Reducing Sugar in Sweet, FROZEN TREATS

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Absolute Zero: Understanding Sugar Reduction in Frozen Desserts

Formulating zero- or low-sugar frozen desserts is a difficult task for scientists who must address consumer desire for good taste and other product attributes, including nondairy and clean label. Kimberly Decker, contributing editor, discusses the challenge of reducing sugar in frozen dessert, and reviews sweetener considerations to achieve success.

Takeaways for Your Business
Achieving Sweet Success

Nearly two-thirds of Americans limit or avoid added sugars, and one-quarter point to sugar as the most likely calorie source responsible for weight gain, according to the newest data from the International Food Information Council (IFIC). This heightened attention to sugar intake—coupled with consumer demand for ingredients that are natural, sustainable and healthful—is forcing food and beverage companies to rethink their ingredient selection and marketing messages, especially in key categories considered indulgent or inherently caloric.

Ice cream and frozen desserts have a reputation for being sugar-heavy, nutrition-void calorie bombs, but today’s consumers are looking for healthier products without the guilt. While consumers have health and wellness top of mind, they aren’t willing to sacrifice taste for calorie reduction—especially when it comes to frozen treats.

In fact, the ice cream and frozen dessert category is strong and shows huge market opportunity. According to product launch data from Innova Market Insights, introductions in the ice cream space grew at a compound annual growth rate (CAGR) of 2.4 percent between 2013 and 2017, totaling approximately 750 launches. But launches with a sugar claim, such as sugar free, low sugar, no added sugar, etc., had a CAGR of 10.9 percent for the same period. Ice creams with a sugar claim now account for about 8.5 percent of launches, up from 6 percent in 2013.

The good news: When it comes to frozen treats, low sugar is in high demand. Brands are rolling out better-for-you frozen desserts featuring organic dairy (and nondairy) ingredients, healthier fats and less sugar. However, modifying the sweetener system to reduce calories is no easy task. Besides considering the flavor impact, the developer must consider water management and the freezing profile.

Also at issue is the “Added Sugars” declaration that will be required on the new Nutrition Facts panel set to go into effect Jan. 1, 2020. While the new panel will likely encourage further innovation in reduced-sugar product development, Pam Stauffer, global marketing programs manager at Cargill, noted taste will continue to be the ever-present arbiter of success, and brands must balance providing indulgence and great taste while also delivering products with a solid nutritional profile.

Cheers,

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Reduced sugar, absolute delight.

Help consumers get their just desserts.

At long last, it’s possible to savor the rich, creamy indulgence of frozen desserts and ice cream – without the sugar overload. With 3 in 4 Americans limiting or avoiding sugar,¹ that’s a critical consideration for formulators.

Reduced-sugar treats that rival sugary versions
Cargill food scientists have the resources and expertise to deliver on consumer expectations for indulgent reduced-sugar frozen desserts and ice cream.

- Sweeteners, including erythritol, stevia and more
- Texturizers to ensure a satisfying consistency and mouthfeel

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¹ International Food Information Council Foundation (IFIC), 2017 Food and Health Survey.
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INSIDER's Take

- Zero- or low-sugar frozen desserts are in high demand, with ice creams in this category accounting for about 8.5 percent of launches, up from 6 percent in 2013.
- Formulating frozen treats is a difficult task for scientists who must address consumer desire for good taste and other product attributes, such as nondairy and clean label.
- Considerations for product formulations include freezing-point depression (so ice cream is still scoopable), bulking, sweetness and, above all, taste.

Ask Thom King where he thinks the frozen dessert category is headed, and he’ll hand you a roadmap. Said the president and CEO of Icon Foods gnomically, “Follow the breadcrumbs to Halo Top.”

Halo Top ice cream—that inescapable frozen dairy phenomenon—“went from a startup to a billion-dollar company in four short years by offering a low-sugar, high-protein option,” King observed. And he’s hardly alone in noticing. “Nearly every one of our dairy customers is focused on chasing Halo Top with their own version of low-sugar frozen desserts,” he said, with the general goal being a calorie count below 300, and combined sugar and carb level below 5 g per pint. “It’s just a massive category that’s blowing up.”

