both impact taste intensity. For example, lowering the pH tends to enhance the potency of aspartame and sucralose, but decreases the potency of monk fruit. Reb A is significantly more potent at refrigeration rather than room temperatures. One solution for

the developer is to bracket your target intensity. For example, if the target is 5 sucrose equivalent value (SEV) in a product, then use the concentration-response curve to test sweetener amounts plus or minus 10% of that target to see how the sweetener behaves in your system.

High-potency sweeteners exhibit two main types of defects: non-sweet side-tastes and poor temporal dynamics. Examples of side-tastes include the bitterness of saccharin or acesulfame potassium; and licorice side-notes in neotame or advantame. Side-tastes, although usually unwanted, are not necessarily unpleasant. Monk fruit can produce a fruity side-taste which may be advantageous in some applications, noted Fry.

To minimize side-tastes, don’t use high concentrations of sweeteners. Approach sweetness in a step-wise process from below. Blending two sweeteners, each below their threshold of side-taste, can readily achieve a higher intensity of sweetness without running the risk of side-effects. Another approach is to resort to flavor additions that might block flavor defects.

A delayed peak and lingering sweetness are common temporal dynamic issues with high-potency sweeteners. Again, one solution is to blend sweeteners. A fast-onset sweetener can remedy delay. However, the fastest onset sweeteners are both artificial, namely saccharin and acesulfame-K. Glycosylated stevia is claimed to exhibit a faster onset than many sweeteners of natural origin. However, these glycosides don’t occur in nature, so check local regulations for “natural” status.

Matching “sweet-sour” profiles is another consideration. For example, the sourness delivery of citric acid closely matches the sweetness delivery of sucrose and invert sugar, which is why orange juice tastes so good. However, if we use Reb A with citric acid, the sourness can be perceived before the sweetness. One



❖ **One strategy to minimize side-tastes is to blend two high-potency sweeteners starting below the threshold of their side-tastes, then increase sweetness in a stepwise process. This can achieve a higher level of sweetness with a reduced risk of side-effects.**



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solution is to blend citric acid with malic acid, which has a delayed sourness onset. Formulators can adjust the ratios of acids to match the temporal sourness profile with the temporal profile of the high-potency sweetener.

Another solution for minimizing side-tastes is the use of calcium, magnesium and potassium mineral additions. This technology has been around for more than 25 years but has recently been the focus of renewed attention. These ions adjust the way high-potency sweeteners are perceived over time.

Finally, adding solutes that increase osmotic pressure can impact the onset and decay of high-potency sweeteners, making them taste much more like sugar. This can be achieved by adding electrolytes, although there is a risk of adding a salty or mineral taste. Another option is to use lower calorie sugars or polyols which contribute to osmotic pressure and sweetness. Examples include erythritol, allulose or tagatose.

In summary, maximizing high-potency sweeteners requires using a properly constituted taste panel and tasting realistic sample sizes. Balancing all of the competing demands for the ultimate choice of sweetener requires dealing with side-tastes and building the sweetness concentration stepwise. Blending sweeteners, adding flavoring systems, blending acids, and adding minerals or solutes are additional strategies that lead to success with high-potency sweeteners, concluded Fry.

*“Maximizing Success with High-Potency Sweeteners,” John C. Fry, Ph.D., Director, Connect Consulting, j.fry@connectco.biz [To access the video and PowerPoint of this presentation, see <https://sweeteners.globalfoodforums.com/sweetener-systems-rd-academy/webinar-how-to-use-high-potency-sweeteners-presentation> or <https://bit.ly/3vc08Tw> ]*

## Maximizing the Sugar Reduction Benefits of Polyols, Allulose & Tagatoses

**A TYPICAL CHOCOLATE CHIP COOKIE** contains 11g of sugar per serving. Many candies and sweets are essentially 100% sugar. “There is no magic drop-in to replace the taste and functionality of sugar. We have to examine all of the tools in our toolbox to find the best way to replace sugar in foods,” said Melanie Goulson, President and Principal Scientist, Merlin Development. Goulson spoke on “Low-Calorie Bulk Sweeteners from Allulose to Polyols: Maximizing Their Benefits in Sugar Replacement” at Global Food Forums’ 2021 Sweetener Systems Premium Webinar.

