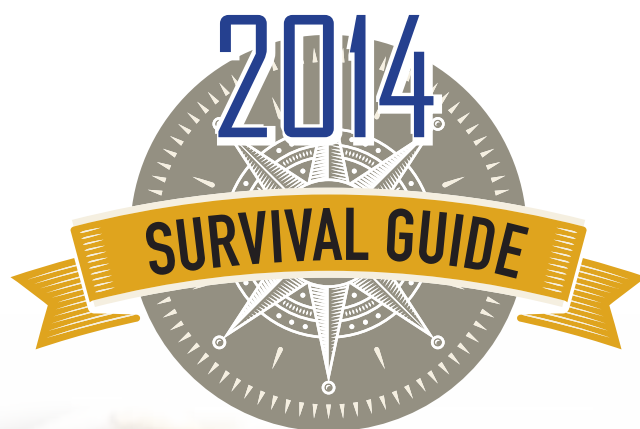


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P R E S E N T S



SWEETENERS

What sets your
ingredient apart?

Inside:

- Market Watch
- The Science of Sweet Taste
- Optimizing Flavors and Sweeteners
- Buyer's Guide



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Market Watch: Sweeteners

BY JUDIE BIZZOZERO

SENIOR EDITOR

Over the past few years, the sugar content in foods and beverages has become a hot-button issue, with just about all sweeteners coming under intense scrutiny from the healthcare community, lawmakers and consumer advocacy groups.

Currently, one of the biggest considerations for food and beverage manufacturers is the obesity epidemic in the United States. According to the Centers for Disease Control and Prevention (CDC), more than 69% of U.S. adults are overweight or obese. That, coupled with consumer concern over sugar intake and studies citing adverse health effects of consuming too many caloric sweeteners, have food and beverage product designers looking for ways to reduce calories without sacrificing taste or texture.

One particular area of growth is high-intensity sweeteners. A recent report from Mintel, Chicago, and Leatherhead Food Research, Surrey, United Kingdom, estimates the global market for high-intensity sweeteners for food and beverage manufacturing reached \$1.27 billion in 2013, and will increase to nearly \$1.4 billion by 2017. Gaining ground quickly as “natural,” plant-based high-intensity sweeteners are stevia and monk fruit. The market for stevia for use in food and beverages totaled \$110 million in 2013, with Mintel forecasting \$275 million by 2017.

Consumer perception

According to the International Food Information Council Foundation (IFIC) 2013 Food & Health Survey, 75% of consumers are cutting back on foods higher in added sugars, and 82% are cutting calories by drinking water, and low- and no-calorie beverages.

The recently released Sweetener360 study conducted by Nielsen and Mintel on behalf of the Corn Refiners Association, Washington, D.C., found that more than half of consumers say they are

actively pursuing a healthy lifestyle and avoiding sugars. With regard to avoidance of specific sweeteners, total sugars or calories, the study found that 67% of consumers agree that in order to live a healthy lifestyle, moderation is more important than specific sweetening ingredients.

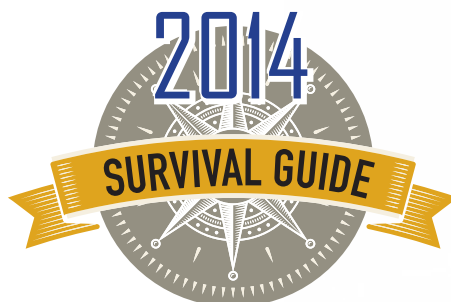
The study also found 75% of consumers say they regularly or occasionally read the nutritional information or list of ingredients on food and beverage labels and packages. Among label readers, four times as many consumers say they read nutrition labels to avoid total sugars rather than HFCS.

Data from the IFIC survey also found that when it comes to low-calorie sweeteners, more consumers believe they can play a variety of roles in overall health—from diabetes management to weight control. For consumers who use low-calorie sweeteners, the top three reasons are calorie reduction (68%), prevention of future health conditions (30%) and taste preference (30%).



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SWEETENERS



TASTEVA® STEVIA SWEETENER FAQ

1) What sets this ingredient apart?

TASTEVA® Stevia Sweetener is a great-tasting stevia sweetener. As a natural sweetener that provides zero-calorie sweetness, it delivers a clean, sweet taste with no bitter aftertaste, even at high-usage levels. This enables sugar reduction up to 50% and higher (depending on application and subject to maximum levels permissible by regulations in force). TASTEVA® Stevia Sweetener is made from an extract of stevia leaves, but it has a substantially cleaner sweet taste than many other stevia-derived sweeteners.

2) What market segments will this ingredient impact?

Market segments impacted by TASTEVA® Stevia Sweetener include natural, beverages, dairy and bakery and snacks.

3) How will this ingredient change the market in the immediate future?

TASTEVA® Stevia Sweetener delivers a “natural” claim without the bitter aftertaste associated with many other stevia sweeteners. This cleaner taste enables higher levels of sugar replacement while maintaining a great-tasting product.

4) For which applications is this ingredient best suited?

TASTEVA® Stevia Sweetener is best suited to beverage, dairy and bakery applications.

5) Are there any limitations to this ingredient, and how can these be overcome?

Formulating with a new sweetener takes time, in order to get it right first time, Tate & Lyle's technical teams are always on hand to help you to balance the application and get very close to the full sugar experience and get to market faster.



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TASTEVA® Stevia Sweetener is a great-tasting, zero-calorie sweetener from a natural source. It allows 50%* or greater sugar-reduction levels in foods and beverages without the bitter/licorice aftertaste often associated with other high-purity, stevia-based sweeteners.

Suitable for use in sugar-free, no-sugar-added and reduced-sugar beverages and foods, TASTEVA® Stevia Sweetener empowers you to create new markets by formulating in ways never before possible.

- Enables significant sugar and calorie reduction
- Facilitates an 8-11% sweetness equivalent
- Sweetness quality verified by extensive consumer research



*Depending on application and subject to maximum levels permissible by local regulations.



The Science of Sweet Taste

BY RENÉE GAN

CONTRIBUTING EDITOR

Sugar, how sweet it is. But is it really that simple? Not really, especially for food product developers hoping to add sweet flavor to their products. But a basic understanding of the physiology of taste, types of sweeteners, sweetness profiles, neurological processing, and other factors that play a role in sweetness perception can help narrow down the possibilities.

The science of taste perception is continually being updated as new discoveries and theories are put forth. A review article in the journal *Nature* (2006; 444:288–294) states, “Contrary to what was generally believed, it is now clear that distinct cell

types expressing unique receptors are tuned to detect each of the five basic tastes: sweet, sour, bitter, salty and umami. Importantly, receptor cells for each taste quality function as dedicated sensors wired to elicit stereotypic responses.”

Furthermore, scientists formerly thought that different areas of the tongue had taste receptors for distinct tastes: more salt receptors at the tip, bitter toward the back and so on. This is no longer the case. The specific taste receptor cells (TRCs) are found distributed in roughly equal proportions to each other in areas across the tongue; that is, sweet, salty, sour, bitter and umami can all be detected in the same areas of the tongue.

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The *Nature* article also describes the specific TRCs implicated in sweetness perception. There are three G-protein-coupled receptors (GPCRs): T1R1, T1R2 and T1R3, with the T1Rs in turn, grouped in three cell types: T1R1 and T1R3 (T1R1+3 cells); T1R2 and T1R3 (T1R2+3 cells); and TRCs containing T1R3 alone. Through mouse studies, it was found that both T1R2 and T1R3 played a critical role in sweet taste perception.

Sweetener types

Naturally occurring, carbohydrate-based sugars are found in many plants and fruits. Mono- and disaccharides, such as sucrose and fructose, are among the most common. Most of these possess sweetness indices of relatively close to 1, where 1 represents the sweetness of sugar. For example, fructose has a sweetness index of 1.3 and, on the lower end of the scale, maltose has a reported sweetness index of 0.2 to 0.4. Common syrups, molasses and honey also hover around the 1 mark (depending on their composition). Polyols, such as mannitol, sorbitol and xylitol, also have sweetness ratings of near 1 with values being approximately 0.5, 0.6 and 0.95, respectively.

High-intensity sweeteners are another story, having sweetness indices several hundred and even thousands of times sweeter than sugar by weight. They can be classified into artificial and natural categories. Saccharin, the oldest of the artificial sweeteners, is 300 times sweeter than sugar. Acesulfame-K is 200 times sweeter. Sucralose, a sugar derivative, is 600 times sweeter. The natural high-intensity sweeteners are plant extracts, also with very high sweetness levels compared to sugar. Stevia-based sweeteners are some of the most popular of these, and are

High-intensity sweeteners are another story, having sweetness indices several hundred and even thousands of times sweeter than sugar by weight.

roughly 300 times sweeter than sugar. *Luo han guo*, or monk fruit, has been reported to be between 210 to 250 times sweeter. Thaumatin, a protein-based sweetener from an African fruit is about 2,000 times as sweet as sugar.