And yet, it’s just one brand of ice cream. Frozen yogurt, pops and bars, the burgeoning crop of plant-based frozen desserts: All are being swept up in a wave of reformulations as health-minded consumers aim to ax sugar across their food and beverage choices.

That said, frozen desserts rise or fall on their indulgence quotient—and sugar makes no small contribution to it, both by way of its sweet taste and its behind-the-scenes functionality in frozen systems. So, sugar reduction poses the challenge of maintaining that anticipated indulgence, but without all that indulgent sugar.

Fortunately for formulators and consumers, ingredient suppliers have parleyed an understanding of sugar’s role in frozen media into ingredients that can function much like it—and let people feel good about coming back for more.
All Hail Halo Top

Dewey Warner, research analyst, Euromonitor International, also has marveled at Halo Top’s success. “This is a brand that we estimated grew by almost 2,500 percent in 2016, and over 100 percent in 2017,” he said. “Those are insane numbers. Granted, it’s coming from a very small base. But that’s the reason for all the buzz around it.”

Within the trajectory of Halo Top’s rise, Warner saw “two juxtaposing forces” he said reflects the mindset of today’s frozen dessert consumer and the near-existential crisis that such a mindset could present for the frozen-dessert category—if manufacturers don’t play their cards right.

“On one hand,” Warner said, “health and wellness trends are definitely exerting some influence on the industry. The biggest that everybody’s talking about is what’s driving growth for Halo Top-style innovation.” Setting aside the Los Angeles-based brand itself, legacy players such as Breyer’s and Ben & Jerry’s are introducing lower-sugar alternatives of their own. “Health and wellness,” Warner said, “is obviously creating a lot of demand and growth for these low-cal, low-sugar desserts.”

Low Sugar, High Demand

Looking ahead, Warner mused, “Now that more players are getting involved in this low-sugar, low-calorie, higher-protein space, it remains to be seen how well Breyer’s or Ben & Jerry’s or any other possible future entrants perform. 2018 is going to be a big year for determining that. It’ll be interesting to see if even Halo Top can keep up the growth.”

That said, the market for ice cream and other frozen desserts is in no danger of melting away. Product launch data from Innova Market Insights covering 2013 to 2017 showed introductions in the ice cream space alone grew at a CAGR of 2.4 percent, totaling about 750 launches.
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The upshot: When it comes to frozen treats, low sugar is in high demand. Carol May, CEO, Wisdom Natural Brands, said, “The majority of American adults—68 to 70 percent—want to reduce the sugars in their diets. We’re not talking about the intrinsic sugars found in milk, or fruits and vegetables, but those sugars like cane or beet sugar, molasses, high fructose corn syrup (HFCS), agave, honey and the like that are added to foods and beverages to improve taste.”

The reasons: Sugar’s excess calories hamper efforts at weight management, for one; and, May noted, “a growing number are concerned about the increasing evidence that added sugars have a negative effect on the cardiovascular and other bodily systems.”

**Sweet Still Scores**

Whatever the reasons, product developers are paying attention. As Ravi Nana, polyols technical service manager, Cargill, affirmed, “From a product development standpoint, the request we’ve been fielding the most is for help with reduced-sugar formulations in frozen dairy desserts.”

But, noted Christine Addington, senior dairy technical service specialist at Cargill, while most of the sugar-reduction calls their team addresses pertain to hard-packed ice cream, “visit any grocery store, and you can see the explosion in the nondairy vegan or vegetarian products. Especially in the nondairy frozen dessert space, many of our customers are aiming for a ‘healthy halo,’ and as part of that, they want to keep sugar levels in check.”

And everyone operating in this space is quick to note: Despite consumers’ concerns about sugar, a sweet taste still scores. “There’s generally no loss of interest in sweet-tasting foods and beverages,” May said. “Quality of life is often seen to be enhanced by such enjoyment.”

Pam Stauffer, global marketing programs manager, Cargill, agreed. “The addition of ‘Added Sugars’ to Nutrition Facts panels will likely encourage further innovation in reduced-sugar product development,” she surmised. “But some rules remain unchanged. Especially in indulgent categories like frozen desserts, taste will continue to be the ever-present arbiter of success. Brands will have to balance providing indulgence and great taste while also delivering products with a solid nutritional profile.”

