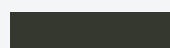


REFINED SUGAR IS THE PROBLEM

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# NATURAL SUGAR REDUCTION IS THE SOLUTION



ICON FOODS







Sugar is, in itself, natural. In fruits it's present as fructose and in dairy products as lactose. Honey contains 40% fructose and 30% glucose. Sucrose, a sugar naturally produced in plants, contains equal parts fructose and glucose. Yet even though natural ingredients are to be lauded, too much of a sweet thing is not a good thing. Especially when sugar is added to foods. Not only does the food become less nutrient dense, it compounds the effects that sugar has on the body.

The good news from a health perspective is that Americans are becoming more aware, thanks in part to the mandated change of the Nutrient Facts panel to call out added sugars.



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From a food manufacturing standpoint, there are also positive developments. Although sugar isn't an easy ingredient to reduce or replace because of its unique taste and functional attributes, natural high intensity sweeteners from Icon Foods are coming to the forefront to meet the demand to reduce added sugar and in some cases, completely eliminate it.



**ICON FOODS**



# | SWEET BEGINNINGS



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The bittersweet conundrum is that an affinity for sweetness comes naturally to people. Infants and young children typically select the most intensely sweet tastes. As an article published in *The Journal of Nutrition* points out, “human desire for sweet taste spans all ages, races, and cultures. The liking for sweet taste is both innate and universal.” <sup>1</sup>

ICON FOODS



The preference begins early in life as sugar is present in mother's milk. The expectation is set early on that sweet foods deliver energy. Breast milk naturally contains lactose, but secondhand sugars such as fructose are also passed to the infant.<sup>2</sup> Studies have shown that the composition of breast milk is shaped by the maternal diet, so the composition of the milk has the potential to contribute to childhood obesity and future metabolic disease risk.



**SWEET BEGINNINGS CONTINUED**





The link between sugar and energy is fundamental. Consider glucose, for example. While consumed in some foods, it's also the metabolic product derived from the breakdown of galactose and fructose (monosaccharides), lactose and sucrose (disaccharides) or starches (polysaccharides). Once glucose is present in the body, it enters the blood and travels to energy-requiring tissues. Every organ system from the adrenal gland to the thyroid plays a role in glucose regulation.

When glucose levels are too high numerous pathologies may develop. Hyperglycemia can cause obesity, type 1 and type 2 diabetes, and life-threatening complications that include damage to the eye, kidneys, nerves, heart, and the peripheral vascular system. <sup>3</sup>

While a preference for sugar has likely been with us since ancient times, our consumption has risen astronomically. Two centuries ago, the average American ate only two pounds of sugar a year. In 1970, we ate 123 pounds of sugar annually. Today the average American consumes about 150 pounds of sugar a year. Hence the rise of obesity and disease and the call to action to reduce sugar in the diet. But today's trends also shun anything artificial, so sugar's replacement must appeal to the consumer's eye toward clean label ingredients.

Zero calories without using artificial ingredients is highly achievable. Stevia is perhaps the best known of the plant-derived sweeteners. Early generations of the extract from the plant, *Stevia rebaudiana*, had a pronounced bitter off-note that was strongly reminiscent of licorice. Today's products are more refined as scientists have gained a greater understanding of optimum plant varieties and growing conditions. Most importantly, they have honed in on the precise components of the leaf that provide sweetness — glycosides. About 50 glycosides have been identified, but less than 10 are abundant in the leaf. The relative sweetness of each of these, as well as their sensory properties, varies.

One of these, Rebaudioside A, more commonly referred to as Reb A, is the sweetest of the steviol glycosides. As levels of Reb A increase in a stevia product, flavor improves.

Icon Foods offers an exceptionally clean flavored, highly purified product, SteviaSweet RA99, that contains a minimum of 99% Reb A. In some applications, the intensity of Reb A hits the perfect note. In others its overwhelming sweetness is cloying. To help find the right balance, one can choose from products with different levels of Reb A. The company has products ranging from 75%, 80%, 95% and 98%.