## Types of Low-/No-Calorie Sweeteners

| Non-Bulking Sweeteners (High Potency) | Bulk Sweeteners (Low Potency) |
|---------------------------------------|-------------------------------|
| • Stevia sweeteners                   | • Erythritol*                 |
| • Monk fruit sweeteners               | • Maltitol*                   |
| • Aspartame                           | • Isomalt*                    |
| • Acesulfame potassium                | • Mannitol*                   |
| • Sucralose                           | • Sorbitol*                   |
| • Saccharin                           | • Xylitol*                    |
| • Neotame                             | • Lactitol*                   |
| • Advantame                           | • HSH*                        |
|                                       | • Allulose**                  |
|                                       | • Tagatose**                  |
|                                       | *Sugar alcohols (Polyols)     |
|                                       | **Rare sugars                 |

SOURCE: MELANIE GOULSON, MERLIN DEVELOPMENT, MGOULSON@MERLINDEV.COM/2021 SWEETENER SYSTEMS PREMIUM WEBINAR

**Popular ingredients in low-/no-calorie sweetener systems can be classified as high or low potency.**

There are two main categories of low- or no-calorie sweeteners: high-potency, non-bulking sweeteners and low-potency, bulk sweeteners. A combination of the two types can be used to replace sugar with success.

High-potency sweeteners include natural sweeteners, like stevia and monk fruit, and artificial sweeteners, such as acesulfame potassium and aspartame. These sweeteners are used at parts per million.

The other group, bulk sweeteners, includes sugar alcohols and rare sugars. These ingredients are used at a higher level, closer to a one-to-one replacement for sucrose. Rare sugars, like allulose and tagatose, are relatively new to the category. (See chart “Types of Low-/No-Calorie Sweeteners.”)

Polyols are related to sugars, but the sugar aldehyde group has been reduced to an alcohol molecule. They occur in small quantities in nature and are primarily produced by a hydrogenation reaction. Erythritol is unique, in that it is a four-carbon polyol produced by fermentation and is often considered natural. Since it is excreted intact by the kidneys, it is also considered zero-calorie.

Allulose is found in many mainstream products, but tagatose usage has been limited by supply. “Both are produced commercially by chemical conversion, by enzymatic conversion or by fermentation,” said Goulson. The latter two processes potentially may be considered natural. These two rare sugars have unique chemical bonds that are not easily metabolized and provide sweetness, bulk and functionality in finished products.

All bulk sweeteners share some unique attributes including sweetness, low calories and being non-cariogenic. They may be



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**In sugar-reduced cookies, a small amount of a heat-stable sweetener, like sucralose or acesulfame potassium, boosts the sweetness of maltitol, which is 90% as sweet as sucrose. Allulose or tagatose can be added for browning via the Maillard reaction.**

much more or less soluble than sucrose, and much more or less hygroscopic than sucrose. Polyols are non-browning, because they no longer possess the aldehyde group. Erythritol has the most cooling effect. Regulations vary widely by type of ingredient, application and country—so formulators need to check local regulations carefully, advised Goulson.

## HIGH-POTENCY SWEETENERS

High-potency sweeteners are many times sweeter than sucrose, ranging from about 200 times as sweet as sucrose for stevia and aspartame, to some 20,000 times as sweet for advantame. They do not replace any of the bulk or functionality of sugar. Low-calorie bulk sweeteners are much closer to the equivalent sweetness of sucrose, noted Goulson. Other than erythritol, they contribute from 0.4 calories per gram (allulose) up to 3 calories per gram for hydrogenated starch hydrolysates (HSH). They have some very good characteristics that can be leveraged in combination with high-potency sweeteners to improve the overall sweetness profile of products.

Typical challenges in sugar reduction include lack of sweetness intensity, unpleasant side tastes, and delayed onset of sweetness or lingering aftertaste. These problems prevent formulators from achieving a well-balanced, overall taste profile. The best sweet taste results are often achieved with combinations of sweetener ingredients to achieve optimal sweetness intensity, taste quality and temporal dynamics.

Each sweetener has a concentration-response curve. For a typical high-potency sweetener, the curve flattens at about 6 sucrose equivalents of sweetness (SEV); that is, increased sweetener no longer substantially increases perceived sweetness with modest increases in concentration. If the goal is to reach

8 or 10 SEV, pushing the concentration can result in bitterness, black licorice notes and lingering aftertaste, in exchange for very little added sweetness.