Profiling sweet taste

The flavor profile of common table sugar (sucrose) is the target that all other sweeteners are trying to hit. The issue with many of the high-intensity sweeteners, and essentially all other sweeteners, is that the sweetness and flavor profiles just don't match that of sugar. There are many factors beyond the actual sweetness level that come into play, as well. Andrea Belford, lead food scientist, Ingredion, Inc., Westchester, IL, sheds some light on this. "Sweetness has many dimensions, including intensity, time-intensity profile, cleanness (lack of other tastes), texture/body, flavor release and valence," she says. "These dimensions can all be measured through sensory analysis. Sucrose is typically the standard by which all of the other sweeteners are measured—an exception may be sugar-free products where aspartame may be the standard." This is an interesting point. With high fructose

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corn syrup and aspartame being ubiquitous in many of today's foods, the flavor expectation of sweetness may be changing. In fact, many diet soft drinks that are sweetened exclusively by aspartame in the United States have a combination of aspartame and acesulfame-K in Canada and other countries to more closely mimic the flavor profile of sugar. In spite of this, due to the U.S. preference for the taste profile of aspartame, the noncaloric sweetener is used by itself in many U.S. diet drink formulations.

Greg Mondro, senior flavor chemist, Kerry Ingredients & Flavours, Cincinnati, says: "Each high-intensity sweetener has its unique challenges in terms of sweet profile, off-notes, stability and intensity. That is why a blend of high-intensity sweeteners is often the best solution for these barriers."

Sensory analysis is used to determine sweetness intensity and profiles. "Sucrose sweetness equivalence or relative sweetness to sucrose of a given sweetener can be calculated after determining the equi-sweet concentration against a known sucrose solution concentration by sensory analysis," Belford says. "Descriptive sensory analysis measures the individual tastes and aromatics (characteristic flavors) found in sweeteners, such as 'confectionery,' 'caramel,' 'grassy' or 'licorice,' to name a few. In time-intensity methodologies, the panelist measures the changes of perception of an attribute over time, creating a curve that measures and illustrates such information as the onset of sweetness, time to maximum sweetness intensity, and duration of sweetness."



Brain power

With respect to the way that our brains register the sweet taste, Kathryn Deibler, Ph.D., lead beverage scientist, Ingredion, Inc., explains, "Sweet perception follows bottom-up neurological process (peripheral reactive type responses to sensory input) along with top-down neurological process (cognitive or memory driven, higher-order)."

Of the reactive-type responses, Deibler says, "The primitive bottom-up process is mediated by receptor cells found in taste buds throughout the oral cavity and on the tongue. When a compound activates the receptor cell, a signal is sent to the brain and interpreted as 'sweet.'"

To illustrate the higher-order (top-down) neurological processing, Deibler cites functional magnetic resonance imaging (fMRI) studies, such as those reviewed by Small and Prescott (*Experimental Brain Research*, 2005; 166:345) that have shown the brain responds to aroma compounds commonly associated with sweet taste in a similar fashion to the actual sweet compounds themselves.

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Modro concurs: “There are several physical factors involved in taste, and oftentimes, smell is one of the first triggers. For instance, aroma from sweet brown flavors like chocolate, caramel or vanilla deliver sweet taste perception before anything is actually put in the mouth. So, aroma could be used to amplify taste perception. Other factors for sweetness include flavor system, texture, and even a retronasal effect that occurs after swallowing a food or beverage.”

Flavors can also alter sweetness perception. “Multi-modal effects between sweetness and other oral flavor characteristics may be due to effects at the receptor level, top-down effects, or a combination of the two,” says Deibler. She notes that use of a “near threshold level of a sweet-associated flavor can drastically modulate the sweet perception” of a rebaudioside A sweetener in select applications.

Color is another factor that can have an influence. Deibler mentions a study (*Journal of Japan*, 2003; 208(5):349-352) that shows more-intense color results in a more intense sweet perception.

Enhancement of sweet taste

One study (*PNAS*, 2010; 107(10):4, 746-4,751) proposes searching for “molecules capable of enhancing sweetness perception. Ideally, such an enhancer molecule would not elicit sweetness on its own but it would boost the sweetness intensity of a lower amount of sweetener or sugar.” The study’s author describes the evaluation of positive allosteric modulators (PAMs) on the human taste receptor via a sensitive cell-based assay they developed. The PAMs themselves have no inherent sweet taste, i.e., are non-agoist, and

two of them, identified as SE-2 and SE-3, allowed for a 50% to a more than 80% reduction of sucralose while retaining the same sweetness intensity in human taste tests.

A discussion of sweetness enhancement cannot be complete without mentioning the odd effect of miraculin, a compound extracted from a west African berry aptly named “miracle fruit.” When the tongue is coated with miraculin, sour substances, such as lime juice and even vinegar, taste sweet. Researchers have postulated that miraculin binds with the T1R2 + T1R3 receptors as an antagonist at neutral pH, but changes into an agonist at acidic pH, thereby suggesting a mechanism for the seemingly remarkable phenomenon (*PNAS*, 2011; 108(40): 16,819-16,824).

Some substances act as straight antagonists, blocking the sweet taste receptors. Lactisole is one such molecule. One study found the T1R3 receptor is implicated in lactisole blocking the sweet taste in humans and primates (*The Journal of Biological Chemistry*, 2005; 280:15,238-15,246).

Other factors for sweetness include flavor system, texture, and even a retronasal effect that occurs after swallowing a food or beverage.

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Other factors

Other factors, such as genetics and the unique life experiences of the individual, which encompass social and cultural factors, can play a role in sweetness perception. Taste is not just a physiological response to chemicals in receptors; there is very much a psychological component. A study published in the *Journal of Consumer Research* (2010; 36(5): 748-756) showed that “advertisement content for food products can affect taste perception by affecting sensory cognitions.” The study demonstrated that advertisements aimed at engaging more than one sense—for example, taste, texture and sound—resulted in higher taste perception than those focusing on taste alone. So, even the way the mind anticipates a food prior to it being eaten can have an effect on taste perception.

Mixing it up


This means that a multi-pronged approach is best for mimicking the sweetness profile of sugar. “Generally, sweet modification involves multiple strategies in order to increase upfront sweetness and smooth, sweet profile, and to minimize challenges caused by alternative sweetener systems,” Mondro says. “The goal is

often to have a sweetener system that is more sucrose-like, which can be achieved through modifying the characterizing flavor system, acid system and textural properties.”

Deibler agrees: “There is no silver bullet for bringing the sweetness perception of other sweeteners to match sucrose. Approaches to modify sweeteners are application- and, often, formulation-specific. Application professionals apply multiple approaches to make incremental progress toward simulating the several dimensions of sweet perception.”

As a strategy to address some of the other functional properties of sugars, Deibler says, “Polyols are particularly helpful in building back the mouthfeel that sucrose imparts, but is missing from the high-intensity sweeteners. Further, they ‘round-out’ the sweetness perception with their time-intensity profiles that are closer to that of sucrose.

“Collaboration with flavor houses allows for rebalancing the aromatic flavors influenced by flavor release,” Deibler adds. “An integration of polyols, nutritive sweeteners, high-intensity sweeteners and flavors allows our ingredient experts to achieve a more sucrose-like sweet perception in specific applications.”

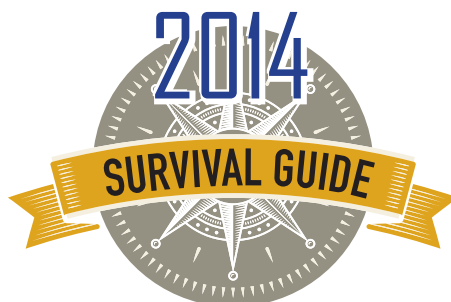
All of this goes to show that there is more to sweetness than meets the tongue. 

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This article was originally published in [“Sweeteners for the Future,”](#) an exclusive, online-only Digital Issue.

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SWEETENERS

KRYSTAR®
Crystalline Fructose

KRYSTAR® CRYSTALLINE FRUCTOSE FAQ

1) What sets this ingredient apart?

Sweeter and more soluble than sucrose, KRYSTAR® Crystalline Fructose has been developed to have exceptional sweetness synergy and flavor enhancement. Its high solubility and low a^w (water activity) help extend shelf life and keep the glycemic index low.

