2017 Sweetener Systems Conference

What's Inside on Sweeteners...

- Changing Consumer Attitudes
- Advances in Perception & in Health
- Update on Added Sugar Regs
- Sugar Reduction: Strategies; Baked Goods
- Polyols; Natural Sweeteners

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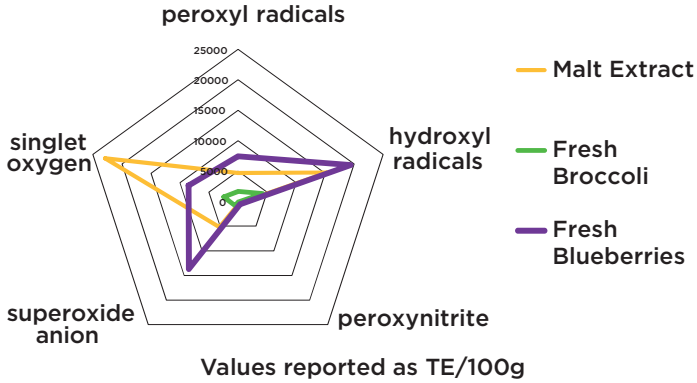

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2017 Sweetener Systems Conference Summary

Even as Global Food Forums held its second annual Sweetener Systems Conference, the topic of sugar and other sweeteners continued to heat up globally, as controversy and challenges impact a wide range of stakeholders in the food system.

The conference, held November 7, 2017, in Lombard, Ill., USA, opened with an overview of consumer attitudes toward sweeteners and a review of innovative sweetened consumer products. This was followed with an update on emerging understandings of sweet taste perception. While an FDA-proposed rule extends the compliance date to list "Added Sugar" on labels for a year and half, another speaker reviewed practical difficulties with the new regulation and ways it may or may not be enforced. Other speakers took an objective look at nutritional issues surrounding sugar and sweeteners; at sugar-reduction strategies overall; and in baked goods; and at useful and trending ingredients in sweetener systems. A brief summary of the excellent presentations from this year's program is provided here.

All presentations or/and adapted versions made available by the speakers may be accessed at www.GlobalFoodForums.com/2017-Sweetener-Systems/Store.

Please consider attending our next annual Sweetener Systems Conference, October 23, 2018, at the lovely The Hyatt Lodge, McDonald's Campus, Oak Brook, Ill., USA. (www.GlobalFoodForums.com/2018-sweetener-systems)

Networking with industry experts and peers is one advantage of a conference focused on sweeteners and formulations.

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The Global Food Forums Story

Welcome! We hope you find this, our 2nd Sweetener Systems Post-conference Summary, useful.

We launched Global Food Forums in 2012 with the vision of developing a family of in-person, niche product development conferences for the food, beverage and nutritional products industries.

Each of our events, which also includes the Clean Label Conferences and Protein Trends & Technologies Seminars, is tied to an important, long-term consumer and industry trend in which applied food science plays a crucial role. The technology-based programs are designed to provide R&D and other food scientists with practical and impartial formulation advice, along with consumer insights, information on emerging ingredients, regulatory updates and other factors impacting product formulations. Our Sweetener Systems Conferences fit well with this goal.

Sugar's benefits in foods go far beyond sweetening, as its physio-chemical properties improve the color, flavor, texture and even microbial safety of products. Consumer sweetener preferences will continue evolving. Ingredients and sweetener technologies will continue advancing. Nutritional knowledge will increase. And, there is no end in sight to the politics and regulations surrounding sweeteners. Sweeteners will be a turbulent topic with challenges and opportunities for years to come.

With food technologists as core customers, all our company decisions are guided by how they will impact this community's event experience. To date, our events have drawn over 2,500 attendees. They range from bench-level food scientists to VP/directors of R&D, regulatory and other functions related to product development, as well as those interested in interacting with this community to better understand their needs and challenges.

We hope you'll attend our future events, including our 3rd annual Sweetener Systems Conference, October 23, 2018, at the beautiful Hyatt Lodge at McDonald's Campus, Oak Brook, Illinois. We'll work hard to make it one of your best conference experiences ever!

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

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For an inside look at the team,

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What Are Consumers' Attitudes Toward Sweeteners

Tom Vierhile, MBA, Innovation Insights Director with the UK-based data management company GlobalData, gave a thoughtful discussion on consumer feelings about sweeteners that ended with a summary of unique future developments in sugar reduction.

He began his presentation, "Sweeteners in the Crosshairs: How Do Consumers Really Feel About Sweeteners and are These Feelings Changing?" by giving a brief introduction to GlobalData. He noted that it tracked innovation in over 50 markets to discover game-changing product trends through an organized trend framework that revealed eight mega-trends and 63 sub-trends.

"Globally, 54% of consumers are paying attention to the ingredients in their foods and drinks," explained Vierhile. "Growing interest in 'cleaner' foods; rising worries about food allergies; and food contamination issues are making consumers more 'ingredient-aware,'" he stated. Ingredient concerns tend to be much higher for products targeted to children.

Consumers are actively trying to reduce consumption of sugar and fat because of their perceived negative impact on health. A majority of consumers are either trying to reduce sugar consumption or consume it in moderation. Concern about sugar tends to rise with age, and consumers are increasingly linking sugar with weight gain. Obesity issues have escalated universally, and the U.S. leads the pack. Sugar taxes and education are seen as tools to change behavior.

"Views toward specific sweeteners are as varied as the sweeteners themselves; for example, agave, stevia and honey are seen as most healthful with just over one third of consumers globally saying each has a positive health impact," Vierhile claimed.

Globally, aspartame is viewed more negatively now than high-fructose corn syrup. Sweeteners derived from nature are more likely to have a positive perception than sweeteners that are not. This explains honey's health halo, with 77% of consumers globally (63% of Americans) believing honey has a positive impact on health.

But views toward honey and stevia are changing. Honey cannot escape worries about chronic health issues like obesity or type 2 diabetes. The positive "buzz" around honey may be easing because of these concerns. Stevia is in the opposite position as honey. Worries about obesity may be helping stevia, as consumers learn more about it. Not ingredient experts, a surprisingly high percentage of consumers globally say they are not familiar with the sweeteners xylitol, monk fruit, agave and erythritol.

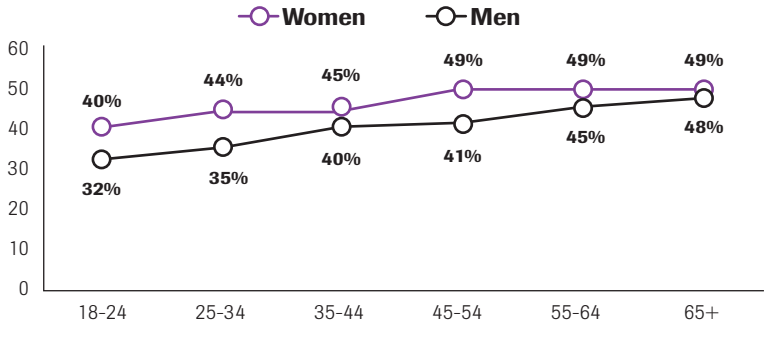
Sugar reduction is extending to categories beyond beverages and confectionery.

Regarding sweetener claims, Vierhile stated that "little consensus exists." No single sweetener claim emerges as the most attractive to consumers, as it is perceived that eliminating sugar comes at a cost, since sugar substitutes have their own issues.

