

SHUTTERSTOCK



HEALTHIER FOOD, BY STEALTH

Ingredient companies help food makers quietly take **SUGAR AND SALT** out of processed foods

MELODY M. BOMGARDNER, C&EN WASHINGTON

PROCESSED FOODS have been getting a bad rap in the media lately. Food writers such as Michael Pollan have identified them as the major contributor to America's epidemic of obesity, heart disease, and diabetes. Newspaper articles document the local, organic, and all-natural movements as reactions to the food industry's common qualities of tasty, cheap, and convenient.

But the average American isn't an organic-loving locavore. The vast majority of consumers continue to make food purchase decisions on the basis of taste, followed closely by value and convenience. Food experts and nutritionists agree that popular foods such as frozen dinners, boxed cereals, canned soups, and soft drinks are not going away.

Almost all foods are processed to some degree, and to label all processed foods as unhealthy is not helpful to consumers, argues Eric A. Decker, head of the food science department at the University of Mas-

sachusetts, Amherst. "This advice about what to eat is very elitist," he says. "People can't always afford to shop for only fresh fruits and vegetables. I get frustrated by the 'eat more kale' strategy of nutrition."

However, Decker and other food industry experts say that slowing or reversing the occurrence of ailments such as heart disease and diabetes will require changes to the food supply. Reducing obesity, an important long-term challenge, means removing excess calories, particularly those that come from added sugars, from processed foods. In the shorter term, Decker says, food makers are focused on reducing sodium, which could more quickly benefit the 75 million Americans who have high blood pressure.

Indeed, food manufacturers are responding to pressure to remake their products

with less added sodium and sugar. But they are doing it quietly. In fact, the industry's name for the strategy is stealth reduction.

The reason for the stealth is that food makers have learned that many consumers won't buy a product touted as having lower sodium or sugar. Without even trying the product, they will reject it under the assumption that it won't taste good. The stealth route, however, presents a high bar for food makers: The healthier food has to taste just like the original because, in many cases, it looks just like the original.

Luckily for the major food brands, food ingredient makers have some tricks up their sleeves to make this invisible transformation possible. Chemical and flavor companies including DSM, Corbion Purac, Celanese, Tate & Lyle, and Givaudan are

& MORE ONLINE

Take a quiz to test your understanding of salt and sugar in your favorite foods at <http://cenm.ag/salt>.

Salt

offering strategies customized to specific foods and beverages that enable versions with lower sodium or sugar to taste like the original product.

In many cases, food makers can remove up to about 10% of sodium and sugar from foods without customers noticing the difference. One example given by food professionals is Heinz Tomato Ketchup. The label on the famous condiment makes no mention that the product inside has 8.5% less sodium and sugar than it did back in 2005.

BUT EVEN WITH HELP, it's no simple matter to remove more than 10% of sodium and sugar without noticeably changing the taste. And removing more than 25% may not only ruin the taste but ruin the food entirely.

Take bread, for example. It is the highest single source of sodium in the American diet, and it also contains added sugar. Without salt to control fermentation, dough volume increases too quickly. Without sugar, the yeast has no food. Sugar also softens the texture of the bread. Both salt and sugar contribute to the browning of the crust through the Maillard reaction. Salt acts as a natural preservative in bread, inhibiting the growth of microbes. In fact, for many foods, food safety and shelf life can be significant barriers to reducing salt and sugar.

Another problem is that large reductions usually call for replacement substances that mimic the taste of sodium or sugar. But many substitutes, such as high-intensity sweeteners and nonsodium salts, add bitter or metallic off-tastes to food and beverages.

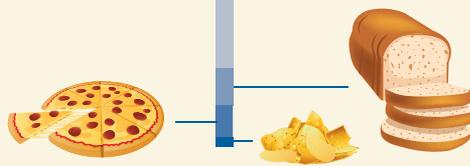
"What makes this so difficult, and why food science is so challenging, is that the solution is different for every single food," Decker says.

If reducing salt and sugar is so hard, and consumers are unwilling to buy products marketed as having less of them, one might wonder why food makers are bothering to make changes at all. The main reason is pressure from government health agencies and nongovernmental public health organizations. For example, health agencies in the European Union, Canada, and New York City have all published guidelines for sodium reduction that cover hundreds of foods.

"With salt, the pressure is specifically because of heart health risk. And whenever voluntary guidelines are recommended, the wise company takes that very seriously and tries to see to what degree it can conform," says Lynn Dornblaser, director of innovation and insight at the market research firm Mintel.

Up to 75% of sodium that Americans consume comes from processed foods.

Bread accounts for more sodium consumption than any other single food category at 7.3%. Pizza accounts for 6.3%. "Salty snacks," like potato chips and corn chips, account for 1.8%.



Where does the sodium come from?