**ICON FOODS**

# Natural High Intensity Sweeteners





## NATURAL HIGH INTENSITY SWEETENERS, CONT.

To further temper the forceful sweetness, Icon Foods pairs Reb A with another glycoside, Rebaudioside M in SteviaSweet RA99M. The combination results in a synergistic effect in which the sweetness of Reb A is modulated. Off-notes are suppressed. Stevia products are 250 to 350 times as sweet as sugar, so their use in foods is generally measured in the tenths or hundredths of a percent. It's wise to begin at the low end and gradually increase levels until the desired sweetness is achieved.

Monk fruit is another important sweetener to have in the toolkit. Extracts from the fruit of the *Siraitia grosvenorii* plant (also called Luo han guo) contain a group of glycosides called mogrosides. Mogroside V is the sweetest and least bitter. Sweetness ranges from 125 to 250 times the sweetness of sugar. Just as stevia has a licorice-like edge to its sword, monk fruit has its own pointed note that's similar to melon rind. Icon Foods uses a proprietary double resin column filtration system that removes these potential off-notes. MonkSweet comes in conventional V-25, V-40, V-50 and organic V-25, the names reflecting the concentration.



Research is identifying antioxidant activities of mogrosides, particularly mogroside V.4 This mogroside is a triterpenoid isolated from a traditional Chinese medical plant. One study found mogroside V possesses inhibitory activity of tumor growth in vitro and in vivo models of pancreatic cancer. “These results therefore demonstrate that the natural, sweet-tasting compound mogroside V can inhibit proliferation and survival of pancreatic cancer cells via targeting multiple biological targets,” the study concluded. 5 Still another study suggests mogroside V inhibits hyperglycemia-induced lung cancer cells migration and invasion.6 As research continues, further benefits of reducing sugar with these sweeteners will likely be uncovered. While the sweetening potency of these natural ingredients limits their use to extremely small inclusions in the formula, there still are health benefits to replacing sugar with antioxidant rich, natural high intensity sweeteners. Scientists are also studying stevia as well with one group substantiating stevia’s role in antidiabetic properties.7



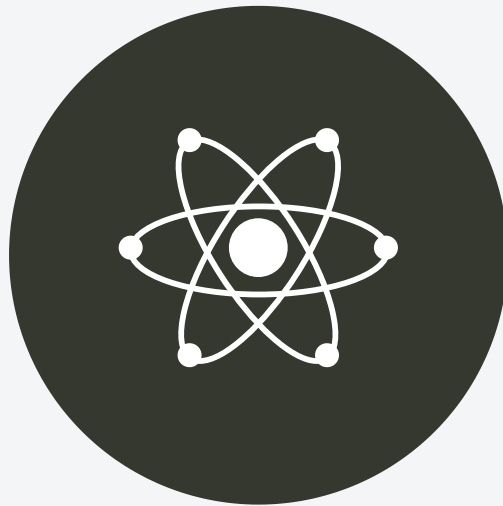
Mogroside V



Stevia



antidiabetic



inhibit tumor growth





# Sugar Alcohols

ICON FOODS

Also referred to as polyols, sugar alcohols have a structure similar to sugar molecules. The presence of a hydroxyl group for the aldehyde or ketone group is the differentiator. Unlike sugar, they are low-digestible carbohydrates.

Two polyols are particularly valuable assets in natural sugar reduction. Xylitol is 100% as sweet as sucrose. It has a pronounced cooling effect. Erythritol is 70% as sweet as sugar with a milder cooling sensation. Both are noncariogenic.

Xylitol is often used in confectionery products, primarily gum. Erythritol is used widely in a variety of foods. With just 0.2 calories per gram, it is ideal for use as a bulking agent, especially since it is compatible with other sweeteners.