Few differences are seen by consumers between "no added sugar" and "low sugar" claims. However, the "no added sugar" claim is viewed as appealing for younger consumers "when offered in a more natural state, and unsweetened products are perceived as more healthful, but lacking in taste appeal."

Mixed results show that there may be no magic bullet for sweeteners. Replacing one artificial sweetener with another one backfired for Pepsi, as consumers wanting the original aspartame-based formulation rebelled. In Australia, Coca-Cola ran into resistance rolling out Coca-Cola No Sugar to replace Coca-Cola Zero (both with aspartame). Sugar reduction tends to focus on soft drinks and confectionery. However, many other categories offer reduction

Concern About Sugar Tends to Rise with Age (2016)



SOURCE: TOM VIERHILE, INNOVATION INSIGHTS DIRECTOR, GLOBALDATA/2017 SWEETENER SYSTEMS CONFERENCE, GLOBAL FOOD FORUMS, INC.

Women of all ages tend to be more concerned about sugar consumption than men, though concern levels by gender tend to converge with age.

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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. BENEO's ingredients offer new ways to replace sugar and add nutritional benefits without compromising on taste and texture.

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opportunities, including bread, wine and even meat, with Applegate Naturals launching the first sugar-free bacon.

In the future, re-engineering sugar to be less caloric has promise. Nestle has developed a new process that takes sugar and changes its physical structure. New hollow sugar crystals are said to dissolve faster and deliver identical sweetness as regular sugar, with fewer calories.

"Artificial sweeteners may be in for a rough ride," Vierhile predicted. Recent studies have found associations with negative health impacts on weight gain, type 2 diabetes and other health issues from non-nutritive sweeteners.

"Sweeteners in the Crosshairs: How Do Consumers Really Feel About Sweeteners and are These Feelings Changing?" Tom Vierhile, Innovation Insights Director, for GlobalData, clientservices.consumer@globaldata.com

Is Removing Caloric Sugars the Answer?

"Humans have a strong preference for sweet taste, but that's a problem from a health perspective. In order to develop reduced-sugar products, food formulators need to understand how sweet taste works," said Nancy E. Rawson, Ph.D., Associate Director of the Monell Chemical Senses Center, Philadelphia. Completely eliminating caloric sugars from reduced-sugar products makes no sense, a concept that led to the title of her presentation: "Why No Calorie Makes No Sense."

Reducing sugar content is a priority, especially when developing products for children. Food formulators already have a large tool box, including non-nutritive sweeteners, high-potency sweeteners, sugar alternatives, polyols, sensory interactions and physical approaches. But this is not enough.

About 20 years ago, the taste receptors for sweet and *umami* were discovered. According to Rawson, these T1R genes are believed to have evolved from species that lived more than 400 million years ago. Evolution matches sensory apparatus to nutrition requirements, and each species must solve the fundamental problem of obtaining sufficient nutrients while avoiding being poisoned. Sugars provide a rapidly accessed source of calories necessary for omnivore survival. By replacing caloric sweeteners with non-caloric ones, we are trying to fool Mother Nature. But this is not working, because the brain response to non-caloric sweeteners is different than the response to caloric sweeteners.

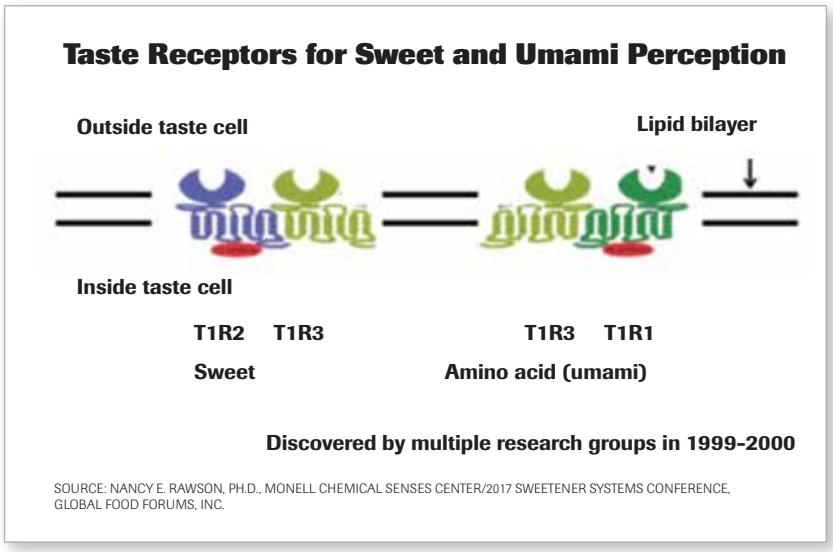
To understand sweet taste, one needs to understand taste detectors. The tongue's taste cells are the initial chemosensors of the alimentary tract. The tongue contains papillae, and taste buds line the mucus-filled cavities of these papillae. In order for a food to be perceived as sweet, a compound has to get to the cells in these crevices.

Rawson explained that there are three types of taste cells within each taste bud. Type I taste cells are probably involved in tasting salt and managing ionic concentration. Type II cells are responsible for detecting sweet, *umami* and bitter tastes. When activated, Type II cells release ATP, which communicates with type III cells and nerves.

T1R2 and T1R3 taste receptors are the primary detectors for sweet taste. Both control mice and knockout mice (lacking the T1R3 receptor) respond to caloric sweeteners, but the response to artificial sweeteners is eliminated in knockout mice. An independent sugar-detection pathway is made up of glucose transporters. These transporters take up glucose, which is metabolized to generate ATP, leading to downstream signalling and sweet detection. (See chart "Taste Receptors for Sweet and Umami Perception.")

There are also brush border digestive enzymes (BBE) located in the taste buds. These BBE and amylases are present in sufficient quantity to break down starches and disaccharides into glucose and fructose. This enzymatic pathway is sufficiently active to contribute to sweet detection. If you eliminate both the T1R3 and enzyme pathways, you abolish the response to disaccharides.

The second sweet-detection pathway is sensitive only to sugars that can be transported by glucose transporters, i.e., monosac-



T1R2 and T1R3 taste receptors are the primary detectors for sweet taste. Both control and knockout mice (lacking the T1R3 receptor) can detect caloric sweeteners, but mice without T1R3 receptors do not respond to artificial sweeteners.

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charides. Non-nutritive sweeteners only act on the first pathway. Nutritive sweeteners act on both pathways, although these are not equal. Thus, taste cells are providing information on both perceptual and nutritional quality. A new definition of sweet will need to encompass the ability of taste cells to detect caloric content.

Is it possible to shift preference for sweet foods? Paul Wise and colleagues reduced dietary sugar intake of subjects by 40% vs. a control group. After four months, subjects in the low-sugar group perceived a pudding as sweeter. But this effect did not persist. One month after discontinuing the reduced-sugar diet, the subjects went back to baseline.

> ***"A new definition of sweet will need to encompass the ability of taste cells to detect caloric content."***
>
> ***– Nancy E. Rawson, Monell Chemical Senses Center***

Shifting preference for sweet is going to be harder than shifting preference for salt. Some people have a lot of alpha amylase enzyme, while others don't have as much. This variation alters the sensory response to polysaccharides. Genetic variation accounts for 23-30% of the total phenotypic variation in perceived intensity across a set of sweeteners, which influences, but does not fully account for, differences in our sweet-taste experience.