2) What market segments will this ingredient impact?

Market segments impacted by KRYSTAR® Crystalline Fructose include indulgent, beverages, dairy and bakery and snacks.

3) How will this ingredient change the market in the immediate future?

KRYSTAR® Crystalline Fructose can help formulators balance their sweetness profile and mask the aftertaste of some natural-origin and high-potency sweeteners. Additionally, KRYSTAR® Crystalline Fructose offers a fast sweetness onset and a clean finish. This unique benefit gives a boost to fruit, chocolate, caramel and cinnamon flavor notes.

4) For which applications is this ingredient best suited?

KRYSTAR® Crystalline Fructose is best suited to beverage, dairy, and bakery and snack applications.

5) Are there any limitations to this ingredient, and how can these be overcome?

KRYSTAR® Crystalline Fructose does not deliver an “all-natural” claim, but the need for a “natural” claim can easily be satisfied by other Tate & Lyle offerings such as TASTEVA® Stevia Sweetener and PUREFRUIT® Monk Fruit Extract.



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THE SWEETER SWEETENER.

Providing up to 70% greater sweetening power than sucrose for the same amount of calories, KRYSTAR® Crystalline Fructose has been developed to have exceptional sweetness synergy and flavor enhancement. Its high solubility and low aW (water activity) help extend shelf life and keep the glycemic index low.

- Wide ranges of applications
- Low glycemic index
- Helps reduce calories



KRYSTAR®
Crystalline Fructose

Optimizing Flavors and Sweeteners

BY CINDY HAZEN
CONTRIBUTING EDITOR

Whether we're talking economic or environmental issues, there's a common theme: We should do more with less.

The food industry can relate. We've all heard consumers say they want a longer shelf life but no preservatives; natural, organic and artisan at low cost; full flavor and sodium reduction; and no added sugar without compromising sweetness.

We can't meet every consumer expectation in this space, but we can give you some tips to help you get the most out of your sweetener system.

First things first

Sweeteners don't look alike, taste alike or behave alike. Yet, there's a tendency to compare. Sugar, or sucrose, is the standard because it's familiar to us and, importantly, it's sweet from start to finish.

"Sweetness is measured in how quick and how long sweet lasts in your mouth," explains Laura Ennis, senior beverage innovation technologist, David Michael & Co., Philadelphia. This can be measured by a temporal sweetness profile. "Different sweeteners are rated on their intensity over time, and these results can be plotted onto a graph. For example, crystalline fructose peaks very early and fades rather quickly, whereas

sucrose peaks later and lasts longer, hence the reason that most chewing gums are accentuated with artificial sweeteners to keep the sweet profile lasting longer. Non-nutritive sweeteners tend to take the longest to peak and, therefore, lack this upfront sweetness."

Perception of sweetness occurs when a sweet molecule comes in contact with a sweet receptor in the taste bud. "Protein conversions lead to depolarization of the cell, which then leads to a buildup of the ions within the cell and causes the neurons to perceive sweetness," says Richard Davidson, vice president, Hagelin Flavor Technologies, Inc., Branchburg, NJ.

When the receptor is saturated, more sweetness can't be detected. "If you drink a soda and then eat a piece of candy, depending on how much sugar is in the candy, you can't taste the sweetness of the candy because you've already peaked the receptor," Davidson says. "It can't detect any more sweetness. You get to a point of diminishing returns."

Sweetness can seem enhanced by mouthfeel. "Perceiving more fullness in your mouth aids in sweetness perception," says Ennis. "Fats and bases that coat the mouth can detract from sweetness."

In the search to reduce sugar consumption and to optimize sweeteners, the industry is trying to come up with a silver bullet that will

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trick the cell into thinking a molecule is more sweet than it actually is.

“You can go the old-fashioned way and use a molecule that is sweet. Sometimes we use vanillin, ethyl vanillin or heliotropine,”

Davidson says. “Those are components that will make you perceive more sweetness, but unfortunately they also carry flavor characteristics. Vanillin is going to taste vanilla-like. Heliotropine is going to be more of a cotton candy type flavor. Caramel furanones add sweetness, but again, they are characterizing.”

Flavor companies are developing molecules built to get the receptor to depolarize more rapidly to give a stronger sweetness perception without adding a flavor note. “You want to act on the chemistry on the cell, not to induce the flavor response,” Davidson says. “That’s been the trick.”

Artificial advantages

Nonnutritive sweeteners have proved popular for many decades. Zero calories is one benefit of non-nutritive sweeteners. Potency is another.

For example, aspartame is 150 to 200 times as sweet as sucrose. “Aspartame is unique in that its taste profile is good enough to allow it to be used as a sole sweetener,” says Ihab E. Bishay, Ph.D., senior director business development/application innovation, Ajinomoto Food Ingredients, Chicago.

Yet, compared to sucrose, aspartame has “slow onset of sweetness and leaves a lingering aftertaste,” says Ennis. “It is also not very stable to heat and shelf life.” It’s best at more-neutral pH because it undergoes hydrolysis in high-acid or alkaline conditions.

Aspartame is composed of two essential amino acids, L-phenylalanine and L-aspartic acid, and a methyl ester. When heated, aspartame

has a tendency to break down to phenylalanine and aspartic acid.

Acesulfame-K (acesulfame potassium) also has issues with heat stability; however, it’s more stable than aspartame. At 200 times the sweetness of sucrose, it gives an early onset of sweet, but it can leave a bitter aftertaste. This is especially true at high concentrations. Aspartame and acesulfame-K are often used together at 50/50 or 60/40 levels, respectively, depending on the end product. “Their synergy together covers the entire sweetness curve,” says Ennis.

Advantame, derived from aspartame and vanillin, is a new sweetening ingredient developed by Ajinomoto. It does not have any synergies with high-potency sweeteners, says Bishay, however, it “has a similar stability profile to aspartame, but is more stable than aspartame under higher temperature and higher-pH conditions.” In general, 4.5 is considered a higher-pH condition, but he notes all formulations are unique.

This powerful molecule is 20,000 times as sweet as sugar and about 100 times as sweet as aspartame. Currently, it is awaiting FDA approval as a sweetener. The FEMA (Flavor and Extract Manufacturers Association) expert panel, FEXPAN, has so far given it GRAS approval as a flavor enhancer in very specific applications at maximum usage levels: 2 ppm in nonalcoholic beverages; 1 ppm in milk products; 1 ppm in frozen dairy products; and 50 ppm in chewing gum.

“If you go above that ppm you are deemed to be sweetening the product,” explains Skip Rosskam, president, David Michael & Co., who’s company is working with Ajinomoto to evaluate their new molecules that may have flavor modification or enhancement affect.

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“What we found, when compared to sweetness profile of sucrose, was that advantame had some gaps,” Rosskam notes. “Normally, there is a bell-curve effect with sucrose. We observed that advantame started well, lost a little bit before hitting the peak, went back up again and, as it finished, we found a slight aftertaste. So, we engineered a flavor that allowed advantame to fill in the gaps, achieve a rounded profile and eliminate any aftertaste. We learned that by putting these two products together we could modify the sweetness profile in three of the four categories.” Only chewing gum is excluded.

Both products are being used in some school-lunch programs. “We’ve engineered chocolate milk with a 25% calorie reduction,” Rosskam says. Typical chocolate milk might be made with cocoa, a stabilizer like carrageenan, 6% high fructose corn syrup (HFCS) and an artificial flavor. “We would take that same formula and reduce the sweetener HFCS by 25%,” he says. “We would then add the advantame at no more than what is allowed in milk products, which is 1 ppm along with our flavor.”

Sucralose is a powerful sweetener that can be used alone or in combination with other sweeteners. This chlorinated sugar compound delivers 400 to 600 times the sweetness of sucrose. Davidson says sucralose “is probably one of the best at mimicking sugar in terms of time intensity.”

Ennis finds it lacks mouthfeel, and its sweetness can linger. “It can be difficult to work with in the powder form, and is expensive, which is why many times it is used in combination with other non-nutritive sweeteners such as aspartame and acesulfame-K.”

In the absence of a sweetener that is identical to sucrose, “the answer lies in creating a combination with them,” says Mariano Gascon, vice president, R&D, Wixon, St. Francis, WI. “Because each application is very specific, there’s not a single combo mix that works all the time. Fats play a significant role in any flavor perception, so be aware of its effect. Also, keep in mind that a combination can create a synergistic effect, but other sensory effects like suppression or fatigue would apply. If you found the right combo to simulate onset of sucrose in your product but there is some bitterness or lingering effects, use taste modifiers at that point.”