In comparison, bulk sweeteners have a linear concentration-response relationship. These sweeteners can only be used within certain limits because of potential regulatory, digestive tolerance or cost limits. “If the high-intensity sweetener can’t get to 8 to 10 SEV, and the bulk sweetener can’t be used at 8 to 10 SEV, what’s a formulator to do? Adding, for example, 2 SEV from a low-calorie bulk sweetener to the high-intensity sweetener can achieve the desired result,” said Goulson.

Erythritol is 70% as sweet as sucrose and has a clean, sweet taste. It has a quick onset of sweetness and quick decay, like sucrose. Blending stevia with erythritol improves the sweetness taste quality and temporal dynamics. Sucrose is the gold standard. At 8 SEV, stevia has many off-flavors, including herbal, bitter, chemical and astringent notes. By blending erythritol with stevia, the taste profile becomes more like sugar, with high sweetness intensity and improved taste quality and temporal dynamics compared to the high-potency sweetener alone.


All high-potency sweeteners are used at parts per million concentration of the formula. In a beverage, water makes up the difference and is the low-calorie bulking agent. In other applications, sucrose contributes to bulking, structure, browning and shelflife stability. In a cupcake, sugar is 25-30% of the cupcake and 50% of frosting. A blend of high-potency sweeteners and functional, low-calorie bulk sweeteners can address structural issues (spread and rise); textural issues (crispness and chewiness); and shelflife issues (staling).

In a cookie, maltitol, which is 90% as sweet as sucrose, can be used for sugar reduction. Adding a small amount of a heat-stable sweetener, like sucralose or acesulfame potassium, will boost sweetness. Maltitol resists crystallization, so provides good textural properties but no browning. To achieve the desired cookie color, add allulose or tagatose, which contribute to browning via the Maillard reaction, advised Goulson.

Sugar-free confections are another category where the functionality of low-calorie bulk sweeteners is critical. The sweetener must replace the appearance, structure, texture and storage attributes of sugar. Hard candy is an example of a sucrose glass. It is characterized by a clear, shiny appearance and brittle texture. Hard candy retains these properties if it is stored below the glass-transition temperature.

Isomalt is an ingredient that provides excellent performance in sugar-free hard candies. A blend of isomalt and high-potency sweeteners is often used in sugar-free hard candy where isomalt





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has a high glass transition temperature. Isomalt is also frequently used in sugar-free chocolate, noted Goulson.

Statistical design can be used to optimize the functionality of sugar replacers. A 2021 study from Seoul (<https://doi.org/10.3390/foods10102464>) explored various combinations of isomalt, maltitol and xylitol in a sugar-free hard candy. The authors recommended using 90.21% isomalt for hardness; 8.63% maltitol for sweetness; and 1.16% xylitol for color and clarity.

Food formulators should remember there is not a single drop-in replacement for sucrose that works in all applications. Blending high- and low-potency sweeteners, as well as combinations of low-calorie bulk sweeteners, has the potential to deliver optimal performance in applications.

*“Low-Calorie Bulk Sweeteners from Allulose to Polyols: Maximizing Their Benefits in Sugar Replacement,” Melanie Goulson, President and Principal Scientist, Merlin Development, [mgoulson@merlindev.com](mailto:mgoulson@merlindev.com) [To access the video and PowerPoint of this presentation, see <https://sweeteners.globalfoodforums.com/sweetener-systems-rd-academy/benefits-polyols-allulose-and-tagatose-presentation> or <https://bit.ly/36pxzr6> ]*

## Adding Value to Formulations with Sweet Enhancing Fruit Ingredients

**FRUIT, IN AND OF ITSELF**, is a consumer-friendly ingredient. As consumers have become more conscientious about their health and wellness, the demand for sugar reduction or replacement with more healthful options has increased. Adding value to formulations with sweet-enhancing fruit ingredients is one of the benefits of this movement toward healthier eating. In her presentation titled “Formulating with Whole Fruit Ingredients,” Kristen Sparkman, MSc, Culinologist, CuliNex, LLC, presented a wide variety of whole fruit options for food formulators and discussed properties and functionalities associated with each one.

Fructose, the primary sugar in fruit, is 1.2 to 1.8 times as sweet as sucrose. Fructose is metabolized in the liver and does not need insulin to be absorbed; therefore, fructose does not raise blood glucose levels compared to many other sugars, including glucose and sucrose.