Humans have an inborn drive for sources of energy, driven by 400 million years of evolution. So, we are not going to fool Mother Nature very easily. The true target for a sweetener needs to include a caloric component. Companies should strive for sugar reduction, not elimination.

"Why No Calorie Makes No Sense," Nancy E. Rawson, Ph.D., Associate Director of the Monell Chemical Senses Center, nrawson@monell.org

Problems with Labeling Added Sugars

Food manufacturers take note: There still remains an important, albeit small (perhaps 1-1/2 year) window of opportunity for food and beverage companies to convince the U.S. Food & Drug Administration's (FDA) to modify or eliminate its pending sugar-labeling regulations, according to Bruce Silverglade, Esq., Principal at the Washington, D.C.-based law and lobbying firm, Olsson Frank Weeda Terman Matz PC (OFW Law). Silverglade's 2017 Sweetener Systems Conference presentation was titled "FDA's Nutrition Facts Panel and the Labeling of Added Sugars."

A number of arguments exist as to why the pending requirement for "added sugar" labeling on the Nutrition Facts should be revisited.

Provisions of the final rule Nutrition Facts rule can still be revisited through FDA guidance documents, use of enforcement discretion and/or issuance of interim final rule.

Why is there the need? The FDA's pending regulations for "added sugar" labeling make no sense. The Nutrition Facts label of a snack bar, for example, will read, "Total Sugars 10g; Added Sugars 10g." "You can say, 'reduced sugar' or 'sugar free,' 'no added sugars,' but not 'low sugar.' But the real stickler is 'added sugars per serving,'" Silverglade said. The regulations, he maintained, are unworkable.

He listed five principle reasons: 1) the science to support sugar content rules is "tenuous at best;" 2) the pending labels are "confusing and misleading;" 3) the rules rest "on very shaky legal grounds;" 4) the technology currently does not exist to verify compliance; and 5) the regulations would put U.S. food and beverage manufacturers totally at odds with global standards.

First is the lack the scientific support: "A big part of problem is that sugar labeling regulation began as a political, rather than scientific project. So political science quickly overcame real science," said Silverglade. "As a result, the FDA flipped and flopped and flipped again to develop rationales for the regulations."

"Moreover, the FDA ultimately based its decision to require 'added sugar' labeling on the recommendation of the 2015 U.S. Dietary Guidelines Advisory Committee (DGAC), which was heavily politicized," asserted Silverglade. Subsequently, the FDA failed to submit its conclusions to a customary review by the U.S. National Academy of Sciences (NAS). As it was, the foundational scientific evidence utilized by the DGAC to justify added sugar labeling was very limited and very weak. Presumably, Silverglade implied, the NAS would have noted this.

The second reason is label confusion: The FDA's own research projected that 24% of consumers would be misled by the pending added-sugar labeling regulations, said Silverglade.

For example, an FDA study indicated that about 25% of consumers would choose a food higher in saturated fat and sodium merely because its "added sugar" label listing was lower than that for an alternative, higher "added sugar" product that contained healthier saturated fat and sodium levels. "This shows the danger of the FDA stressing a particular nutrient level to such a degree that consumers misunderstand the total nutrition label and take away the wrong message."

Furthermore, under the pending regulations, continued Silverglade, a bag of sugar would have to declare 8g of sugar per serving on the Nutrition Facts panel and also 8g of "added sugars" per serving.

"This is nonsensical!" said Silverglade.

The third reason involves legal concerns: The FDA is required to engage in "reasoned decision making." If not, the FDA violates the Food, Drug and Cosmetic Act by engaging in "arbitrary and capricious" action. Silverglade maintained that the FDA did this in bypassing the NAS review process, thereby violating the U.S. Administrative Procedures Act. He also noted that, for the Federal Trade Commission (FTC) to make a case against misleading advertising, it need only show that 15% of consumers could be misled by a particular advertisement. But the FDA's own research indicated that as many as 24% of consumers would be misled by the proposed added sugar claims. The FDA cannot, by law, mislead consumers.

There are also 1st Amendment issues (regarding free speech), continued Silverglade. "Under the doctrine of commercial free speech, companies have a right not to be forced to make misleading claims."

In addition, the lack of existing technologies whereby to verify added sugar label claims will require extensive (and very expensive) record-keeping that will likely require access to confidential files by the FDA, thereby threatening companies' trade secrets.

And, finally, an "added sugar" ruling places U.S. food and beverage manufacturers well outside of the standards set by neighboring Canada and international *Codex Alimentarius* guidelines, thereby threatening their competitiveness. "Health Canada investigated 'added sugars' labeling and rejected it as being impractical," said Silverglade.

Thus, it behooves U.S. food and beverage manufacturers to propitiously lobby for changes, while that narrow window of opportunity remains open.

"FDA's Nutrition Facts Panel and the Labeling of Added Sugars,"
Bruce A. Silverglade, Principal, OFW Law, bsilverglade@ofwlaw.com

Sensory Sampling: Balancing Sweet & Sour

Most who work with the sensory aspects of sweeteners are familiar with the concept of temporal profile; that is, the perceived sweetness intensity of a component over time. However, as Melanie Goulson, MSc., General Manager, Merlin Development, notes, acidifiers also have characteristic temporal profiles.

With the goal of demonstrating how the sweet/sour taste balance of products can be managed by considering the temporal characteristics of the ingredients and then matching them, Goulson and John Yasosky, MSc, also with Merlin Development, held a hands-on interactive session at the 2017 Sweetener Systems Conference.

An example of this concept would be model aqueous solutions of sucrose and citric acid; one of stevia and citric acid; and one of stevia and a citric-malic acid blend.

Benefits to optimizing the sweet/sour balance in products include improved organoleptics, better flavor performance and even cost savings. Attendees were able to taste samples of the concept and ask questions one-on-one during this interactive event. For more information on the concept activity, see https://goo.gl/WyMDYm .

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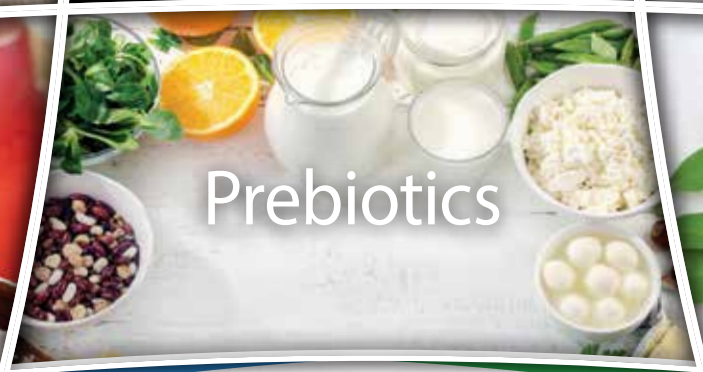

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Does Sugar Cause Obesity?

"So, when you see someone who is obese…do you ask, 'Is it too much sugar; is it too much carbohydrate; or is it just too [insert colorful adjective] much?" Professor Julie Miller Jones, of St. Catherine University in St. Paul, Minnesota, characteristically likes to get straight to the point, and she did so in her 2017 Sweetener Systems Conference presentation titled "Sugar and Spice and Everything Nice? Is This Truth in Labeling?"

Rightly or wrongly, sugar has been identified with obesity and other disease states. To this, Jones (also characteristically) proffered correctives.