Sugar alcohols

“Like other bulk sweeteners, polyols exhibit more of a direct relationship between sweetness level and concentration,” says Ron Deis, Ph.D., director, global sweetener development, Ingredion Inc., Westchester, IL. “What can affect the overall sweetness profile are solubility, level of sweetness versus sucrose, and heat of solution. Many polyols have a more negative heat of solution, exhibited as a cooling effect in the mouth as their crystalline structure melts. Erythritol and xylitol have a very notable cooling effect.”

The cooling effect varies with the polyol. “All of them have a clean, sweet, but weak, taste,” says Gascon.

Xylitol is the sweetest and approximates sugar with 100% the sweetness of sucrose. Erythritol is about 70%, and maltitol has 80%. Mannitol (50% as sweet) and sorbitol (60%) require a laxation claim in accordance with Title 21 of the *Code of Federal Regulations*, Part 180, Section 25(e).

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Deis says that, in the past, polyols have only been thought of in the context of sugar-free applications. “As formulators try to reduce calories, sugar and glycemic response in applications, polyols should be a part of the thought process,” he says.

Polyols are low-molecular-weight, low-digestible carbohydrates (LDC) with many similarities to fiber and prebiotics. “Maltitol, maltitol syrups and polyglycitols are very similar in molecular weight to sugars and corn syrups, and can replace them in many applications—particularly in many confectionery, dairy and bakery applications,” Deis says. “If reduced calories and reduced sugar are the goals, these polyols should be a part of the formulation plan. Maltitol and maltitol syrups also can work well with stevia or other high-potency sweeteners to achieve a good sweetness profile in dairy beverages, confectioneries and baked goods, while erythritol has been used with stevia in beverages and all-natural applications.”

Corn sugars

Like other bulk sweeteners, high-maltose corn syrup (HMCS) and HFCS “exhibit a direct relationship between sweetness level and concentration in a concentration-response curve,” says Deis. “Maltose is about 30% the sweetness of sucrose, and glucose about 60%, so a high-maltose syrup will be less sweet than a regular corn syrup. However, the unique sweetness and flavor profile of a high-maltose syrup makes it a favorite of confectioners when it can be used.”

Two HFCS products are available to manufacturers: HFCS 55 is 55% fructose and 45% glucose, and HFCS 42 is composed of 42%

fructose and 58% glucose. HFCS 55 has the same relative sweetness as sugar.

Sucrose is a disaccharide made of fructose and glucose units bonded together. “HFCS also contains fructose and glucose, but they are monosaccharides. They are free sugars,” explains John S. White, Ph.D., nutritional biochemist and president, White Technical Research, Argenta, IL, scientific consultant to Corn Refiners Association (CRA).

Though virtually indistinguishable from sugar in terms of sweetness, the trained taster may pick up slight differences even with HFCS 55. “Sugar would give you a broad peak,” explains White. “We would see an initial rapid peak from the fructose, which would decay rapidly, and right behind that, a little bit later in time but before the peak of sucrose, we would see a shorter peak for the glucose. Now the fructose peak would have a value of 117 in comparison with 100 for sucrose. It’s a very sharp peak. It builds quickly and decays rapidly. Then that’s followed by the glucose peak, which is much lower than sugar, about 62. Sometimes it’s given a range between 60 and 70. It builds more slowly than fructose does, but more quickly than sucrose, and then it declines as the sucrose peak is building.”

The broad sweetness peak of sucrose tends to mask some flavors in the system. “You get more of them with the HFCS because of the faster build and faster decline of sweetness. You can get enhanced fruit and spice flavors with HFCS that are masked by sucrose,” White says.

HFCS offers flavor stability in low-pH applications like soft drinks, which have an average pH of 3.5. “In a sucrose or sugar-sweetened beverage, the bond between the

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fructose and glucose is hydrolyzed by acid,” explains White. “This process starts immediately after bottling and continues until it is consumed by the purchaser. The warmer the temperature of storage, the faster this inversion takes place. The more hydrolysis that takes place, the more this sugar-sweetened product comes to resemble HFCS as this free fructose and free glucose is liberated. The concentration of those goes up and the concentration of sucrose goes down.”

Diet soft drinks may not appeal to consumers who prefer traditionally sweetened beverages because one of the things sugar and HFCS bring to the party is mouthfeel.

► SUGARS VS. SUGARS

Soft drinks and high fructose corn syrup (HFCS) have gotten a bad rap as the leading cause of obesity. According to John S. White, Ph.D., nutritional biochemist and president, White Technical Research, Argenta, IL, scientific consultant to Corn Refiners Association (CRA), the consumers who voice concern about HFCS are a vocal but very small minority. “There have been six expert panels since 2007—these are scientists who are experts in this area—and they have all concluded that HFCS and sugar are metabolically equivalent. In addition, a number of prominent nutritionists have said the same thing,” he says, naming Michael Jacobson of The Center for Science in the Public Interest (CSPI) as an example.

“The bottom line is there isn’t a shred of evidence that high fructose corn syrup is nutritionally any different from sugar,” says Jacobson in *USA Today* (“Nutrition Experts Battle Industry Groups Over Sugar,” March 2, 2010).

This is supported by a study published in *Nutrition Journal* (2012; 11:55). The researchers’ data suggests that removing HFCS is “pointless and potentially misleading to consumers, since HFCS and sucrose are nutritionally interchangeable.”



Replacing missing solids is one of the challenges of using high-intensity sweeteners. Diet drinks might be sweetened with as little as 0.01% solids. However, sweetener solids in a traditional soft drink are about 10%.

High intensity, naturally

Some consumers and manufacturers are looking for zero calories in a natural package. Enter stevia, a group of sweetener ingredients derived from naturally occurring glycosides in the stevia plant. Compared to sugar, relative sweetness of these glycosides varies, as does flavor.

“All of the steviol glycosides, and in fact many high-potency sweeteners (both natural and synthetic), have some degree of bitterness associated with their flavor profiles,” says Deis.

Rebaudioside A (reb A) is about 400 times sweeter than sugar. It is one of the least bitter steviol glycosides, “but still has a flavor profile which limits the total sugar equivalence that can be replaced,” Deis says. “In most cases, it is not a standalone sweetener. That being said, we have learned a lot about what other ingredients work well with stevia and in which applications it works very well. We have had a lot of success in dairy applications, such as flavored milks, smoothies and yogurts. Stevia pairs well with nutritive sweeteners, such as sucrose and fructose, some fructose-based ingredients, such as agave sweetener and short-chain FOS, as well as certain flavor components—all of which affect the overall sweetness profile in the application system.”

Deis describes Ingredion’s naturally derived reb A stevia sweetener as having a very clean taste profile. Because it’s produced from a single proprietary cultivar, lot-to-lot consistency is

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assured. This is important, because once the finished product's flavor is developed, food manufacturers don't want to reformulate to adjust for off flavors, sweetness intensity or overall taste profiles that can change if different stevia varieties are used or if extracts are sourced from several locations.

"There is no particular component of stevia contributing bitterness," says Deis. "The science of bitterness taste receptors is less understood than that of sweetness taste receptors, except for the fact that there are many more bitterness receptors than sweet receptors."


It doesn't take many bitter-inducing compounds to make the product taste bitter. "The threshold for the recognition of sweetness is detectable in 1 part in 200 parts of sucrose," explains Davidson. "Bitterness is perceptible in 1 part per 2 million parts. The problem is, once you detect the bitter, it becomes very difficult to detect sweet."

This can be a problem with formulating with stevia. "We've done studies here where we've ratcheted up the levels to get to the point where it's too sweet," Davidson says. "You can't do that. When you get to the point where it's ostensibly too sweet, then you find out that it's too bitter as well."

Rather than working to enhance the sweetness of stevia, his company has worked to modify bitterness.

Monk fruit sweeteners, extracted from the fruit of *Straia grosvenori*, are another naturally derived high-intensity option with 150 to 200 times the sweetness of sucrose. Like stevia, components within the plant vary in sweetness. Monk fruit, also called *luo han guo*, contains five different mogrosides (II, 111, IV, V and VI).

Mogroside V is the sweetest. Only 0.5% to 1.5% extractable mogrosides are present in the dried fruit, so it's been more expensive than stevia. But, just because an ingredient is currently more expensive, it doesn't mean that the cost per use is more expensive, especially if additional flavors aren't needed. The flavor of monk fruit is more neutral than stevia, though it is sometimes described as having a slight note of melon rind.

