

a breakthrough
approach in
natural
masking
technology



 **SENSIENT**[®]
FLAVORS

EXECUTIVE SUMMARY

The demand for healthy foods and beverages at retail runs the gamut:

consumers want less sodium, fat, calories, and added sugar; enhanced nutrient profiles benefiting from vitamins, minerals, and other nutraceuticals; and all natural labels free of artificial ingredients. There's just one problem: sugar substitutes and added nutrients often bring with them a strong bitter taste profile that's off-putting for many consumers, and most masking agents on the market can't meet all natural demands. Sensient Flavors' Smoothenol 2G line is an all natural toolbox approach to masking, based on the latest research in human perception of bitter taste. With Smoothenol 2Gs, manufacturers can meet the health profile consumers want...without compromising the taste they demand.

It's a fact:

Today's consumers want cleaner ingredient labels and healthier foods and beverages at retail.

An orange circle containing the text "less sugar".

less
sugar

A dark orange circle containing the text "more vitamins".

more
vitamins

A blue circle containing the text "less fat".

less
fat

A dark grey circle containing the text "more protein".

more
protein

A green circle containing the text "less sodium".

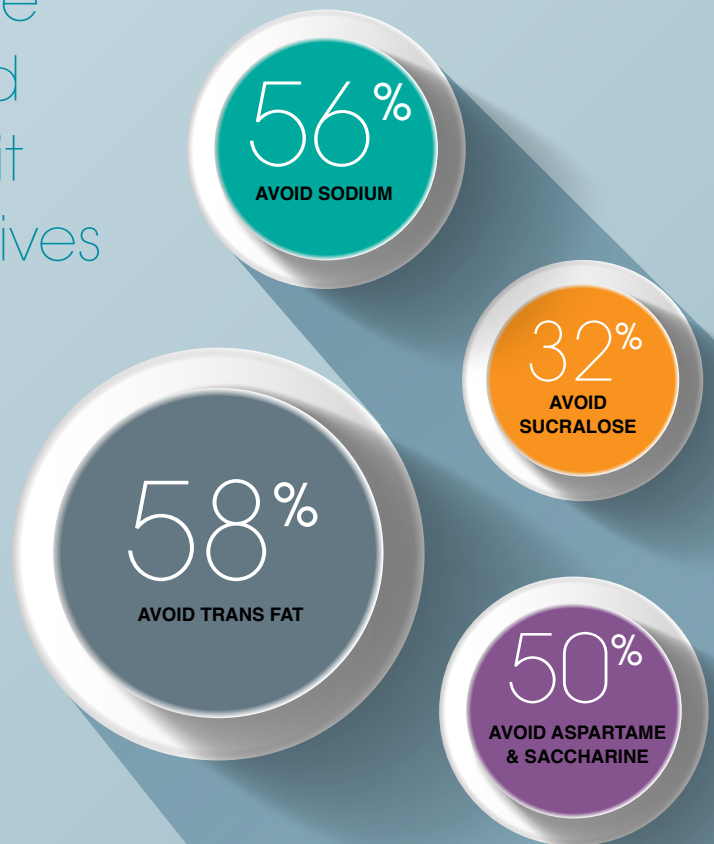
less
sodium

Between a heightened awareness of the global obesity epidemic, expanding consumer scrutiny of additives and sugar substitutes, and the ever-increasing demand for natural labels, it's clear that the food and beverage market is trending toward low-calorie, low-sugar, and generally better-for-you options.

According to market research coming out of The Hartman Group (1), despite a retreat back into the kitchen during a lackluster economy, consumers are still looking to prepared foods to make up at least a component of their eating routines. The good news? Researchers found that regardless of whether consumers are eating snacks or full meals, 75 percent of the time, their practice involves some kind of prepared food or beverage. While convenience surely plays a part, consumers may also be turning to prepared products because they prefer the taste over homemade options – and when it comes to taste, very few shoppers are willing to compromise.

“Consumers are more knowledgeable and active in their pursuit of healthier alternatives than ever before.”

The challenging news is that the prepared foods of the past, marked by high levels of sodium, sugar, fat, and additives – often the same ingredients that enhance a product's taste – just don't meet the expectations of today's shoppers who, with increased access to health information in the media and online, are scrutinizing labels more than ever. In fact, The Hartman Group found that while shoppers still primarily look to the easy-to-navigate nutrition facts panel to determine a product's health profile (86 percent of all shoppers cited this source as the leading indicator of a product's overall health), 83 percent are also taking the time to scan and decipher the arguably more confusing ingredients listings.