"Obesity is endemic around the world: People are terrified because, while we (Americans) may be [some of] the fattest people on the planet, other people are catching up really fast," said Jones. The Internet hasn't helped. "Internet media is filled with misrepresentations and accusations," says Jones.

She pointed to an Internet link [http://www.rheumatic.org/sugar.htm] listing 146 reasons (and counting) why sugar allegedly ruins people's health (e.g., dietary sugar can impair the structure of DNA). World organizations such as the Pan American Health Organization have adopted strong anti-sugar policies. In Chile, for example, any product with added sugar must prominently display a black warning logo identifying the product as "high in sugar." World Health Organization (WHO) Director of Nutrition in Health and Development, Dr. Francesco Branca, went so far as to claim that, "Nutritionally, people don't need any sugar in their diet."

So, are the alleged links between sugar consumption, obesity and other diseases supported by the science? Jones emphatically argues "no." Much of the evidence claiming negative effects from sugar consumption is based on epidemiological data. "One thing that I want to emphasize to consumers is that epidemiological studies only show associations, not cause-and-effect. For example, we know that high-fat ice cream, low-fat ice cream and cell phone use are associated with obesity; we also know that sales of workout shoes and clothing are associated with obesity." But these are only associations. High-level consumers of sugar-sweetened beverages can just as easily be marathon runners or people with poor dietary and lifestyle habits.

Sugar, per se, does not cause weight gain or diseases. Actual scientific studies claiming links between sugar and sweetener consumption to obesity, diabetes, cardiovascular health or other disease conditions are problematic at best, said Jones. She deconstructed a list of studies claiming such links. Some studies were inconclusive; other studies overdosed rat diets with sugar.

"What we can do is associate excessive sugar intake and calories with obesity, and obesity with Type II diabetes," said Jones. Ditto for excessive fat or protein intake. "There is also agreement that high circulating sugars in the blood are high-risk factors for a number of complications." But high blood sugar levels don't necessarily equate to high sugar consumption.

But, more fundamentally, "If you look at historic sweetener intakes, based on disappearance data, you will see that the consumption of caloric sweeteners as a percentage of the diet has steadily declined and, today, is at a slightly lower level found in the 1970s. But total calorie intake has risen, and people have become more obese over that period. What we find is that it is not grains; it is not sweeteners; it is not fat…it's everything together: It's the calories!"

Unfortunately, much of the public's confusion is exacerbated by media obfuscation of already questionable scientific data, through misinterpretation and the use of misleading headlines. This encourages consumer media and non-profit organizations to create deductive links between sugar consumption

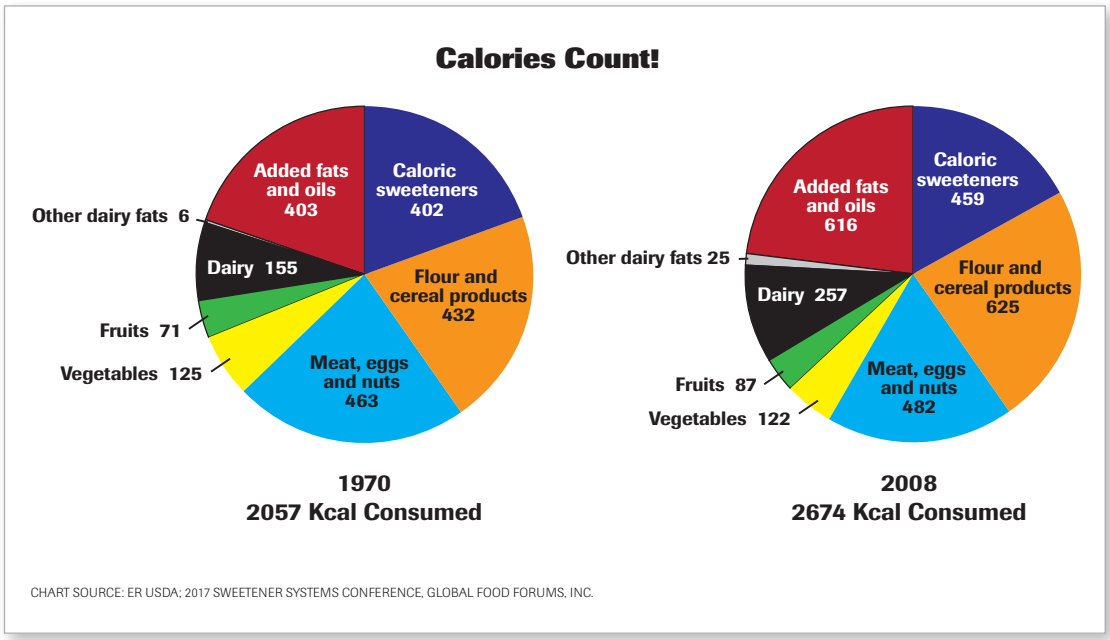


CHART SOURCE: ER USDA; 2017 SWEETENER SYSTEMS CONFERENCE, GLOBAL FOOD FORUMS, INC.

Is it sugar or calories? Between 1970-2008, average individual caloric consumption grew from 2057Kcal/day to 2674Kcal/day (+30%), whereas caloric sweetener consumption during that same period decreased from 19.5% of total calories to 17.2% of total calories.

> ***"…consumption of caloric sweeteners as a percentage of the diet has steadily declined."***
>
> ***— Julie Miller Jones, Emeritus Professor, Catherine University***

and cardiovascular disease "…that we really don't have the data to support," Jones concluded.

This can have unfortunate consequences. One of the (several) benefits of dietary sugar is that it increases the palatability of very nutritious foods. Jones cites an example of "zealous parents in New York" that successfully banned the consumption of flavored, sweetened milk in schools. This drove milk consumption way down, "along with calcium, riboflavin and other important nutrients found in milk." Eventually, pediatricians and parents realized their mistake and tried to return flavored milks to school lunch menus but, alas, kids had by then switched their beverage preferences…to their detriment.

"We really need to be careful that we don't, with good 'motives,' end up making the wrong, uninformed and untested choices that are detrimental, said Jones.

In conclusion, it's not the sugar: It's the lifestyles and the calories!

"Sugar and Spice and Everything Nice? Is This Truth in Labeling?" Julie Miller Jones, Ph.D., CNS, CFS, LN, Emeritus Professor and Distinguished Scholar of Food and Nutrition, St. Catherine University, jmjones@stkate.edu