Besides cost, label claims and nutritional panel targets should be considered. It's important to explore what sweetener types work best for each flavor profile and application. Marie Cummings, manager, food applications and product development, David Michael & Co., gives a final point worth remembering: "If any sugar or fructose is permitted to meet the nutritional requirements, even at low percentages, they tend to improve the flavor impact, particularly upfront." 

Cindy Hazen, an industry veteran with more than 25 years experience, developed food science chops in seasonings, dry blends, beverages and more. Today, when not writing or consulting, she expands her knowledge of food safety as a food-safety officer for a Memphis-based produce distributor. She can be reached at cindy-hazen.com.

This article was originally published in the Nov. 2012 issue of [Food Product Design](#).

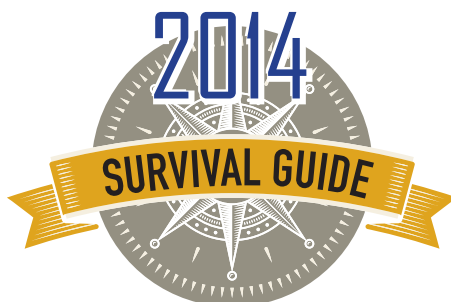


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SWEETENERS



PUREFRUIT® MONK FRUIT EXTRACT FAQ

1) What sets this ingredient apart?

By leveraging the natural sweetness of monk fruit, PUREFRUIT® Monk Fruit Extract is an excellent-tasting, zero-calorie sweetener. Consumers trust products that, like PUREFRUIT® Monk Fruit Extract, can claim to be extracted from fruit.

2) What market segments will this ingredient impact?

Market segments impacted by PUREFRUIT® Monk Fruit Extract include natural, beverages, dairy, and bakery and snacks.

3) How will this ingredient change the market in the immediate future?

PUREFRUIT® Monk Fruit Extract delivers claims of both “natural” and “sweetened with monk fruit extract,” which many consumers find appealing. Additionally, it can be used with all other sweeteners, and blends can be developed to provide a desired taste and nutrition composition.

4) For which applications is this ingredient best suited?

PUREFRUIT® Monk Fruit Extract is best suited to beverage, dairy and bakery applications.

5) Are there any limitations to this ingredient, and how can these be overcome?

Starting to use any new sweetener can be complex. Fortunately, Tate & Lyle's technical teams are available to help you to balance the application and get very close to the full sugar experience.



TATE & LYLE

ADVERTORIAL

SWEET AND NATURAL.

Extracted from monk fruit and trusted by consumers, PUREFRUIT™ Monk Fruit Extract provides a natural, great-tasting, zero-calorie sweetness.

Harvested by hand from small farms on subtropical Asian hillsides, monk fruit extract ("luo han guo") provides 200 times the sweetness of sugar. Thanks to this sweetness and exceptional stability, PUREFRUIT™ Monk Fruit Extract is perfect for a wide range of food and beverage applications.

- 150-200 times sweeter than sugar¹
- 70% of consumers see monk fruit as a good fit for their healthy diet²
- Enables sugar reduction by 50% or more



¹Tate & Lyle Internal Sensory Research 2011-2013
²Illuminas, U.S. Sweetener Landscape Study, May 2012

Buyer's Guide: Sweeteners



Ajinomoto North America

400 Kelby Street
Fort Lee, NJ 07024
Phone: (201)292-3200
www.ajinomoto-usa.com

ADM

4666 Farires Pkwy.
Decatur, IL 62526
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Greg Dodson
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For more than a century, the people of Archer Daniels Midland Co. have transformed crops into products that serve vital needs. Today, 30,000 ADM employees around the globe convert oilseeds, corn, wheat and cocoa into products for food, animal feed, industrial and energy uses. With more than 265 processing plants, 460 crop procurement facilities, and the world's premier crop transportation network, ADM helps connect the harvest to the home in more than 140 countries.

Almendra

One W. Court Square, Ste. 750
Decatur, IL 30030
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www.almendra.com.sg
elisabeth audouze
sales@almendra.com.sg

Almendra manufactures high-purity stevia sweeteners for the food and beverage industry. Our high-purity Stevioside™ products bring clean taste profiles, high sweetness intensity, safety and consistent taste batch to batch. Because tasting is believing, ask for your sample now.

American Fruits & Flavors

10725 Sutter Ave.
Pacoima, CA 91331
Phone: (818)899-9574
Toll Free: (800)527-6709
www.americanfruits-flavors.com

With more than 50 years in business, American Fruits & Flavors (AFF) has extensive experience and capabilities in offering flavors (liquid and powder), fruit blends, natural fruit sweeteners, fruit concentrates and spray-dried juices from its divisions: AFP and Mutual Flavors. We also provide innovative custom product development. At AFF we strive to maintain the highest standards of quality and service.

Arnhem Group, The

25 Commerce Drive
Cranford, NJ 07016
Phone: (908)709-4045
www.arnhemgroup.com
Karyn Rosenberg
krosenberg@arnhemgroup.com

Arnhem's Oh! So Sweet product line helps food and beverage manufacturers reduce calories, carbohydrates and costs. Oh! So Sweet is a natural zero-calorie flavor enhancer that allows manufacturers to reduce or replace sugar, while offering clean "natural flavor" labeling. Oh! So Sweet comes in granular and liquid form, with intensity levels ranging from 150 to 1,000 times the sweetness of sugar. Our Flavex line of multi-functional hydrocolloid proteins allow manufacturers to increase yield, reduce purge, improve mouthfeel and texture in meat, poultry and seafood products.

Atlantic Chemicals Trading of North America Inc.

116 N. Maryland Ave., Ste. 210
Glendale, CA 91206
Phone: (818)246-0077
www.act.de
Rodrick Safarian
r.safarian@act.de

Atlantic Chemicals Trading specializes in the global sourcing and distribution of ingredients for use in food, beverage, cosmetic, nutraceutical and pharmaceutical products. For more than 25 years, we have partnered with major Chinese producers of acidulants, amino acids, antioxidants, preservatives, sweeteners and vitamins with the goal of providing the highest quality products at the most competitive prices. We look forward to the opportunity of working with you and servicing your ingredient needs.

Batory Foods

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Toll Free: (800)367-6975
www.batoryfoods.com
Rob Alleman
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Batory Foods is a leading national distributor of high-quality food ingredients for food and beverage, nutraceutical and confectionery manufacturers. Founded in 1979, Batory Foods was created to be a "one-stop shopping" partner to customers for all their ingredient needs. Today, Batory Foods operates a network of distribution facilities across the country serving thousands of customers with a full portfolio of ingredients and exceptional customer service.

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BENE0 Inc.

201 Littleton Road, 1st Floor
Morris Plains, NJ 07950
Phone: (973)867-2140
contact@beneo.com

Big Tree Farms

2305 Ashland Street, Suite 506-c
Ashland, OR 97520
Phone: (541)488-5605
Church Kirchner
church@bigtreefarms.com

Big Tree Farms has been the pioneer of organic coconut sugar in the global market for more than a decade, and is one of the few fully integrated, sustainable and totally transparent supply chain companies that work in direct partnership with farmers (14,000 and growing). We process foods at origin and distribute internationally. We operate the largest certified organic cacao supply chain in SE Asia. We own and operate multiple processing facilities, including our bamboo-built chocolate factory on Bali—the first certified organic chocolate factory in SE Asia. Also; Coco Hydro dehydrated coconut water.

Biolotus Biotech Co. Ltd.

No. 7 Crystal Ave.
Xi'anfeng Industrial Park
Baoying County
Yangzhou, 1444 China 225800
Phone: +86-18-083-789550
www.biolotus.com
Hongxia Zhai
sales@hystevia.com

Biolotus is a professional stevia and lotus extracts manufacturer. We can extract 500 tons of high purity steviol glycosides and 1500 tons high-purity reb-A products every year with advanced manufacturing technology. Thanks to stable and high-quality products, we have established long-term cooperation relationships with many customers in the worldwide.

Blue California

30111 Tomas
Rancho Santa Margarita, CA 92688
Phone: (949)635-1990
www.bluecal-ingredients.com

Blue California is a leader in the development and manufacture of purified botanical extracts. Our innovative technology and expertise in extraction and purification of plant bioactive components allows us to offer safe and purified natural botanical extracts such as FDA GRAS-affirmed Good&Sweet reb-A 99% and purified natural L-theanine 98%.

Briess Malt & Ingredients Company

625 S. Irish Rd.
PO Box 229
Chilton, WI 53014
Phone: (920)849-7711
Toll Free: (800)657-0806
www.briess.com

Cactus Botanics Ltd.