That’s tough to do, especially if it’s sugar on the frozen dessert hit list.
Sugar Reduction in Frozen Desserts

Sugar the Standard

“Traditionally, sucrose has been the No. 1 sugar used in these desserts. Corn syrups, corn syrup solids and HFCS are also used in frozen treats, but to a lesser extent,” Nana noted.

Sugar didn’t attain this top spot by accident, either. As Brian Surratt, senior scientist at Cargill, explained, “Sugar is considered the gold standard of sweetness for a reason. Our expectations and sweetness perceptions are built around what sugar tastes like. When we start taking sugar out of a formulation and replacing it with other sweeteners, it changes how we interpret the sweetness.”

Further cementing its value is sugar’s role in enhancing flavor in reduced-fat, frozen desserts—which, “takes us back to the original challenge of reducing added sugars in formulations without compromising taste,” noted Tammy Reinhart, business development senior manager, specialty food ingredients, food systems Americas, Tate & Lyle.

“Developers need to consider more than just taste when reducing and replacing sugar in frozen desserts. “Our overall eating experience is very much predicated on the functions that sugar performs in these complex systems,” Surratt said. “In frozen desserts, sugar impacts texture, ice crystal formation, how the dessert melts on the tongue, elasticity, freezing-point depression and more. It can be difficult to find alternatives that mimic sugar’s role in this space.”

Tough Ice to Crack

Which frozen dessert is the hardest to reformulate? “They’re all hard!” Surratt exclaimed. “Frozen desserts are some of the most complex food systems we’ve created. They contain all three phases—solid, liquid and gas—and that makes it extremely challenging to manipulate critical ingredients like fats and sugars. To be successful, you need a deep understanding of how each component interacts with the water, fat and air inherent in the system.”

The profusion of frozen nondairy alternatives gives formulators yet another puzzle to solve. “Twenty or 30 years ago, if you’d inventoried the frozen dessert section, you might find one nondairy option,” Surratt recalled. “Today, there’s an entire freezer section
dedicated to dairy alternatives.” And fortifying these products with levels of plant protein above what occurs naturally in the plant-milk base—as many brands do—further alters finished-product texture, hardness and melting properties.

But nondairy treats are here to stay. According to data from SPINS, vegan and plant-based frozen dessert sales continue to rise, up 31.7 and 11.5 percent, respectively. So, Surratt said, “It’s clear there’s more diversity in the frozen dessert aisle than ever before. But fortunately, many of these nondairy desserts are aimed at a different audience with different expectations for the sensory aspects of the products.”

Frozen Dessert Fundamentals

While expectations differ in their finer points—and fans of vegan, nondairy ice creams may tolerate textures and tastes that would make premium ice cream connoisseurs blanch—a few fundamentals of the frozen dessert eating experience are universally prized. And again, sugar has traditionally been critical to achieving them.

Take its effect on freezing-point depression. When the concentration of a solute (like sugar) rises in a solution (such as an ice cream mix), the temperature at which that solution freezes drops. “This is why we’re still able to scoop ice cream when it’s ‘frozen,’” explained Andy Estal, director of customer technical service, BENEO Inc. “Because it’s not frozen solid. The freezing point has been depressed, or lowered, by the dissolved solids.”

With sugar the primary dissolved solid in ice cream, Estal continued, “as soon as you remove sugar, you upset the delicate balance of dissolved solids, which affects freezing-point depression.” When that depressed freezing point starts to rise, “all sugar’s functionality aspects, such as the scooptability and freeze-thaw protection from ice crystal growth that affect texture and are linked to freezing-point depression, change. So, to make reduced-sugar ice cream, you need to replace the sugar with an ingredient or system of ingredients, that’ll replicate the dissolved solids’ level to preserve the same freezing-point depression.”
As Estal mentioned, closely related to freezing point is the absence of ice crystals in an ice cream mix. Sugar loves water and can effectively tie up free water in the mix, thereby preventing it from forming large ice crystals that interfere with the “smooth, silky texture expected in desserts like premium ice cream,” Nana said. “Things like the molecular weight and structure of the solute molecule all affect ice-crystal formation.”