And while most consumers avoid trans fat (58 percent) and sodium (56 percent) – two ingredients clearly listed and easily found on the nutrition facts panel –shoppers are studying ingredients lists for perceived red flags, especially when it comes to artificial ingredients. Specifically, more and more consumers are rejecting chemical sweeteners: nearly 50 percent of consumers said they deliberately avoid aspartame and saccharine in their diets, while 32 percent avoid sucralose. In summation, it's clear that today's consumers are more knowledgeable and active in their pursuit of healthier alternatives than ever before, and food and beverage manufacturers

are wise to cater to this increasingly growing subset of shoppers.

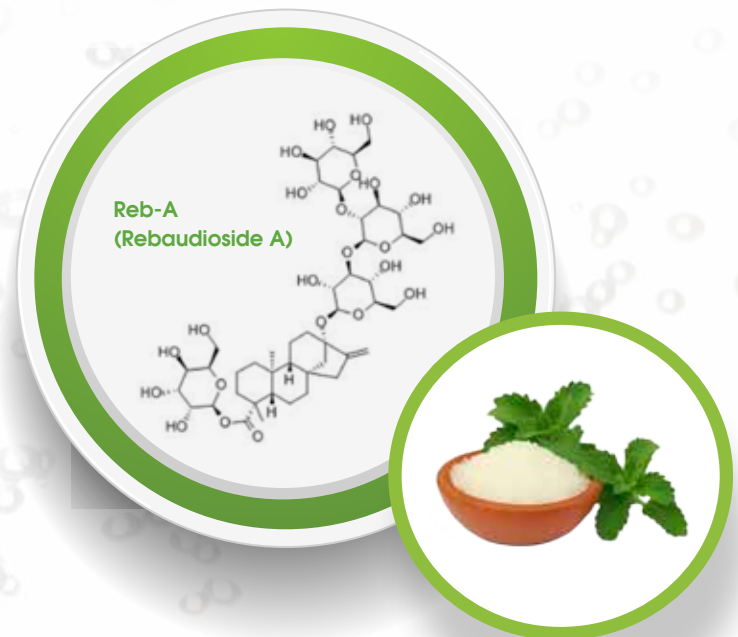
There's just one important caveat: if a product doesn't taste great, shoppers won't purchase it. So even while the importance of health rises in the minds of consumers, it's critical for formulators to remember that at the very top of their priority list is always, always taste. And when health-offending ingredients like fat and added sugar are removed or replaced with alternatives, manufacturers often find themselves in the challenging position of having a product that might meet health expectations but falls far short on taste.

Thanks to Smoothenol 2G, manufacturers can tip the scales back to a place where health need not be compromised for taste to remain king.



In order to keep up with this demand for healthier products, formulators are finding themselves faced with the unique challenge of developing natural and nutritional foods and beverages that still deliver on taste.

The first way food and beverage manufacturers are rising to consumers' health demands is by targeting conventional sweetening and flavoring agents like sugar, sodium, and fat, and replacing them with non-caloric artificial and natural alternatives. For example, Rebaudioside A (Reb-A), a non-caloric, natural sweetener found in stevia, has skyrocketed in popularity, eclipsing the artificial market. The



problem is that Reb-A has a bitter, lingering aftertaste that is unpalatable for many consumers, especially those in the mainstream market that are used to the purely sweet taste profile of sugar. It's clear that if Reb-A is going to gain traction on a mainstream scale, the metallic aftertaste must be masked. Other natural sweeteners on the market are no less challenging; they tend to achieve the same desired health benefit, but the taste of the finished product is altered and, as in the instance of stevia, not for the better.

Various compounds can contribute to consumers' perception of bitterness.



Aside from natural sweeteners, artificial alternatives offer an effective way to lower calorie intake; unfortunately, they also have a bitter, lingering aftertaste that many consumers reject. Not to mention, artificial sweeteners pose a problem for manufacturers targeting the

ever-expanding health-minded consumer set, who have ruled these ingredients out of their clean living plan.

When ingredient substitution falls short of expectations, another way manufacturers can enhance a product's health profile is to take a note from the increasingly popular functional food and beverage category, and tap into the myriad vitamins, minerals, and other functional ingredients available in today's growing nutraceutical market. But while added nutrients increase health appeal, they also bring with them a complex profile of bitterness that can be difficult to mask.

It's clear that though each nutrition enhancing approach brings to the table its own benefits, one hurdle remains a consistent threat: a bitter, metallic, chalky, astringent, or otherwise off-putting taste. And in a steeply competitive food and beverage market where there are so many options, manufacturers shouldn't have to choose between offering a healthy product and offering a great tasting product. That's why so many formulators are turning to masking agents to reduce the undesirable tastes associated with sweetening alternatives and added vitamins, minerals, and health boosters.