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Alhambra, CA 91803
Phone: (562)219-2167
www.cactusbotanics.com
Carol Cheow
carol.c@cactusbotanics.com

Cactus Botanics is an expert on botanical extracts. It is FDA registered; ISO 9001:2008, kosher/Halal certified; and all operations are cGMP compliant. The key products are: bayberry bark extract (Myricetin), brown seaweed extract (Fucoidan), epimedium extract (Icarrins), milk thistle extract (Silymarin), stevia leaf extract, ginseng extract series, lutein, zeaxanthin, *Griffonia simplicifolia* extract (5-HTP) and resveratrol. In addition to various powder extracts, it also offers fruit juice powder, amino acids, vitamins and other nutritional ingredients.

California Natural Products

P.O. Box 1219
Lathrop, CA 95330
Phone: (209)858-2525
www.cnp.com

California Natural Products is a GFSI compliant, world class manufacturer of conventional and organic food ingredients from grains, including rice syrups and rice syrup solids (DE 26-70—varying carbohydrate structures), RiCevia™ natural and “Made With Organic” glycemic control rice syrups, Dextri-Plus™ rice oligodextrins and Bake Trim™ (the rice syrup solid that provides dough conditioning, *trans*/saturated fat replacement and emulsification benefits for baked goods and nutrition bars). Certified gluten-free by GFCO.

Cargill

15407 McGinty Road W., MS 62
Wayzata, MN 55391
Phone: (866)456-8872
Toll Free: (866)456-8872
www.cargill.com/food/health
Mike Matthews
mike_matthews@cargill.com

Cargill is utilizing consumer insight, regulatory and scientific expertise to develop and market products that help customers capitalize on the growing demand for healthier consumer packaged goods. It provides food, beverage and dietary supplement ingredient solutions relevant to some of today's most pressing health concerns.

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Ciranda Inc.

221 Vine St.
Hudson, WI 54016
Phone: (715)386-1737
www.ciranda.com

Ciranda supplies non-GMO, organic, sustainable and Fair Trade ingredients, including oils and shortenings, lecithin, cocoa powders and chocolate, tapioca-based dextrose, starch, maltodextrins and syrup solids, agave syrup, inulin, coconut oils, coconut flour, milk and desiccated. Non-GMO and organic tapioca syrups and maltodextrins offer label alternatives to corn-based syrups.

Davis Trade & Commodities

515 S. Flower St., 36th FL
Los Angeles, CA 90071
Phone: (323)595-5317
www.dtcint.com

Davis Trade & Commodities offers grains, oilseeds, nuts, honey, beans, rice and animal feed.

Domino Specialty Ingredients

1 N. Clematis St., Suite 400
West Palm Beach, FL 33401
Phone: (561)366-5150
Toll Free: (800)446-9763
www.dominospecialtyingredients.com
Lisa Estes
LEstes@dominofoods.com

Are you developing a new formulation or striving to improve existing recipes? Domino Specialty Ingredients has the right product applications for your supplement, food or beverage needs. Our customized sweeteners include zero-calorie stevia extracts and stevia/sugar blends, organic blue agave nectar, organic and natural molasses, malt, evaporated cane juice, co-crystallized sweeteners, fondants, organic and natural rice, rice syrup, rice bran and rice flour products and more.

DuPont Nutrition & Health

Four New Century Pkwy.
New Century, KS 66031
Phone: (913)764-8100
Toll Free: (800)255-6837
www.food.dupont.com
Mark Kempself
mark.kempself@dupont.com

DuPont™ Danisco® is the brand for a range of ingredients that help provide enhanced bioprotection, an improved nutritional profile, and better taste and texture with greater cost efficiency and lower environmental impact, meeting the needs of manufacturers of food and beverages, dietary supplements and pet food. DuPont Nutrition & Health addresses the world's challenges in food by offering a wide range of sustainable, bio-based ingredients and advanced microbial diagnostic solutions to provide safer, healthier and more nutritious food.

Farbest Brands

160 Summit Ave., Ste. 200
Montvale, NJ 07645
Phone: (201)573-4900
Toll Free: (800)897-6096
www.farbest.com
Lorna Samgour
information@farbest.com

Farbest Brands has supplied ingredients to the food, beverage and nutritional product industries for 58 years. Farbest ingredients include dairy proteins (casein, caseinate, whey), soy protein, pea protein, vitamins and carotenoids, specialty nutrients, specialty sweeteners and carbohydrates and gum acacia.

Garuda Int'l. Inc.

180 W. Chestnut St.
Exeter, CA 93221
Phone: (559)594-4380
www.garudaint.com
Bassam Faress
garudainfo@garudaint.com

Garuda International Inc. promotes its B-CAN brand high-percentage water-soluble oat beta-glucan, an FDA-GRAS approved ingredient. Several organic and natural ingredients including nopal fiber, Jerusalem artichoke flour, sugar-cane wax policosanol, milk calcium, Quillaja and yucca extracts are offered. New additions include agave nectar, agave inulin fiber and stevia.

GWJ Green Wave Ingredients

14821 Northam St.
La Mirada, CA 90638
Phone: (562)207-9770
Toll Free: (866)470-4000
www.gwiusa.com

Founded on the principles of reputable partnerships, trust, quality, value and longevity, GWJ's goal is to become one of America's leading distributors and suppliers of nutritional and proprietary branded ingredients. Operating from its southern California headquarters, the Ingredients Superstore prides itself on keeping more than 200 products in stock and ready for immediate delivery.

HELM U.S. Corp

1110 Centennial Ave.
Piscataway, NJ 08854
Phone: (732)981-1116
www.helmus.com
Christian Wulf
cwulf@helmnewyork.com

Founded in 1969, Helm U.S. Corp is a national distributor of ingredients for the food industry with corporate offices in Piscataway, New Jersey.

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Imperial Sugar Company

3 Sugar Creek Center Blvd., Suite 500
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www.imperialsugar.com

Ingredient House, The

120 Applecross Road, 2nd Fl.
Pinehurst, NC 28374
Phone: (910)693-0037
www.theingredienthouse.com/index.php/home
Peter Brown
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The Ingredient House is a global food ingredient supplier providing customers with that special combination of service, quality and value. Our supply partners with the experienced Ingredient House Team bring you high-quality products that add value to your business with a service that is consistently viewed as leading in our field.

Ingredion Inc.

5 Westbrook Corporate Center
Westchester, IL 60154
Phone: (708)551-2536
Toll Free: (866)961-6285
www.ingredion.com/us

Ingredion, a leading global ingredients solutions provider, offers a complete range of nutritional and sweetener ingredients that can help food, beverage and supplement manufacturers deliver energy and weight management, satiety and glycemic, bone and digestive health claims for their products. Key products include a range of soluble and insoluble fibers (NutraFlora prebiotic fiber, Hi-maize resistant starch, NUTRIOSE soluble fiber) AQUAMIN calcium/mineral matrix, and new WEIGHTAIN satiety system.

IsoAge Technologies

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Athens, GA 30603
Toll Free: (855)847-6243
www.isoagetechnologies.com

JK Sucralose Inc.

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JK Sucralose Inc. is one of the largest professional sucralose manufacturers in the world. We designed long-term capacity of 4,000 tons and qualifying us as a supplier of multi-national food and beverages equipped with a Clean Class 100,000 GMP facility qualified for pharmaceutical standard. We have certificates such as GMP, HACCP, ISO 9001, ISO 14001, OHSAS 18001 and Sedex; Badatz Kosher and MUI Halal for food regulation and the RQA & BRC certification, which are verified by a third party authority with its direct sales branches in the U.S., Europe, Japan and India.

Jungbunzlauer Inc.

7 Wells Ave., Ste. 15
Newton Center, MA 02459
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Markus Gerhart
Markus.Gerhart@jungbunzlauer.com

Jungbunzlauer is one of the world's leading producers of natural and nature-identical ingredients for food, beverage and supplement applications. Using the natural process of fermentation, our ingredients are produced from renewable carbohydrates. The quality products allow improvement of the nutritional profile for our customer's applications. In addition, by the use of highly bio-available materials, their food and beverage products can be augmented with positive nutrition.

Life Bridge Int'l.

3387 Chicago Ave.
Riverside, CA 92507
Phone: (951)684-0027
Toll Free: (855)684-0027
www.lifebridgeintl.com
Elizabeth Vasquez
sales@lifebridgeintl.com

Life Bridge Int'l. Corp. is a distributor with an office and warehouse in California. Due to its direct and stable affiliations with manufacturers in China, Life Bridge is able to provide quality ingredients ranging from amino acids, APIs, polyols, sweeteners, prebiotics, vitamins and nutraceuticals to natural extracts at very competitive pricing. Not only is Life Bridge committed to innovative trends and market familiarity but is also strongly committed to regulatory compliance.