Sugar also influences a frozen dessert’s meltdown properties—or how long it can wait on the counter before it starts to liquefy. Meltdown times are particularly important in applications like popsicles and soft-serve ice cream, Surratt noted. “And as we adjust the level of sugar in a formula, depending on the replacement, we may increase or decrease the hardness, and create shorter or longer meltdown times.”

Then there’s sugar’s bulk-solids contribution. A frozen dairy formulation—an ice cream mix, for example—occupies a certain volume, and its sugar content is responsible for a certain volume within that volume. Remove a set quotient of sugar, and it needs to be replaced with an equal proportion of something else or the mix will be volumetrically off. That’s why high-potency sweeteners, which deliver sugar’s sweetness at vastly reduced-use levels, literally leave something lacking in a frozen dessert formula.

**Sweetener Synergies**

It’s also why high-potency sweeteners—and any other single ingredient, for that matter—cannot replace sugar in frozen desserts on their own. “Right now, there isn’t a ‘holy grail’ when it comes to sweeteners,” Reinhart said. “Sugar replacement is never really a 1:1 exchange.”

Fully understanding what sucrose brings to a formulation physically, chemically and in terms of sensory and consumer perception is the first step in what she calls “a holistic approach to reducing added sugars on labels”—an approach she believes “can help manufacturers deliver on consumer demands without sacrificing consumer acceptance.”

The key challenge lies in finding the right mix of solutions, she said. “Employing ‘sweetener synergies’ that include label-friendly, high-potency sweeteners, such as stevia and monk fruit, enables formulators to deliver healthier and tastier dairy products, with cleaner labels.”

And for today’s consumers, those clean labels are nonnegotiable, which is why they’re “clamoring for natural sugar alternatives with fewer calories,” said Faith Son, vice president, marketing and innovation, PureCircle. In fact, she said, Mintel’s recent “Sugar & Sweeteners Report” found six out of 10 consumers claim to want more natural sugar substitutes.

Among those substitutes, Son said, stevia’s been leading the way with 20 percent growth in new products. “According to our propriety research, seven in 10 consumers now state that they’re familiar with it,” she said.
The zero-calorie, naturally sourced sweetener ticks plenty of consumers’ feel-good labeling boxes, and current iterations approach sugar-like taste parity—which wasn’t something one could always say for stevia products that preceded them.

As Son explained, when stevia was first commercialized roughly a decade ago, Rebaudioside A (Reb A) was both the most abundant molecule in the conventional variety of stevia leaf and the main stevioside used in stevia sugar substitutes. “But what we discovered was that there were limitations with using Reb A alone,” she continued. “It’s still a fantastic ingredient and works well in reduced-sugar products, but to truly take the leap forward, we went back to the leaf and discovered that there are dozens of different molecules there. When used in varying combinations they can create a great, sugar-like taste in low- to zero-calorie products.” And largely, that’s what current stevia blends do.

Still, stevia is frequently matched with other nonsugar sweeteners, including the sugar alcohol erythritol, which Nana said, “is well-suited to replace sugar in frozen desserts, especially ice creams.” Because its molecular size is about one-third that of sugar, it depresses the freezing point by a factor of three, compared to sugar. “So, if all you want to do is match the freezing-point depression of sugar, you only need to use one-third the amount of erythritol in the formula,” he continued. “That higher effect on freezing-point depression helps soften reduced-sugar ice creams, creating the scoopable texture consumers crave.” And in the bulk solids department, erythritol replaces sugar at a 1:1 ratio.

“But to tackle the last challenge,” Nana said—re-creating sugar’s sweetness—“erythritol needs a little help.” With about 60 to 80 percent sugar’s sweetness, it counts on high-intensity sweeteners, like stevia, to round out a product profile. As an added benefit, Nana said, erythritol can mask some of stevia’s off-flavors. “Using combinations of erythritol and stevia, product developers can easily achieve a 25 to 30 percent sugar reduction. That’s enough to make a reduced-sugar label claim, yet still deliver an ice cream that consumers will rave about. Deeper reductions are possible; the key is landing the right sweetener blend.”

Another 1:1 functional sucrose replacement is the sugar alcohol isomalt. According to Estal, isomalt is about half as sweet as sugar, “so when making a partial replacement of sugar in ice cream—up to about 25 percent—no other sweetness correction is needed.” At higher replacement levels, he suggested combining it with chicory-root-derived...
oligofructose, plus high-intensity sweeteners such as sucralose, acesulfame potassium (ace K) and aspartame, creating a “synergy” that “reduces the artificial aftertaste of the high-intensity sweeteners to produce a balanced, rounded flavor that enables food producers to make a ‘no sugar added’ claim with confidence.”