An Innovative Strategy to Reduce Sugar

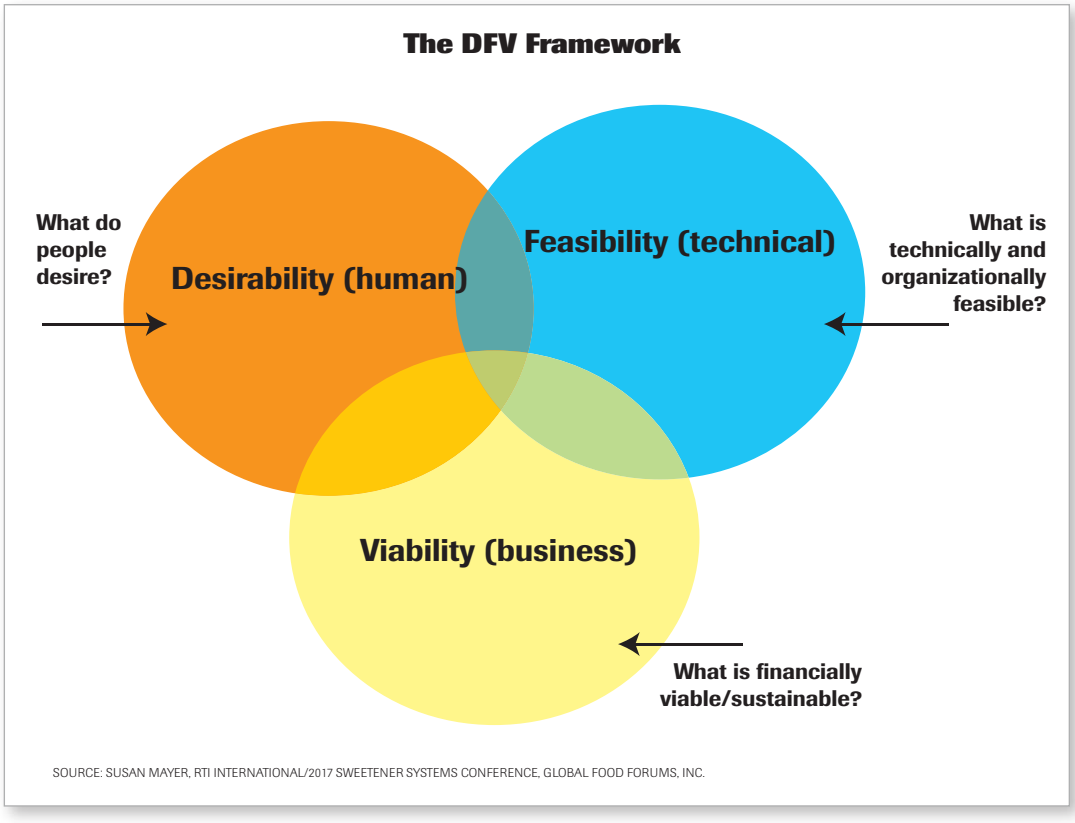
Many questions are raised before innovation begins in a process such as sugar reduction, including: How do you grow in emerging markets? How do you get smart from the beginning? What features should you include? What products will let you compete? How can we lean on local partners but assure quality? Susan Mayer, MSc, CFS, Innovation Advisor with RTI International, discussed these questions as she began her presentation titled "An Innovative Approach to Sugar Reduction."

Anchoring her presentation on an approach by RTI International, she explained that the non-profit research institute uses a Desirability Feasibility Viability (DFV) Framework to identify intersections at which innovation is found, as it provides solutions across the supply chain and frames the challenge throughout the innovation process. During the Desirability phase, the needs of the end-user and customer are understood. The product may be sold to a customer, who may not be the ultimate consumer, thus leading to the following: What are the perceived real benefits for the customer and the user? What drives purchase decisions for products?

In looking at Feasibility, what are physical, biological, contextual and environmental requirements? In early development stages, you're looking a little more broadly than simply whether you can make the product in your plant. How can you learn from others who have made something similar? Also, how might products, partners and expertise be leveraged?

Viability involves identification of the market opportunity and business model to grow and scale an innovation. That is, ask yourself

The DFV Framework reveals the intersection of technology, markets and users. That intersection is where innovation happens.



SOURCE: SUSAN MAYER, RTI INTERNATIONAL/2017 SWEETENER SYSTEMS CONFERENCE, GLOBAL FOOD FORUMS, INC.

who the consumer is and what do they want? What is the consumer willing to pay? Can you make it? Should you make it? Will the new product give you a unique advantage over the competitor, or is the new product going to cannibalize an existing product?

In looking specifically at sugar reduction, understanding the Desirability challenges requires understanding what aspects or definitions of "sugar reduction" are important to consumers. Consumers may associate certain brands with higher sugar, which may open the pathway for a new brand, perhaps with emerging ingredients. Those wanting lower grams of sugar might be satisfied with smaller serving or package sizes. Consumers wanting "no added sugar" may give rise to products made with fruit flavors, which are often provide by sweet flavor and sweet-related taste. Products made with ingredients providing perceived-to-be-healthy benefits along with sweetness may include the addition of fructo-oligosaccharides (FOS) that can be labeled as probiotics, or those containing fiber, such as inulin. Consumers may simply want reduced sugar—requiring bulk replacement, plus other formula adjustments to maintain taste and texture.

In considering Feasibility, the product developer must determine whether the product is manufacturable and where it can be made. If the equipment isn't available, can more equipment

Eight Sweeteners, One Anti-Sweetener

All food sweeteners provide useful formulation benefits, depending on the application. In order for attendees to try consumer products of significance, a New Sweetener Products Sampling Station was held at the 2017 Sweetener Systems Conference. Three of nine examples are discussed below.

In her presentation, "An Innovative Approach to Sugar Reduction," Susan Mayer, RTI International, also discussed desirability, feasibility and viability aspects of these and other products sampled, including Lakanto Sugar Free Syrup and Chocolate, Smarty Grow Omega-3Bars and Bitsy's Brainfood Smart Cookies. Her presentation is at https://goo.gl/gctJMB.

• **Säpp Birch Water:** It's been suggested birch water could be the next "super drink." Säpp is one of several brands on the market. Its website notes that it is "sustainably harvested once a year in the Springtime in pristine birch forests of North America and Europe." Sweetness is provided by xylitol, which is derived from xylan hemicellulose in the bark. Products are touted for their low glycemic index and magnesium content, among other nutritional benefits.

• **Wella Bar line of Chilled Organic Protein Bars:** Originally found at 2017 NPEW, the Peanut Cacao variety claimed "wild flower honey" on the front of the pack. Identifying the flower source is popular with some high-end honey products. By late summer 2017, that differentiating characteristic was declared only on its website. Its label notes, "A portion of sales of Wella Bars goes to fund research to enhance the health and vitality of honey bees." The bars require refrigeration, which may explain that, while they were disparaged on Amazon.com due to their hardness (and supposedly not shipped refrigerated), refrigerated samples purchased from Costco had a soft, pleasant texture.

• **Crave Crush:** An August 7, 2017, press release explains that Crave Crush (a dietary supplement composed of gymnema, zinc, sorbitol and mint) is a lozenge that helps limit cravings for foods with sugar within seconds. Gymnema influences the tongue's sweet-taste receptors, thereby preventing activation of those receptors by sugar molecules and thwarting those receptors from signaling the brain. Although the product noted that it would suppress the sense of sweet taste for up to an hour, most conference attendees were able to taste significant sweetness again in 30 minutes or less.

For an overview of all nine products, including their nutritional profile and ingredients used, see the gallery at https://goo.gl/FjfwF6.

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be leased, or can the product be co-packed elsewhere? Food safety and stability are also critical and must be addressed.

At the Viability stage, the question becomes: Should we make this? Can ingredients, packaging and the process be adjusted so the product's viable cost meets the price point? In addition, can the product get from production to distribution to the consumer at the desired shelflife?

For example, in assessing the DFV Framework of a product such as Wella Chilled Organic Protein Bars (see sidebar "Eight Sweeteners, One Anti-Sweetener"), there are challenges in all aspects, including the target market, product texture and market competition. Is the product meeting consumer needs? Can the product be placed where they want or expect to find it? The refrigerated protein bars claim of "wild flower honey" listed on the front of the package may appeal to consumers who prefer high-end honey products.