Fruit ingredients come in various shapes, sizes, moisture content and forms. Sparkman described the differences between dried fruits, granules and powders, and purees and concentrates.

Air-dried fruit gives a chewy texture, while freeze-dried pieces provide a little bit of a crunch. Dried fruit is shelf-stable; provides visual differentiation due to their color or piece size; and

## GMO FRUIT IN THE U.S.

One of the questions raised during the Q&A session involved the GMO status of fruit crops. GMO fruit sold in the U.S. is relatively limited.

Examples include papaya and a few varieties of apples. Rainbow papaya was developed to resist the ringspot virus after Hawaii’s papaya industry crop was nearly destroyed in the 1990s. A few GMO apples were created to resist browning after being cut to reduce food waste. Some approved fruit and vegetable crops are not widely grown or may not be on the market. It’s always best to check GMO status with your fruit ingredient supplier before using. —Global Food Forums Editors

### For More Information:

- FDA’s New Plant Consultations (12/16/2021) - <https://bit.ly/32eesP8>
- FDA’s How GMOs Are Regulated for Food and Plant Safety in the United States (4/22/2020) - <https://bit.ly/3q6cs3m>
- FDA’s GMO Crops, Animal Food, and Beyond (9/28/2020) - <https://bit.ly/3Fhw4YL>
- FDA’s Agricultural Biotechnology (9/29/2020) - <https://www.fda.gov/food/consumers/agricultural-biotechnology>

can be infused with flavor or sugar-stabilized. In the latter case, sugar is infused into a fruit, increasing its shelflife.

Sparkman suggested that fruit granules and powders are generally underutilized. They have good moisture absorbency, although a formulation’s moisture may need adjustment depending on the product texture desired. “Granules and powders are good for bar applications. If the [mixture] is already a little soft, adding fruit powder might help bind it and give it structure, making it run more easily during production,” explained Sparkman.

Purees and concentrates have great visual color and intensity. “Depending on the fruit you’re using, you can usually find two or three different Brix degree (°Brix ) levels to tailor to your application,” said Sparkman. “You’re going to want a different °Brix for a filling than you would for a salad dressing. This plays into finished water activity (Aw). Generally, the lower the Aw you want, the higher °Brix you’ll be aiming for. A lot of these products can be stabilized with sugar to get °Brix where it needs to be,” she added.

## FRUITS OF INTEREST

Apples are very versatile and come in a wide variety of formats. Their neutral sweetness and light color make them compatible with various flavors. Given their subtle flavor, they can be used as a neutral flavor base, as top-notes added with strawberry, for instance; or their flavor can be pushed forward, becoming the more dominant note.



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■ **The neutral sweetness and light color of apples means they can be used as a neutral flavor base and top-notes from another fruit added, or their flavor can be the dominant flavor note.**

Although slightly more impactful in flavor, pears have many similarities to apples while still being relatively neutral. As with apples, they work well in both sweet and savory applications. “In a barbecue sauce, for example, the sweetness of sugar can be replaced with pear puree. Savory, spicy and salty notes would still come through,” said Sparkman. Pears are high in fructose and fiber.

“Dates have moved into the health-conscious space... and have marketable health benefits given their dietary fiber, calcium, potassium and iron content,” suggested Sparkman. They are versatile due to their neutral and balanced sweetness. While naturally dark, the reducing sugars in dates help develop Maillard browning, giving a nice caramel color to baked products such as cookies. Dates can also function as a fat replacer. As a result of their binding and texture-modifying properties, dates “give pliability and softness to bars, especially in the production stage, but also during shelflife,” explained Sparkman. The benzoic acid and cinnamic acid content of dates provide antimicrobial properties.

Prunes, slightly less sweet than dates, have many other similarities, including their antimicrobial properties. Using prune juice

concentrate at 70° Brix as a 1:1 replacement for invert sugar or corn syrup in baked products proved successful without further formula modifications, noted Sparkman. As prunes are mildly hygroscopic, they can help with staling. However, this may require an initial moisture adjustment to produce the desired texture.

“Raisins are an iconic fruit and a good sweetener that create a chewy texture and softness while limiting Aw,” said Sparkman. Raisin powder can be dusted on cereal as a sweetening agent, like frosted cereal, without added sugar. Raisins can also be used as a fat replacer and for texture enhancement. As a fat replacer in a brownie application, the more raisins used, the more the sugar needs to be decreased. Yet, fat replacement isn’t the only benefit achieved. The brownie will not only have a chewier texture, but the raisins will also help control breakage, noted Sparkman.