Malt Products Corporation

88 Market Street
Saddle Brook, NJ 07663
Toll Free: (800)526-0180
www.maltproducts.com

Mitsubishi International Food Ingredients Inc.

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Mitsubishi International Food Ingredients Inc. focuses on the development of naturally derived functional ingredients for dietary supplements, food and beverage, and health related products.

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NATUREX Inc.

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naturex.us@naturex.com

Naturex manufactures natural specialty ingredients for the food & beverage, nutrition & health and personal care industries. Headquartered in France, Naturex employs more than 1,400 people and has 15 production units located in Europe (France, Italy, Spain, Switzerland, Poland and England), the United States (New Jersey and California), Brazil, Australia, Morocco and India. The group also has several sales offices worldwide.

New Trend Group

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www.newtrend-group.com
Guo Angel
angel@newtrend-group.com

New Trend Group is a global leading manufacturer of sucralose, food grade glycine, and blended sweetener. New Trend Group was established in 2001, the company's headquarters is located in Shenzhen City, China. Our products have been exported to North America, South America, Europe, Asia-Pacific, and Middle East markets, mainly used for food and pharmaceutical industries.

Nutra Food Ingredients

4683 50th St. S.E.
Kentwood, MI 49512
Phone: (616)656-9928
www.nutrafoodingredients.com
Tim Wolffis
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Nutra Food Ingredients specializes in the production and distribution of quality raw materials. We manage everything from raw product production schedules to getting the product to a customer's facility. Our core products include NutraGelatin, including kosher gelatin, pork, bovine and fish gelatin; NutraCollagen, including type II and Type I & II; NutraVpro Vegetable Proteins, including pea, rice and soy protein; organic erythritol; organic inulin; and functional animal proteins for meat applications.

Pearson Sales Co.

2303 Mt. Vernon Ave.
Pomona, CA 91768
Phone: (909)784-3840
Warren Windham
warren@pearsonsales.com

Pearson Sales Company is an industrial food distributor of dry ingredients. Product categories include starches, sweeteners, salt, dairy solids, egg and meat powders, savory enhancers, grains and food additives.

Prinova

285 E. Fullerton Ave.
Carol Stream, IL 60188
Phone: (630)868-0300
www.prinovausa.com

Prinova is your singular source for custom high-quality ingredient, flavor, and value-added solutions. We offer liquid vitamin blends, proteins, aromas, botanicals, sweeteners, a full spectrum of flavor formats and much more. Strategic stocks in 15-plus global distribution centers and exceptional inventory management systems guarantee continuity of supply. Prinova has a BRC Grade-A Certified state-of-the-art liquid blending facility and R&D applications laboratory. Let our experts guide you through every step of product development, from raw material consultations to formulation and fortification.

Prosweetz Ingredients Inc.

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Edison, NJ 08837
Phone: (732)512-0886
www.prosweetz.com
Shawn Miller
shawn@prosweetz.com

ProSweetz Ingredients Inc. is a distributor that supplies food ingredients globally. We have strong positions in the following product categories: high-intensity sweeteners, natural sweeteners, flavor and fragrance raw materials, herbal extracts and more. We have warehouses and offices located in Central New Jersey, California and Florida to better support our customers' business.

PureCircle

915 Harger Road, Suite 250
Oak Brook, IL 60523
Phone: (630)361-0374
www.purecircle.com



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Rochem Int'l. Inc.

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Phone: (631)738-1188
Toll Free: (877)6-ROCHEM
www.rochemintl.com
Robyn Frisch
rfrisch@rochemintl.com

Rochem International supplies a full range of products to the dietary supplement, sports nutrition, food, and cosmetic/personal care industries that include: sugar-free/low-glycemic sweeteners, fibers and prebiotics, vitamins and amino acids. Its product line is designed to serve companies that want to provide the highest quality ingredients to their customers.

Roquette America Inc.

Customer Innovation Center
2211 Innovation Drive
Geneva, IL 60134
(630)463-9430

SARAYA Co. Ltd.

1528 W. Hastings
Vancouver, BC Canada V6G 3J4
Phone: (604)683-7807
www.sarayahealth.com
Margarita Valou
mvalou@sarayacanada.com

Our mission is to increase the sweetness and well-being in your life and the planet! We supply all-natural, zero-calorie sweeteners such as pure monk fruit extract and Lakanto.

Scoular Co., The

250 Marquette Ave., Ste. 1050
Minneapolis, MN 55401
Phone: (612)851-3737
www.scoular.com/markets/food-manufacturing/co-packing-solutions/
Sam Mischke
smischke@scoular.com

Scoular supplies the functional food market with high-quality ingredients. Scoular's wide range of co-pack capabilities and expertise allows us to orchestrate precisely tailored solutions and services to meet your needs, including custom turnkey co-packing, dry/wet blending, pouching, aseptic/hot fill bottling, agglomeration and spray-drying applications.

Sensient Flavors LLC

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JeanPhilippe Giorgis
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Sensient Flavors offers value-added flavor systems that bring life to products. With industry-leading expertise in the savory, beverage and sweet markets, we provide comprehensive solutions that meet requirements. Thanks to our wide-ranging product library, development teams and cutting-edge facilities, we're able to implement technical solutions for complex challenges.

Stauber Performance Ingredients

4120 N. Palm St.
Fullerton, CA 92835
Phone: (714)441-3900
Toll Free: (888)441-4233
www.stauberusa.com
Shirley Rozeboom
srozeboom@stauberusa.com

STAUBER is a one-stop supplier of a broad spectrum of solutions for the nutritional, food, and beverage industries. The ingredients we use lead to breakthrough products for our customers. Whether you need a new formulation or a cost-effective solution to a product challenge, our experienced team can offer creative and effective support for your requirements.

Steviva Ingredients Inc.

725 N.W. Flanders St., Ste. 402
Portland, OR 97209
Toll Free: (800)851-6314
www.stevivaingredients.com

Steviva Ingredients Inc. is a global ingredient supplier with a focus on all-natural high-intensity sweeteners and sweetening solutions for manufacturers. Steviva Ingredients sweeteners and bulk ingredients are all natural, GMO free, soy free, corn free and allergen free.

Suzanne's Specialties

421 Jersey Ave., Ste. B
New Brunswick, NJ 08901
Phone: (732)828-8500
Toll Free: (800)762-2135
www.suzannes-specialties.com
Joel Thomson
joel@suzannes-specialties.com

Suzanne's Specialties Inc. supplies alternative sweeteners to the health food industry, and the industrial and institutional food markets, including brown rice syrup, honey, tapioca syrup and agave syrup, available as organic, and most in a conventional version. All of our products are made with the highest quality organic and all-natural ingredients, which will give your formulas and applications "Sweetness The Way Mother Nature Intended."



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Buyer's Guide: Sweeteners



Sweet Additions

4440 PGA Blvd., Ste. 600
Palm Beach Gardens, FL 33410
Phone: (561)472-0178
Kelly Bruce
customerservice@sweetadditions.com

We are an ingredient company that produces and markets natural and organic cane- and grain-based sweeteners and starch derivatives. Our products include evaporated cane juice, evaporated cane juice medium invert syrup, evaporated cane juice syrup, oat syrup, rice syrup, rice maltodextrins, rice syrup solids, tapioca syrup, tapioca maltodextrins and tapioca syrup solids.

Sweet Green Fields

11 Bellwether Way, Suite 305
Bellingham, WA 98225
Phone: (360)483-4555
www.sweetgreenfields.com

SweetLeaf Stevia Sweetener

1203 W. San Pedro St.
Gilbert, AZ 85233
Phone: (480)921-1373
Toll Free: (800)899-9908
www.sweetleaf.com
Gurudhan Khalsa
gkhalsa@wisdomnaturalbrands.com

Wisdom Natural Brands® is the parent company of SweetLeaf Stevia® Sweetener, winner of 11 global taste awards and a natural alternative to sugar and artificial sweeteners. SweetLeaf products are made with Non-GMO verified, USDA certified organic stevia extract. In a variety of forms—packets, shakers, tablets, and SweetLeaf Liquid Stevia Sweet Drops in more than 20 flavors—SweetLeaf gives you natural sweetness and flavor with zero calories, zero carbs, and no bitterness or aftertaste.