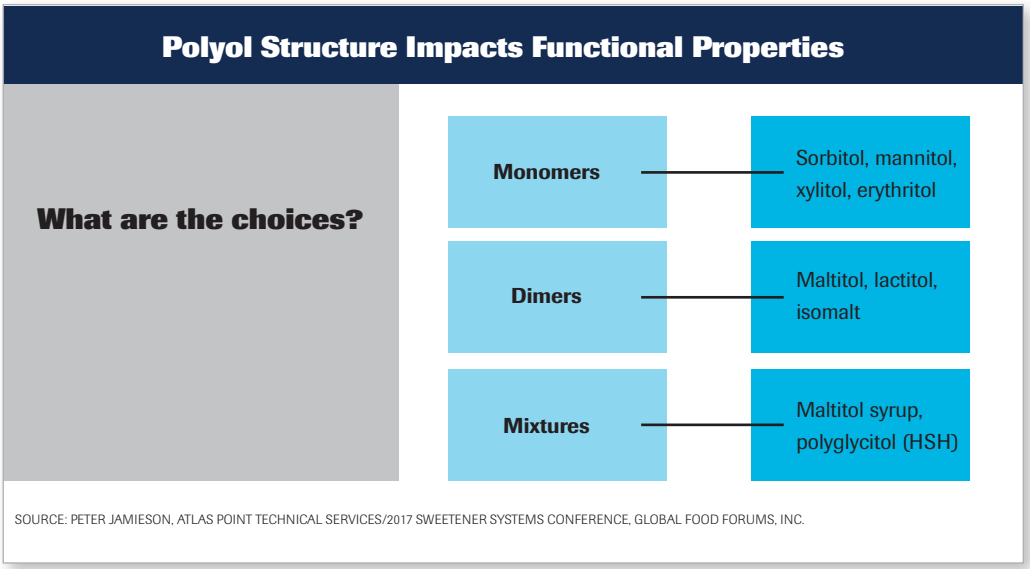
Applying Framework balance is key. Take smart, early steps; "fail fast," then adjust, suggests Mayer. Leverage partners to fill skill or resource gaps. The DFV Framework allows the product developer to look at things more objectively. Are the pieces balanced or is more emphasis placed in one direction more than another? Ultimately, consumers will decide what is desirable, but the product has to be feasible and the business must be viable to achieve success.

"An Innovative Approach to Sugar Reduction," Susan Mayer, MS, CFS, Innovation Advisor with RTI International, Research Triangle, NC, susanmayer@rti.org

Polyols Properties, Trends and How to Label

"Sugars can be classified as monosaccharides, disaccharides or mixtures, such as corn syrup. The key to using polyols for sugar reduction is to select a polyol with similar structure and functional properties as the sugar that you are replacing," said Peter Jamieson, MSc, Principal and Food Scientist, Atlas Point Technical Services, in his presentation "On Trend Ingredients: Polyols Properties, Labeling & Emerging Ares of Interest."

Sucrose is the gold standard, because it is the sweetener to which other sugars are most often compared. Sucrose has unique properties, including its sweetness profile, solubility, melting point characteristics and crystallization characteristics. "Trying to replace sucrose is challenging, but polyols or sugar alcohols work well," said Jamieson.



Whether a polyol is a monomer, dimer or a mixture of molecules with differing numbers of carbohydrate units influences their physiochemical properties. The dimers maltitol, lactitol and isomalt have certain properties similar to the dimers sucrose and maltose.

Polyols are metabolized differently than traditional sugars and carbohydrates. They have a lower glycemic response, lower calories and are also non-cariogenic. Polyols also provide excellent bulk, whereas high-potency sweeteners do not, so polyols can typically be used as a one-for-one replacement for other sweeteners in traditional foods.

Glucose has a reactive aldehyde group. The polyol sorbitol is similar in structure, but the aldehyde has been replaced by a hydroxyl group. This change makes sorbitol no longer recognized as a sugar for nutrition labeling. Replacing traditional sweeteners with polyols can enable products to make nutritional claims, including "no sugar added," "reduced sugar" or "sugar free."

Monomers with a single carbohydrate unit (e.g., glucose and fructose) include sorbitol, mannitol, xylitol and erythritol. Dimers with two carbohydrate units (e.g., sucrose and maltose) include maltitol, lactitol and isomalt. Mixtures include maltitol syrup and polyglycitol syrups. Polyols with more than 50% maltitol are called "maltitol syrup" and function similar to low-DE corn syrups. Those with less than 50% maltitol are called "polyglycitol syrups" and function more like high-DE corn syrups.

Polyols are caloric sweeteners. For example, maltitol has 2.1 calories per gram. They are "carbohydrates," but they are not rec-

ognized as "sugars" or "added sugars" on the nutrition panel. You must call them out in the nutritional panel as "sugar alcohols" when making a sugar claim.

Jamieson explained some of the physical characteristics of polyols. Polyols are non-reactive and very stable at high temperatures. Polyols do not react with colors, flavors or actives. They do not participate in Maillard browning, which can be either a positive or negative attribute, depending on the application.

Generally, polyols have a negative heat of solution, so energy is being absorbed, resulting in a cooling sensation. Erythritol has a heat of solution of -42, compared to sucrose with a -4. When replacing sugar in chocolates, too much erythritol can make milk chocolate taste like mint chocolate.

Solubility in water is a key attribute that affects performance in baked goods, confectionery, beverages and variegates. Polyols have a wide range of solubility. Sorbitol is very soluble and is often used as a humectant. In contrast, mannitol is not very soluble.

Molecular weight of polyols affects viscosity in confection; freeze point depression in ice creams; and starch gelatinization point in baked goods. When replacing sucrose with a molecular weight of 342, good choices would be maltitol or isomalt, which both have a similar molecular weight.

Relative sweetness is important, especially as companies are tending to minimize use of high-potency sweeteners. Note that xylitol has the same sweetness as sucrose, while lactitol is only 40% as sweet.

Polyols are part of the family of low-digestible carbohydrates (LDC) that also includes polysaccharides, resistant starches and rare sugars. Rare or low digestible sugars include allulose, tagatose and isomaltulose. All LDCs have some degree of impact on the digestive tract. Some have an effect on osmotic laxation, while others impact fermentation by microflora in the GI. Individuals have different responses to LDCs and can adapt to increased levels of LDC in the diet.

A current trend is to focus on sugar reduction, rather than total sugar replacement. The goal should be to deliver a good eating experience.

"On Trend Ingredients: Polyols Properties, Labeling & Emerging Areas of Interest," Peter Jamieson, MSc, Principal and Food Scientist, Atlas Point Technical Services, pete.jamieson@atlas-point.com

Natural Sweetener Characteristics and Uses

Sweeteners have a variety of functional properties, including taste, texture and crystal control, among others. Yet, with diabetes on the rise and an increased focus on nutrition and well-being, consumers are demanding more healthful products, including those with reduced sugar, low-glycemic indices, and low-carb and all-natural ingredients. Thus, product developers must not only understand taste, texture and functionality, but the nutritive value of the products they create.

The increased focus on nutrition puts the emphasis squarely on glycemic index, which has a lot to do with not raising blood sugar, said Mary Mulry, Ph.D., Managing Director, FoodWise One, LLC in her presentation "Functional Properties and Applications of Natural Sweeteners."