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The problem is that many masking agents aren't up for the task. When it comes to minimizing the off-notes of sugar-free sweeteners, traditional approaches to masking fall short: encapsulation or polymer immobilization options successful in the drug industry just don't work in food or beverage applications. Added nutraceuticals present a different challenge altogether in that they often bring a complex profile of bitterness that is no match for a single molecule masking approach.

"Humans perceive a bitter taste when a bitter stimulus binds to these receptors and activates them, sending a message to the brain that the ingested substance is potentially undesirable."

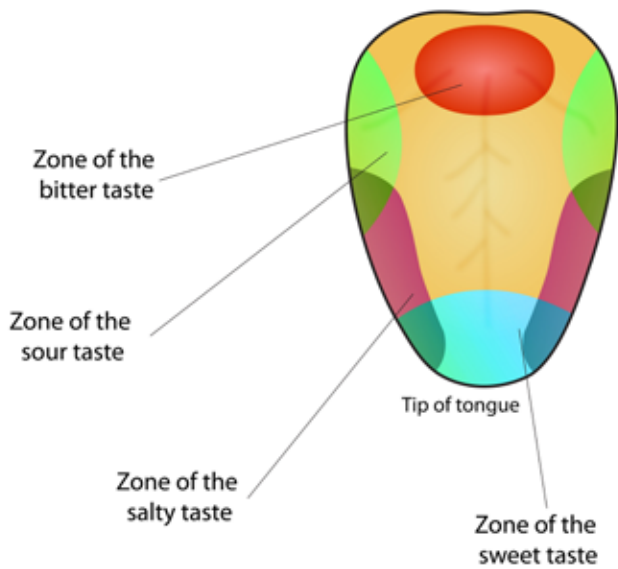


It's important to understand that bitterness is a complex problem that requires a

customized solution.

It is believed that early humans evolved to taste bitterness to protect them from ingesting spoiled or otherwise toxic foods. And since there existed so many poisonous molecules, there also existed many bitter receptors on the tongue that, when contacted by bitter stimuli, sent a message to the brain that the item ingested is potentially toxic, and therefore, undesirable. And though this evolutionary trait remains a hurdle, emerging science on bitter taste receptors illuminates how our ancestors' danger detection influences modern taste experience.

With the advent of modern biology, we now know that there are numerous taste receptors on the tongue, including G-coupled protein receptors (GPCRs) for sweet, bitter, and umami taste and mouthfeel. Scientists have discovered roughly 25 different bitter receptors alone, known as hTAS2R receptors, on the tongue. Humans perceive a bitter taste when a bitter stimulus binds to these receptors and activates them, sending a message to the brain that the ingested substance is potentially undesirable. These molecules capable of activating bitter receptors are known as agonists, and the key to masking this "bad" taste is essentially centered around blocking the agonist's signal to the brain.



basic tastes

greater blocker complexity. And because humans are genetically different, human detection of bitter stimuli remains highly evolved: scientists agree that some individuals might perceive a bitter taste in certain stimuli, while others may not detect a bitter taste at all. The complexity of masking bitterness is evidenced in the example of caffeine, which is capable of binding to five different hTAS2R receptors depending on the shape and size of the binding pocket. In this scenario, formulators could require up to five different compounds just to mask caffeine's bitterness alone before attempting to address any other potentially bitter molecules in the application or genetic differences among consumers.

One aspect of bitter masking involves designing antagonists (molecules that bind to a receptor and, instead of eliciting a signal, prevent an agonist from binding) that can block the bitter agonist; however, this approach is not without its challenges. First, there exists a huge structural diversity in the chemistry of bitter tasting compounds, and research shows that these bitter stimuli can each activate multiple receptor sites. Further, many products often contain multiple bitter stimuli, further increasing the need for



As the complexity of bitterness becomes clear, so too does the value of a toolbox approach offering multiple maskers working in concert to enhance the flavor of a finished product. No longer do formulators need to resort to trial and error when it comes to masking – Sensient Flavors' Smoothenol 2G offers formulators a scientific approach without moving into the artificial space.

Smoothenol 2G

The title "Smoothenol 2G" is rendered in a large, light grey, sans-serif font. It is surrounded by a vibrant, multi-colored background of orange, yellow, and teal. The background is filled with numerous white and teal gears of various sizes, some of which are connected by thin, flowing lines. The overall effect is one of dynamic, interconnected mechanical parts.

offers a toolbox approach that provides manufacturers with the natural solutions they need to compete in a healthy market, while enhancing the flavor demanded by consumers across the board.