Swerve Sweetener

1533 Sams Ave., Ste. C
New Orleans, LA 70123
Phone: (504)309-9280
Toll Free: (888)979-3783
www.swervesweetener.com
Ivan Echegarria
ivan@swersweetener.com

Swerve is a great tasting, natural, non-glycemic sweetener. Contributing zero calories to recipes and formulations, it is ideal for inclusion in baked goods and snacks aimed at the better-for-you market. Swerve's unique blend of ingredients are sourced from fruits and vegetables. It can easily be used in place of sugar, stevia, HFCS and synthetic sweeteners. With excellent functionality and a truly remarkable taste profile, Swerve is paving the way for new product innovations.

Tate & Lyle

5450 Prairie Stone Pkwy.
Hoffman Estates, IL 60192
Phone: (217)423-4411
Toll Free: (800)526-5728
www.tateandlyle.com

We bring more to the market: Only SPLENDA® Sucralose delivers more, right from the start. With 30-plus years of formulation know-how and thousands of recipes, our application team can help your reduced-calorie products get to market faster. And our two global production facilities make short work of logistics. Become a preferred partner of Tate & Lyle. Join our NEW SPLENDA® Sucralose PLUS PROGRAM. Your entire team will benefit from concept-to-lab-to-market innovation, unmatched security and our industry-leading experience.

Techno Food Ingredients

108 N. Ynez Ave., Ste. 200
Monterey Park, CA 91754
Phone: (626)288-8478
www.techno-fi.com
Helena Xue
hx@techno-fi.com

Techno Food Ingredients, a privately-owned company, is one of the leading sucralose manufacturers in China, with sales offices and warehouses located on the U.S. West and East coasts. Techno was founded by a team of professional experts who have been engaged in food ingredients industry for more than 30 years. Our unique and self-developed production process results in the highest quality sucralose, Techno sucralose, which is approved and chosen by numerous top beverage, pharmaceutical, nutritional supplement and food companies worldwide.

Top Health Ingredients Inc.

529 Falconer Place
Edmonton, AB Canada T6R 3A1
Phone: (780)439-1424
www.tophealthingredients.com
Kimmo Lucas
kimmo@tophealthingredients.com

Top Health Ingredients Inc. (THI) supplies healthy GMO-free and gluten-free ingredients to functional-food and wellness companies globally. Products include non-GMO and gluten-free low-cal fiber sweeteners, and vegan plant proteins. Brands include the popular IMO AdvantaFiber, AdvantaDEX (maltodextrin), AdvantaFOS, Advantitol (erythritol), Dextrose, Polydextrose, and AdvantAMINO, the new 80% sprouted brown-rice protein.

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Buyer's Guide: Sweeteners



U.S. Niutang Chemical Inc.

2913 Saturn St., Unit G
Brea, CA 91789
Phone: (714)993-6885
www.niutang.com

Niutang Chemical is one of the world's leading manufacturers and distributors of food additives, chemicals and pharmaceutical intermediates. While we manufacture more than 20 different products that are instrumental to food, beverage, pharmaceutical, nutraceutical and industrial products, our core products include sucralose, aspartame, folic acid and TGIC.

Unichem Enterprises Inc.

1905 S. Lynx Place
Ontario, CA 91761
Phone: (909)321-1000
Toll Free: (888)886-2588
www.unichemsupply.com
Mark Grieco
sales@unichemsupply.com

Unichem Enterprises Inc. is a direct importer and primary supplier of nutritional raw materials available in North America. We provide bulk ingredients to the food, pharmaceutical, cosmetics, veterinary products and nutritional supplements industries.

United Sugars Corporation

7803 Glenroy Road
Suite 300
Bloomington, MN 55439
Phone: 800-984-3585
www.unitedsugars.com

Westco Chemicals Inc.

12551 S. Saticoy St.
North Hollywood, CA 91605
Phone: (818)255-3655
www.westcochemicals.com
Jennifer Anderson
sales@westcochemicals.com

For over a half a century Westco Chemicals Inc. has been a supplier and distributor of list of food, nutritional, industrial, pharmaceutical and personal care chemical ingredients. Westco Chemicals purchases ingredients from a large group of suppliers providing customers with the best wholesale pricing options available for bulk ingredient purchases. Chemical ingredient selections are always available with the shortest lead time possible.

WILD Flavors Inc.

1261 Pacific Ave.
Erlanger, KY 41018
Phone: (859)342-3600
Toll Free: (888)945-3352
www.wildflavors.com

Headquartered in Zug, Switzerland, WILD Flavors GmbH is one of the leading natural ingredients companies servicing the global food and beverage industry. It uniquely combines an 80-year heritage and knowledge in natural flavors, colors, ingredients and flavor systems with a presence of sophisticated creation, application and manufacturing sites in Europe, the Middle East, North America and Asia.

Zhucheng Haotian Pharm Co. (ZCHT)/ Nascent Health Sciences

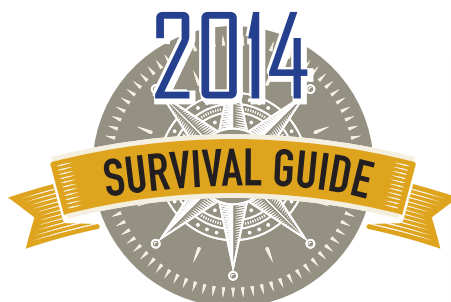
P.O. Box 325
Allentown, NJ 08501
Phone: (609)577-1979
www.zcht.cc
Joseph Zannoni
jzannoni@nascent-health.com

Currently a global leader in the production of inositol and baicalensis, as well as the maker of SoPure™ Stevia, Zhucheng Haotian Pharma Co. Ltd. is a privately owned enterprise incorporated in 1999 in Zhucheng, China. More than 600 employees are dedicated to providing the highest quality products. ZCHT has been certified ISO 9001:2000, ISO 14001:2004, kosher, SFDA-GMP, Halal, HACCP, QS, FSSC 22000:2010, USP, GRAS and FAMI-QS. Nascent Health Sciences is the global market representative for SoPure Stevia and ZCHT products.



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SWEETENERS



SPLENDA® SUCRALOSE FAQ

1) What sets this ingredient apart?

SPLENDA® Sucralose, the original sucralose, is a zero-calorie sweetener that is used to sweeten more than 5,000 products in more than 80 countries. It is 600 times as sweet as sugar in addition to being exceptionally stable. SPLENDA® Sucralose is the highest quality sucralose available, even in low pH beverages.

2) What market segments will this ingredient impact?

Market segments impacted by SPLENDA® Sucralose include health and wellness, beverages, dairy, and bakery and snacks. SPLENDA® Sucralose is used in a wide range of applications where products require sweetness.

3) How will this ingredient change the market in the immediate future?

SPLENDA® Sucralose provides a great-tasting alternative to sugar and other high-intensity sweeteners while enabling a long shelf life, cost saving and reductions in sugar and calories.

4) For which applications is this ingredient best suited?

SPLENDA® Sucralose is best suited to beverage, dairy and bakery applications.

5) Are there any limitations to this ingredient, and how can these be overcome?

SPLENDA® Sucralose does not deliver a “natural” claim, but the need for a “natural” claim can easily be satisfied by other Tate & Lyle offerings such as TASTEVA® Stevia Sweetener and PUREFRUIT® Monk Fruit Extract.



LOOK AT EVERYTHING WE BRING TO THE TABLE.

Only the Tate & Lyle PLUS PROGRAM delivers more, with knowledge, facilities and processes you can count on when you become a **SPLENDA® Sucralose preferred partner**.

Here's how the PLUS PROGRAM helps our partners bring more to market:

- + **EXPERIENCE** – 30+ years of formulation experience and thousands of recipes from the inventors of SPLENDA® Sucralose
- + **INNOVATION** – 100 ongoing initiatives to innovate through the application of SPLENDA® Sucralose
- + **SECURITY** – 200+ analyses performed daily and unrivaled operational and product and safety practices to ensure a zero-defect policy
- + **CONFIDENCE** – World's largest sucralose production capacity and two sustainable global production facilities and logistics support

Learn how you can become a
PLUS PROGRAM preferred
partner at Sucralose.com/PLUS



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TATE & LYLE

WE BRING MORE TO MARKET.

Only SLENDA® Sucralose delivers more, right from the start. With 30+ years of formulation know-how and thousands of recipes, our application team can help your reduced-calorie products get to market faster. And our two global production facilities make short work of logistics.

Become a preferred partner of Tate & Lyle. Join our NEW **SLENDA® Sucralose PLUS PROGRAM**. Your entire team will benefit from concept-to-lab-to-market innovation, unmatched security and our industry-leading experience.



Start with a big idea.

Add our application team.

Take the low-calorie market by storm.

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Learn how you can become a PLUS PROGRAM preferred partner at Sucralose.com/PLUS

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