Brown Rice Syrup: Types and Dextrose Equivalents (DE)

Characteristics	Low conversion	High maltose	Med conversion	Med conversion	High conversion
Glucose	5	4	19	29	41
Maltose	11	34	13	25	17
Total	16	38	32	54	58
Other sugars	60	38	44	22	17
DE	26	42	43	60	70
Viscosity (cp)	150	125	125	100	100

SOURCE: MARY MULRY, FOODWISE ONE LLC / 2018 SWEETENER SYSTEMS CONFERENCE, GLOBAL FOOD FORUMS, INC.

Brown rice syrup, a sweetener converted from starch, is available in varying levels of sweetness and viscosity. Those containing higher levels of simple sugars vs. oligosaccharides have a higher DE and are sweeter. However, the higher the DE, the thinner the viscosity.

Fructose doesn't raise blood sugar like glucose (dextrose), but there are concerns about its use. HFCS is a very functional and inexpensive sweetener, but overconsumption can lead to obesity and other health issues, as well. And, in today's market, there's more focus on organic and non-GMO. Corn is a highly modified crop and has a poor reputation in the natural foods market. These demands are slowly moving into the conventional market.

Blending sweeteners is important, whether nutritive or non-nutritive are used. Satiety and satiation are important in choosing ingredients. Sweeteners neither bring satiety nor satiation, unless they are blended with other macro-nutrients, such as fiber or protein. Alternative natural sweeteners have become increasingly important. Consumers desire natural-sounding ingredients and those that are non-GMO and organic. Additionally, their diet, such as paleo, may dictate the sweeteners used. Another consideration is that food formulators might want to make a health declaration on the ingredient statement.

These natural alternative sweeteners include honey, which is versatile and has a distinctive flavor and high humectancy, but can be costly and is non-vegan. Another natural alternative is maple syrup, which is vegan; has a range of flavor profiles; meets the paleo diet restrictions (as does honey)—but is more costly than other alternatives. Agave has a clean taste and a low glycemic index, because it is high in fructose. It is available raw (i.e., not heated above 118°F). However, agave's high fructose level can also be a negative with some consumers. Brown rice syrups are available in multiple Dextrose Equivalents (DE) that have different sweetener profiles with different functionalities. And, lastly, molasses is used frequently in pet foods.

Other syrups include: tapioca syrup, which has a clean flavor and can be used by itself or blended with other sweeteners; and yacon syrup, a relatively new sweetener, which is less sweet because it contains 50% fructo-oligosaccharides (FOS) and 35% fructose. A prebiotic claim can be made when used, but presently reliability of supply is questionable.

Inulin syrups are less sweet and have a lower DE, but contain more FOS and galacto-oligosaccharides (GOS) that can reduce sweetness and have a binding property that makes them suitable for bars, for example. Other syrups include date, sweet potato, balsamic, sorghum and pomegranate.

Sweeteners are designed to make foods more palatable and have other functional characteristics, but they shouldn't be a large part of the daily nutritional profile. Sweeteners are an additive, not a food, and should be used in moderation. As a product developer, it's important to know what the consumer wants. Consumers rely on the internet for information and believe what they read. These factors should be considered when choosing a sweetener system, but overall, moderation is key.

"Functional Properties and Applications of Natural Sweeteners," Mary C. Mulry, Ph.D., CFS, Managing Director, Foodwise One LLC, Longmont, CO, Foodwiseone@gmail.com

Reducing Sugar in Baked Goods: Practical Considerations & Possible Solutions

"I am just a simple baker," began David Busken, Principal and Consultant with Bakery Development Ltd. Well, that's understating it a bit: He's a master commercial baker and the descendent of a long line of professional bakers.

Busken presented a list of sweeteners typically utilized in bakery goods development. Whereas American bakers traditionally worked with sucrose, honey, glucose (dextrose) or a range of hydrolyzed corn syrups, the field of sweetener ingredients has expanded considerably as consumer preferences have changed and enzyme technology has advanced.

Reduced-Sugar Cookie Formulation

Ingredient	Original	Reduced-Sugar
Sugar	20%	12%
Flour	30%	34%
Fat	10%	13%
Water	10%	11%

SOURCE: DAVID F. BUSKEN, PRINCIPAL, BAKERY DEVELOPMENT LTD.; 2017 SWEETENER SYSTEMS CONFERENCE

Taking sugar out of a formulation requires replacing it with other ingredients. A good place to start is by rebalancing the fat, flour and water in the formula. Sweetness can be adjusted using heat-stable, high-potency sweeteners.

Highest in sugar content on Busken's list were the simple sugars and disaccharides, dried fructose and sucrose, each with 100% sugar content. Lower on the list were: molasses (67%); 42 Dextrose Equivalent (DE) corn syrup solids (27.5%), which consist primarily of dextrins and maltodextrins; and inulin (9.5%), a fructo-oligosaccharide. DE, a measure of reducing-sugar content, designates the degree of enzymatic hydrolysis to which a starch material has been subjected.

Fructo-oligosaccharides, which are relatively new as food ingredients, may contain moderate or high levels of fructose sugar, depending upon their degree of hydrolysis. Suppliers of inulin (a fructo-oligosaccharide) typically offer a range of hydrolysates, varying in sweetness and sugar content. Polyols, or sugar alcohols, contribute sweetness, low-caloric contents and texture control, without having to be labeled as sugars. Newer entrants to the baker's portfolio include low-calorie sugars, such as allulose. Allulose poses a conundrum, however: Though negligible in calories, it must still be labeled as a sugar.

Clean label considerations can also be a factor. For example, while a corn hydrolysate, such as 42 DE corn syrup, might be frowned upon by the clean label community, a 42 DE tapioca hydrolysate might be quite acceptable, despite virtually identical sugar contents.

"So, how does one reduce sugar in a cookie (or biscuit)…from 28 to 22%, for example?" asked Busken.

To make a soft cookie, one can use non-crystallizing reducing sugars, polyols and inulins. "To make a crisp cookie, I suggest a 42 DE corn syrup…once we bake out the moisture, it then becomes very hard." He noted that this ingredient is used to make cookie inclusions for frozen ice creams or yogurt: Increasing 42 DE corn syrup levels to 8% allows them to remain crisp in frozen storage.

To take sugar out of a cookie requires that it be replaced with other ingredients. "For a high-quality cookie, you want to add more fat than flour, because it keeps it richer… 'rich' implying higher levels of fat, sugar or egg." The richer the product formulation, the longer its shelflife! A heat-stable, high-intensity potency sweetener can be used to compensate for the reduction in sweetness, said Busken.

If "richness" is not a goal, Busken recommends replacing the sugar with flour and adding slightly more water to compensate for the added flour. This also increases protein content which, in turn, hardens a cookie's texture. "To improve a cookie's texture, or 'bite,' you will want to create a more open grain structure to compensate for hardness contributed by the added flour," said Busken. Add more egg and more leavening. Or, find a pastry flour with lower protein content, but higher quality protein.

Cookie hardness is also managed by controlling water absorption and length of bake. This is especially important for soft cookies. Choice of sweeteners helps to control texture. Replacing sugar with a blend of HFCS and regular (42 DE) corn syrup works and contributes to a chewy texture. "An 80:20 blend of corn syrup and HFCS will also reduce or slow down fructose crystallization." Low-calorie polyols and some inulins can also impair sugar crystallization and soften cookie textures.