Finally, blueberries, like other fruits, are versatile in sweet and savory applications. They have great characteristic flavor and color and can be leveraged for their marketable health benefits, given their anthocyanin content and Heart-Check certification by the American Heart Association.

Sweet-enhancing fruit includes many value-added properties, from process functionality to extended shelflife to nutritional benefits. One final positive attribute worth noting extends to labeling. Under the recently adopted rules for Added Sugar labeling, only fruit juice and fruit juice concentrate require Added Sugar labeling. In contrast, fruit pieces, dried fruit, pulps or purees do not need to be labeled as Added Sugar on Nutrition Fact panels. [For more detailed information on this topic, see the article “Added Sugars Declarations in Nutrition Facts Labeling,” which is also posted online at <https://sweeteners.globalfoodforums.com/sweetener-systems-articles/added-sugars-in-nutrition-facts-panel>

*“Formulating with Whole Fruit Ingredients,” Kristen Sparkman, MSc, Culinologist, CuliNex, LLC, [kristen@culinex.biz](mailto:kristen@culinex.biz)*  
[To access the video and PowerPoint of this presentation, see <https://sweeteners.globalfoodforums.com/sweetener-systems-rd-academy/sweet-enhancing-fruit-ingredients-presentation> or <https://bit.ly/3hciFGN> ]

**Global Food Forums wishes to thank the sponsors and speakers who contributed their support and knowledge to our 2021 Sweetener Systems Premium Webinar and to this magazine. For those who would like more information on current hot topics and technical advice on sweeteners and who miss in-person events, we are incorporating sessions in these areas into the 2022 Clean Label Conference in Itasca, Ill., a suburb northwest of Chicago’s O’Hare airport. For more information on the conference, go to <https://cleanlabel.globalfoodforums.com/2022-clean-label-conference-overview/> or <https://bit.ly/3HzTpWz> . We hope to see you there!**



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## Added Sugars Declarations in Nutrition Facts Labeling

*When it comes to naturally sweet ingredients, such as fruits and vegetables, what needs to be included as “Added Sugar” in the Nutrition Facts panel?*

— Lauren Swann, MS, RD, LDN, Concept Nutrition, Inc.

**CURRENT NUTRITION FACTS** labeling regulations require a quantitative “Added Sugars” declaration and accompanying percent Daily Value.

“Added Sugars” are defined by the FDA as “added during processing” and include:

- Free mono- and disaccharides (e.g., glucose and sucrose)
- Syrups and honey
- Fruit and vegetable juice concentrates unless diluted (i.e., sufficient free water/moisture is formulated into the product for the concentrate to be made equivalent to a single strength ingredient, based on FDA Code of Federal Regulations’ [CFR] established Brix values for standardized juice)
- Powdered fruit or vegetable juices in excess of reconstituted single-strength juice

FDA does consider foods sweetened with concentrated fruit or vegetable juices—when added as an ingredient to a product but not reconstituted to single-strength juice during processing—to be sugar-sweetened foods.

“Added Sugars” do not include:

- Fruit or vegetable juice concentrates used towards the total juice percentage label declaration or for Brix standardization
- Whole fruit, fruit pieces, pulps and purees, because they are nutrient-rich and maintain the basic properties of a fruit when used as an ingredient
- Dried fruits with no added sugar, because they are essentially dehydrated whole fruit that retains the nutrients and other components of whole fruit (e.g., diced dried apples). However, if additional sugar is added, it must be declared on the label as added sugars
- Fruit juice concentrates used in the fruit component of jellies, jams or preserves standard of identities or the fruit component of fruit spreads
- Whole fruits, pieces of fruit, dried fruit, fruit or vegetable purees (single strength or concentrated), fruit pulps, single-strength juices, fruit and vegetable pastes, and fruit and vegetable powders that are not made from fruit or vegetable juices

If the initial juice ingredient—whether diluted, 100% or concentrated—is further concentrated during production



❏ **Whether sugars that are intrinsically part of fruit-based ingredients need to be considered in “added sugars” calculations on the Nutrition Facts label depends on the nature of the ingredient.**

due to moisture loss, such as through drying or baking, further calculations are required. (See <https://www.fda.gov/media/117402/download>)

FDA’s Industry Guidance on Added Sugars Labeling gives sweetened, dried fruit and sweetened flavorings as examples of other ingredient components to review for gram contributions when totaling added sugars for Nutrition Facts labeling in a finished product serving. The review also includes relevant processing, such as dilution of a concentrated fruit or vegetable juice or fermentation.