When it comes to masking, one size doesn't fit all – developers must take into account a diverse range of sensory and formulary considerations. These considerations include processing variables and ingredient-specific needs, in addition to the influence of other ingredients included in the finished product. For example, masking the bitter aftertaste often associated with stevia will likely require a completely different approach than masking the strong bitter profile associated with added protein content, and even the same bitter stimulus used across different applications will likely require a different masking solution in each instance. Complicating the matter further is that just one bitter stimulus can bind to multiple taste receptors, and many applications often contain multiple bitter stimuli. And in today's market, artificial solutions simply

won't appeal to shoppers seeking an all natural label.

In most cases, the solution to masking bitterness is not found in a single molecule or ingredient, but in an entire toolbox of ingredients that work together to mask off-notes and enhance flavor. Sensient Flavors offers this solution in its proprietary, all natural Smoothenol 2G line of ingredients. The Smoothenol 2G toolbox offers customizable, natural solutions optimal for a broad range of maskers appropriate in a variety of applications from foods and beverages to health products.

Smoothenol 2G is an effective portfolio of natural masking technology systems, created to enhance the palatability of products by masking undesirable off-notes commonly associated with sweeteners, caffeine, vitamins and minerals, nutraceutical and functional ingredients, and beverage bases.

By modifying the sensory perception of these ingredients, Smoothenol 2G essentially eliminates potential aftertaste in a product, meeting the industry need for a masking solution that optimizes taste and is flexible enough to meet specific formulary needs of the finished product, without compromising performance or resorting to artificial additives.

Because Sensient scientists have a portfolio of variations at their fingertips,

"When it comes to masking, one size doesn't fit all."

Smoothenol 2G is easily customizable for a variety of masking needs and applications. Sensient's team of experts work with formulators to assess a product's needs, modify the Smoothenol 2G system to best meet these needs, and combine them with a product's base to create an optimal, one-of-a-kind solution. Smoothenol 2G is flexible and versatile, adaptable to almost any base, and all natural so manufacturers don't need to compromise on the label to achieve their taste and formulary goals. And finally, because it requires relatively low usage levels, Smoothenol 2G is cost effective.



Why is the Smoothenol 2G line the best option available to mask bitterness?

The Smoothenol 2G line of proprietary products developed using advanced knowledge of receptors and ligand design, offer formulators the flexibility of customizing the optimal masking solution while simultaneously maintaining an all natural label. Yesterday's masking technologies were based on a single compound approach that we now know is at odds with the reality of taste receptors. Sensient scientists created Smoothenol 2G with the empirical knowledge of the latest developments in flavor chemistry in mind, offering a sophisticated masking technology that mirrors the emerging science surrounding bitter taste receptors. Smoothenol 2G allows formulators to develop complex masking systems capable of interfering with multiple bitter receptor sites, and blocking the transmission of a bitter signal to the brain.

"The Smoothenol 2G line, a US and EU compliant and GMO-free proprietary technology system, works by modifying the consumer sensory perception and essentially eliminating bitter off-notes and astringency."



The Smoothenol 2G line, a US and EU compliant and GMO-free proprietary technology system, works by modifying the consumer sensory perception and essentially eliminating bitter off-notes and astringency. A complex toolbox of Smoothenol 2G provides formulators with an effective solution to a number of issues ranging from chalkiness to bitterness to astringency to alcohol burn, along with other negative taste attributes found in nutritionally enhanced or artificially sweetened foods and beverages.

Ingredients in the Smoothenol 2G portfolio were formulated to be used in concert to achieve optimal taste, and are tailored by Sensient scientists to meet the specific needs of individual applications.

BITTERFIX

formulas mask the wide variety of negative flavors associated with natural and artificial sweeteners.

ASTRINGENTFIX

products smooth the dry mouthfeel caused by tannins in fruit, tea and red wine.

FUNCTIONALFIX

ingredients reduce metallic off-notes caused by added proteins, omega 3s, vitamins and minerals.

BURNFIX

technology masks the perception of alcohol burn in spirits.

SOURFIX

products soften sour notes associated with citric acid and acidulants in lemonade and citrus-flavored drinks.

The addition of Smoothenol 2G provides finished product manufacturers with a multipronged, positive effect, as evidenced in the example shown,

which centers around enhancing the taste of orange soda. Smoothenol 2G not only reduced the burning mouthfeel and lingering, sweet aftertaste, but also boosted desirable orange aromas.

With the Smoothenol 2G line, Sensient Flavors offers formulators the ability to develop customized, multifaceted masking systems based in the latest technology – and all without artificial ingredients.



Evaluation of Orange Soda with and without Smoothenol 2G

- Orange soda with Smoothenol 2G
- Orange soda without Smoothenol 2G