When high intensity sweeteners are used to replace part or all of the sugar, a gap is left in the formula. From a practical standpoint something needs to be added to bring the formula back to 100%. Simply adding a high glycemic ingredient like maltodextrin misses the point when many of today's customers are striving to keep their blood sugar in check. Because erythritol is non-glycemic it works beautifully in sugar free and lower sugar application.

Sometimes it helps build mouthfeel. Beverages, for example, might be described as thin when sugar is removed. The addition of erythritol helps build the body that consumers expect.



Another important technique to improve mouthfeel is adding fiber such as Icon Foods' Prebiotica Inulin. This non-GMO prebiotic carbohydrate is derived from chicory root. It also supports the clean label ingredient deck while adding a healthy halo. As a prebiotic it helps improve digestion by feeding beneficial bacteria in the gut.

Within the intestinal system lies an ecosystem that's essential to good health. "Alterations of the gut microbiota composition have been associated with a wide variety of conditions such as obesity, type 2 diabetes, inflammatory bowel disease, autism, and behavioral disorders," the authors wrote in The American Journal of Clinical Nutrition. "In the diet, some nondigestible carbohydrates called prebiotics are fermented by the gut microbiota, thereby conferring potential health benefits. Dietary supplementation with purified inulin-type fructans has been shown to exert positive health effects in humans, namely an improvement in intestinal permeability, a decrease in fat mass, an increase in the production of incretin gut peptides acting on satiety and an improvement in appetite control."8

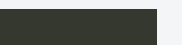
Given inulin's ability to provide satiety, it's a natural fit for foods that target weight conscious consumers as well as those seeking healthier foods.

On the development bench, inulin adds bulk while contributing just one calorie per gram. Although it has a tenth of the sweetness of sugar, it's place in sugar reduction is firmly established. Because it is synergistic with other sweeteners, it brings out their best attributes making them stronger than when used alone. Rather than relying on strength in numbers, i.e. higher percentages, less can be used to get the same effect. The result is not only a better product with a modulated flavor, but lighter ingredient costs.

Inulin can also reduce the use of gums and starches because when hydrated with water, it behaves like a hydrocolloid, forming a gel which is more viscous than cornstarch. Besides acting as a texture modifier, it can act as a fat replacer. And it's finding a place in everything from Hostess Cupcakes to Activia Nonfat Yogurt, Cloud and Joy Low Calorie Ice Cream and a host of other products.



# INULIN





# ALLULOSE



Although newer to the sweetening scene, allulose is game changer. As a nondigestible carbohydrate, it has just 0.2 calories per gram. With 70% the sweetness of sugar, it can add bulk while maintaining sensory and functional attributes. Its taste is similar to sugar with the same upfront sweetness. Not only does it deliver the same temporal profile of sugar without any off-flavors, it gives the same mouthfeel too.

Allulose is a sugar that occurs naturally in wheat, figs, raisins and jackfruit. It can be used as a sole source of sweetness or in combination with other sweeteners. Blending with high intensity sweeteners strengthens its advantage. In addition to rounding out the flavor of stevia or monk fruit, it creates a synergistic effect.

Among its attributes, it doesn't crystallize in high-solid food systems such as fruit preps used in blended yogurt, making it more stable during refrigeration. It excels in frozen desserts by providing freezing point depression. While allulose has widespread appeal in a variety of food products ranging from baked goods to confectionery, condiments, sauces, jams, jellies and more, it's gaining traction in products formulated for the ketogenic diet because not only does it replace sweetness, it has been "shown to lower blood sugar slightly and increase ketones slightly, making it a perfect ketogenic sweetener," said Thom King, president, Icon Foods.



# SWEETENING SYSTEMS



Synergy is also true when combining natural, high intensity sweeteners. Each has their own individual quirk. For some, it's a pesky off-note that is a little too glaring in certain applications. For others, the flavor may be smooth but off point. It may come on too quickly or stay too long. When the right sweeteners come together in optimum proportions, magic happens. The boldness of one is tempered. Together they bring a more melded sweetness with a rounder curve.