For softer, rather than crisp cookies, whole grains work well as sugar replacers—while enhancing the Nutrition Facts panel appeal. They absorb water and break up the dough structure, while also contributing valuable nutrients. Busken recommended using whole oat flakes, rye flakes, buckwheat groats ("they add nice flavor and a whole-grain texture that people expect"), pulse flours (e.g., lentil flour) and flax meal, which contributes a nice flavor along with healthy omega-3 oils. However, "if using pulse flours, make sure that they have been heat-treated, in order to avoid beany aromas and flavors."

"Reducing Sugar in Baked Goods: Practical Considerations & Possible Solutions," David F. Busken, Principal, Bakery Development Ltd., info@bakerydevelopment.com

2017 Sweetener Systems Summary Sponsor Profiles

ADM is a leading food ingredient provider offering ingredients and flavors that are formulated to meet consumer demand across virtually every market segment, including the Baked Goods & Cereals Markets, Confectionary, Dairy, Beverage, Meats & Meals, Health & Nutrition and Snacks. ADM's team of technical specialists, product developers and food marketers collaborate to innovate and formulate food and beverage solutions for customers based on their unique objectives.

BENEO's added-value ingredients are derived from non-GMO and natural sources, and include prebiotic chicory root fibers, the functional carbohydrates Isomalt and Palatinose™, and rice starch—which can all support sugar reduction. The company is the ideal partner to improve a product's nutritional and technological characteristics. In addition to sugar reduction, benefits include fiber enrichment, improved digestive health, sustained energy, and blood sugar and weight management, to name a few. Key technological benefits include taste and texture improvements. Through a unique chain of expertise, BENEO supports industry partners throughout the entire product development process.

Malt Products Corporation is a domestic manufacturer of a wide array of natural sweeteners, ranging from malt extracts (including oat, rye and others), high-quality molasses, tapioca and brown rice syrups and powders, to liquid and dry cane sugar and invert syrups. We recently invested over $35M in state-of-the-art technology at our Dayton, Ohio, facility to serve the growing needs for non-GMO, organic and clean label sugars. Malt Products is committed to demonstrating the nutritional value of these products and helping our customers find new uses across the food, beverage and related market segments.

PanaSource Ingredients is a professional distributor of high-quality ingredients headquartered in Edison, N.J. We specialize in the following categories: high-intensity sweeteners, natural sweeteners, herbal extracts, and additional ingredients for the food, beverage and nutraceutical industry. We have built strong partnerships with strategic manufacturers that enable us to provide high-quality products with continuous supply. At PanaSource Ingredients, our vision is to create a long-term relationship based on trust, integrity, customer satisfaction and loyalty.

Suzanne's Specialties is a manufacturer and supplier of natural and organic sweeteners to health food processors. Our product portfolio includes: organic brown rice syrup, organic rice maltodextrins & syrup solids, organic tapioca syrup & starch, organic honey, organic agave syrup, organic agave inulin, organic sugar, organic invert syrups, organic molasses and organic barley malt syrup. We are uniquely positioned to prepare proprietary blends of natural sweeteners to meet specified customer requirements. We can help you to go from refined sweeteners to completely natural. "Sweeteners the Way Mother Nature Intended" is our motto at Suzanne's.

Tradin Organic offers the finest quality organic sweeteners to fit your ideal application and labeling needs. Every ingredient is certified organic, which means it's always non-GMO. They are produced from traditional and alternative raw materials, with direct grower and processor involvement. Tradin supplies a full suite of organic ingredients. Offering an array of sweeteners, from organic coconut sugar and syrup, organic date paste and organic sweet potato syrup to organic cane sugar and our own organic non-GMO project verified honey, Tradin has a sweet solution for your mix.

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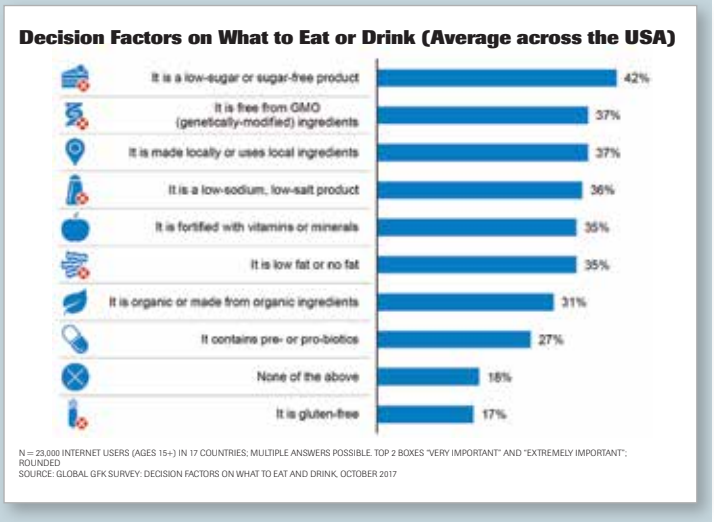
Sweet News Bites

We're looking for unique, non-commercial news related to sweeteners, especially as relates to formulation activity. Please send suggestions to editor@globalfoodforums.com. Scan code at left or go to https://goo.gl/DR8eYw to see more information on the following items:

Global Study Shows Reduced Sugar Top Driver of Food Choices

An October 2017 global survey by Gfk of 23,000 respondents from 17 countries found that consumers' top two deciding criteria in choosing a food or beverage is whether the product is low-sugar/sugar-free or non-GMO. The survey asked, "When deciding which food or beverage product to eat or drink, how important are the following in making your decision?" It then provided 10 options from which respondents could choose multiple answers.



Globally, "It is a low-sugar or sugar-free product" was the top decision-making factor for those 30 to 60+ years old. On average, some 48% said this product characteristic is "extremely" or "very" important to them. This percent was the same for men and women. Also, 48% indicated the same importance for products being free from genetically modified (GMO) ingredients.

However, within the U.S., 42% of respondents identified "low-sugar/sugar-free" as being important. Second place fell to "It is free from GMO ingredients," with 37% saying it was important. (See chart "Decision Factors on What to Eat or Drink.")

Responses from Canada and Mexico followed a similar pattern. Being low-sugar or sugar-free was rated as the most important factor among Canadians (43% of respondents) and Mexicans (52%), with non-GMO falling into second place.

Data was also divided by income. Globally, those of medium, medium-high and high income selected low-sugar/sugar-free as the number one decision-making option, while those living on low income chose non-GMO.

Maltodextrins: To be Sugar Added or Not to Be

In the preamble to the Nutrition Facts label final rule (81 FR 33742 at 33835), whether starch derivatives, such as maltodextrin, would amount to empty calories, could determine whether maltodextrin would be included as added sugar on the label. Starch is partially hydrolyzed to create maltodextrins that consist of glucose chains of varying lengths (dextrose equivalence or DE). The higher the DE, the lower the degree of polymerization, the higher the sweetness level. Maltodextrins have a DE less than 20; varying levels of DEs with different percentages of mono- and di-saccharides; a low level of sweetness; and are more often used as fillers or flavor carriers.

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2017 R&D Report: Protein Ingredients

New market research conducted by NSM Research, Inc. surveys R&D and food application formulators on their attitudes, formulation issues and future trends, as related to their use of protein ingredients. This 87-page *Global Food Forums® R&D Report: Protein Ingredients* is now available. For more information go to: http://goo.gl/WEJ4KQ or contact Peter Havens at Peter@GlobalFoodForums.com or +1.630.621.0230.

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