### **ALLULOSE & ERYTHRITOL: SWEETENER EXCEPTIONS**

Although erythritol is compositionally a carbohydrate (a teaspoon of erythritol is about 4 grams), for nutrition labeling purposes, FDA recognizes erythritol as possessing 0.2 kilocalories per gram, because it is not metabolized during digestion.

Allulose’s caloric value of 4 calories per gram must be included in the Nutrition Facts carbohydrate declaration, but FDA is exercising enforcement discretion for exclusion from the Total Sugars amount, pending future rulemaking regarding amendment of the Total Sugars definition. FDA concludes that allulose is virtually unmetabolized and should not be included in the Added Sugars declaration or Percent Daily Value.

## SUGAR AND CONTENT LABELING CLAIMS

Because there is no Daily Reference Value for Total Sugars, there is no Percent Daily Value and, therefore, no FDA-established regulations defining “Low Sugar” or “Low in Sugar.” This would make the use of such a label claims violation. However, relative claims can be made using the term “Lower,” if in compliance with comparative criteria, as well as declaration and disclosure requirements detailed in the CFR for the phrases: “Lower in Sugar,” “Lower Sugar,” “Reduced Sugar,” “Reduced in Sugar,” “Sugar Reduced” and “Less Sugar.” Also permissible are the claims “Sugar Free,” “Free of Sugar,” “No Sugar,” “Zero Sugar,” “Without Sugar,” “Sugarless,” “No Added Sugar,” “Without Added Sugar” and “No Sugar Added” when regulatory compliance is met.

“Unsweetened” and “No Added Sweeteners” can be used as factual statements. On the other hand, “Low Carb” has never been established (i.e., defined) by the FDA. When an undefined claim is used, the product is considered misbranded, concluded Swann.

*Lauren Swann, MS, RD, LDN, Concept Nutrition, Inc. See <https://foodfactswork.com/> and <https://www.linkedin.com/in/laurenswann/> and <https://m.facebook.com/ConceptNutrition/>*

## REFERENCES:

### FDA Industry Guides:

- Nutrition and Supplement Facts Labels: Questions and Answers Related to Added Sugars

<https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-nutrition-and-supplement-facts-labels-questions-and-answers-related-compliance>

- Declaration of Allulose and Calories from Allulose on Nutrition and Facts Labels

[www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-declaration-allulose-and-calories-allulose-nutrition-and-supplement-facts-labels](https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-declaration-allulose-and-calories-allulose-nutrition-and-supplement-facts-labels)

### Code of Federal Regulations:

- 21 CFR 101.9 – Erythritol and Nutrition Labeling  
[www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.9](https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.9)
- 21 CFR 101.60 – Sugar Content Claims  
[www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.60](https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.60)

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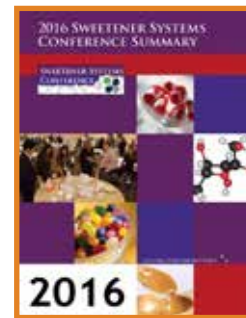
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The above links provide access to post-event magazines. Key learnings from most all presentations at these events are summaries. If more in-depth information is desired, the speakers' PowerPoints can be found at <https://sweeteners.globalfoodforums.com/>

## 2022 In-Person Conferences

We hope you'll join us at our in-person 2022 conferences at the Westin in Itasca, Ill., USA (a Northwest suburb of Chicago located near O'Hare International Airport).



<https://bit.ly/3GXnNcF>



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## Global Food Forums' Webinars



We are pleased to introduce our recent webinars in the areas of clean label, food proteins and sweeteners. These webinars provide insights into key consumer and food product trends as well as technical formulation issues. Some webinars introduce novel ingredients in conjunction with ingredient functionality and application guidance.

Global Food Forums also presented its own premium webinars in each of the three categories mentioned above. Each of these webinars featured non-partial experts who have many years of food industry experience in their areas of expertise. For a listing of past and upcoming webinars, go to <https://globalfoodforums.com/global-food-forums-webinars/>





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