Root of the Matter

BENEO produces a form of highly soluble inulin—also from chicory root fiber—with a controlled composition of short-chain inulin molecules. Estal said it exhibits the ease of use and sensorial properties of oligofructose, and is used in ice cream formulation. It can replace sugar at roughly 25 to 30 percent, weight by weight, based on the same principle as isomalt: “It becomes a dissolved solid, exactly replacing the functionality of the sugar and thus avoiding any changes in freezing-point depression,” he explained. “And in addition to its functional properties, you also gain all the advantages of inulin’s soluble prebiotic dietary fiber.”

Addington said Cargill’s branded chicory root fiber ingredients are showing up in reduced-sugar frozen desserts, too, “as product developers embrace their functional benefits and label-friendly nature.” Versatile and available in a variety of forms with differing degrees of solubility, polymerization, sweetness, fiber content, molecular weight and branching structures, some are excellent fat mimetics, she said, while others function more like a sugar—aiding in freezing-point depression, for example—and yet others help mask the off-notes of high-intensity sweeteners.

Bulking Up

“In reduced-sugar applications, chicory root fiber also serves as a bulking agent,” Addington added. And it’s got company. Maltodextrin performs the same function, she continued, while also “achieving the mouthfeel and creaminess consumers expect from a frozen dessert.”

Other go-to bulk replacers include polydextrose and even some sweeteners with a lower sugar content. Reinhart pointed to her company’s low-viscosity, low-sugar corn syrup with 15 percent mono- and disaccharides (on a dry-solids basis) as an ingredient that “can help provide sucrose’s functional properties beyond sweetness, such as bulking, freezing-point depression and texture.”

And don’t forget starch. Modified starches hold up to industrial conditions like low pH, storage conditions and long shelf life. But if they run afoul of consumers’ clean label requirements, “functional, clean label starches can also help maintain texture in reduced-sugar frozen desserts and meet consumers’ sensory expectations for taste and color in a wide range of applications,” Reinhart said.

Dan Grazaitis, applications manager, TIC Gums, said, “Since gums and gum blends are excellent texturizing ingredients, addition of one or more in place of sugar can replicate sugar’s mouthfeel while minimally affecting the product and consumer experience.”
Locust bean gum is no stranger to ice cream, as its branched structure traps and holds water to ward off heat shock—what happens when ice cream melts and refreezes, “causing water molecules to join together to form larger ice crystals resulting in an icy, grainy texture,” Addington said. Though often appearing with carrageenan—another high-molecular-weight carbohydrate similar in structure to locust bean gum—locust bean gum “is a very efficient texturant on its own,” she said, “not only helping to control free water in the system, but also contributing to mouthfeel.”

**Keeping it Realistic**

With such an abundance of tools in their kits, product developers should have no trouble cutting sugar levels in frozen desserts, right?

Mostly. “In reality, these projects are all complicated,” Surratt said. The more dramatic the reduction, the tougher the task. “When you start to reduce these critical ingredients by 50 to 100 percent, yet still expect the end product to have the taste, texture and eating experience of the original, that’s a pretty tall order.”

His recommendation is to “be realistic in what science can truly accomplish and set achievable expectations. If we aim for small reductions of 20 to 30 percent, we can hit them and still make a great-tasting, indulgent product that consumers will embrace.”

Yes, it’s a challenge. “But we thrive on these challenges,” Surratt boasted. “Success is often built on failure. We may go through 100 formulations before we land on the one that hits all of our product goals. The good news is that there are limitless combinations of ingredients, so if the first attempt fails, go back and try again.”

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Kimberly J. Decker is a Bay Area food writer. While her love of eating led her to study food science at California’s University of California Davis, her love of the written word prompted her to minor in English. Since then, she’s worked in product development for the frozen sector and written about food, nutrition and the culinary arts, getting her hands into everything from cookbook projects for local chefs, to corporate communications and regular appearances on the pages of industry journals. Reach her at kim@decker.net.
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