There's more to the formulaic story than the wizardry of flavor manipulation. Certain ingredients bring functional attributes to the product that are missing when sugar is reduced or removed.

For example, consider the challenge of recreating the multi-faceted role that sugar plays in baked goods. Besides adding sweetness, it feeds yeast to produce carbon dioxide, it provides bulk, it's a humectant, it improves shelf life, it has creaming and tenderizing properties, it's a foaming agent, it adds color via browning and it is a texturizer. While a single sweetening system cannot replace every function, it can assist.

IconiSweet, a blend of erythritol, allulose, stevia extract and monk fruit extract not only lends a balanced flavor profile, the individual components bring different characteristics to the system. Erythritol and allulose suppress any potential off-notes that stevia or monk fruit might impart. Because of its low molecular weight, erythritol lowers water activity, thereby extending the shelf life of baked goods. Allulose participates in the Maillard reaction, so a golden hue is more easily attainable. Bringing inulin into the mix can add bulk, aid foaming, texturize and contribute to humectancy.



Frozen desserts are equally challenged. Freeze point depression is a vital role that sugar plays, creating smaller crystals that are creamier than larger ones. Erythritol and allulose have the same effect, so using IconiSweet in frozen desserts can drastically reduce sugar while maintaining the scoopability, smoothness and flavor that consumers crave.

Other food products also benefit by including this blend in the mix including confectionery, desserts and condiments.

Those who don't require the functionality of erythritol, might choose to formulate with KetoSweet+, a blend of allulose, stevia and monk fruit. The slight cooling effect that erythritol brings to the flavor profile is eliminated, making it a better choice in some applications. This blend can be used in a wide range of food products including: carbonated and non-carbonated beverages, baked goods and frostings, frozen dairy desserts, jams and jellies, sweet sauces, syrups, chewing gum, hard and soft candies and puddings and fillings.



**More on  
Sweetening Systems**



# Customized Solutions

Because sugar is so unique, a single ingredient cannot provide a drop-in replacement. In many applications a premade sweetening system such as IconiSweet or KetoSweet is equipped for the job and will meet the finished product's end goals without added manipulation. But every ingredient in the formula interacts to create a complex, interwoven tapestry of which the sweetener is only a part. The sweetener's effect can be impacted either positively or negatively. The entire scheme may need refinement. Working with a supply side partner who is familiar with the intricacies of each of the ingredients in the sweetening system can reduce development time, not only in creating a custom-made sweetening solution, but also in advising how other ingredients might exert influence.

Some flavors, for example, shine in the light of some sweeteners. Stevia pairs well with ginger, cola and root beer. Not so much with citrus. Yet counterintuitively, grapefruit has an inherent bitter quality that can help reduce the aftertaste of high-intensity sweeteners. Inulin also has a masking effect. The presence of citric acid, tartaric acid or lactic acid will improve the taste of stevia by cutting the lingering sweetness. Ironically citric is the primary acid in citrus, so it might not quickly come to mind that it can be a flavor enhancer in this situation.





# More On Customized Solutions

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In bars, syrups are utilized to hold ingredients together and add humectancy, yet they also add unwanted calories. Increasing the erythritol in the sweetening system may help. Combined with MonkSweet+ (a blend of monk fruit and stevia) sweetness will be greatly enhanced. Utilizing a tight mesh size ensures thorough dispersion and optimal extrusion.

Beverages, confectionery, condiments and more all have their own unique requirements. A company skilled in creating sweetening systems for a host of products within each category, can bring the expertise of thousands of hours on the bench.

One thing is certain, even though trends toward health and wellness will continue to rise, it's doubtful our desire for sweet tastes will be unabated. It's also unlikely that food companies will have more development time. Let Icon Foods take the heavy lifting out of sweetener development to give you a faster, more efficient turnaround.





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