Americans, on average, consume 3,436 mg of sodium per day



U.S. dietary guidelines suggest limiting sodium to 2,300 mg per day



The American Heart Association says that to prevent or lower high blood pressure, consumers should aim for 1,500 mg per day

1 tsp salt = 2,400 mg sodium

97% of U.S. children and adolescents eat too much salt



Stealthy sodium reductions



40%



25%



18%

Meanwhile, childhood antiobesity campaigns have put a spotlight on the amount of added sugars in products such as soft drinks and breakfast cereals. "It seems like now is the time for companies to look very seriously at sugar reduction," Dornblaser suggests.

Especially when it comes to reducing sodium in foods, research—and bitter experience in the marketplace—has shown that it is best to leave consumer choice out of the equation and just make changes without hoopla. A survey conducted by the specialty chemical firm DSM, which sells food ingredients, concluded that consumers have very little understanding of how much sodium they eat or how much is recommended for a healthy diet.

However, a low-salt label can make consumers perceive that the product's taste has been sacrificed. A recent example was the introduction of lower-sodium canned soups by Campbell's in 2008, notes Adam Anderson, DSM's innovation manager for savory ingredients. The healthier versions sold so poorly that in 2011 the company pulled the line from the shelves.

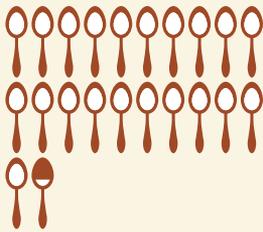
Chemically speaking, Anderson says, firms reducing sodium look to the many ways to stimulate the tongue that give the perception of saltiness. "There is no silver bullet to arrive at the message that this is salty. But with certain natural products such as peptides and yeast extracts in the right application, you can provide the correct salt perception," he says.

DSM uses its knowledge of yeast fermentation and enzymes to look for natural products that stimulate the ion channel in the salt taste bud and send a salty signal to the brain. Successful molecules are usually hydrophobic, according to Anderson. Using a combination of them to trigger both salty and savory taste signals works best, he says, particularly for soups, sauces, dressings, and ready-made meals.

The lactates specialist Corbion Purac also offers a natural fermentation product with a savory flavor that helps put the zing back in lower-salt foods. At the same time, potassium lactate can fix the functional problems that crop up when sodium is reduced by more than 25%. In ketchup,

Sugar

Most Americans consume more than 355 calories of added sugar per day



The American Heart Association recommends that

Women limit added sugar to 100 calories per day



Men, to 150 calories per day

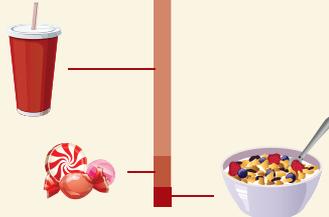


6 tsp sugar = 100 calories

Where does the added sugar come from?

36% of added sugar in American diets comes from soda, energy drinks, and sports drinks.

Ready-to-eat cereals contribute 3.8% of added sugar to the diet, the sixth-highest food category after candy, 6.1%.



Stealthy sugar reductions



← 25%



← 23%



← 8.6%

for example, removing too much salt will cause ingredients to separate and the red color to degrade. And in bakery and meat products, manufacturers need a product to combat microbial activity.

The issue with the potassium swap is the element's telltale bitter aftertaste. So Corbion has developed a specialty version. "What is unique is we use a patented process to clean the potassium flavor out," says Ivo van der Linden, Corbion's category manager for food preservation.

Potassium also plays a role in lowering sodium in foods such as Progresso's canned minestrone soup, which contains potassium chloride in addition to regular salt. Progresso is made by General Mills, which says it reduced sodium in its soups by 20% in 2012. Campbell's Condensed Tomato Soup is made with what the label calls "reduced-sodium natural sea salt." Some versions of sea salt contain as much as 75% potassium chloride.

Adding potassium to foods brings an important benefit in addition to

sodium replacement. Potassium is a mineral that lowers blood pressure, but most Americans do not get enough of it. One serving of Campbell's tomato soup has 700 mg of potassium, 20% of the recommended daily intake.

For applications where only sodium chloride will do, Tate & Lyle found a way to make a small amount of salt have a big effect. The company has introduced Soda-Lo—hollow microspheres of salt that are only 20 μm in diameter. A cubic crystal of

table salt, by comparison, averages about 300 μm on a side. "Because the spheres are so small and hollow, the salt dissolves very rapidly on the tongue for a real salty flavor," says Andy Hoffman, director of wellness product development at the British food ingredient firm.

The microsphere technology originated at the University of Nottingham, in England. To make the spheres, Tate & Lyle creates a solution of salt and a natural hydrocolloid. When tiny droplets of the mixture are dried, the salt crystallizes around the hydrocolloid to form the microsphere structure. The hydrocolloid remains in the center.

Product testing by Tate & Lyle suggests that using the microspheres can reduce sodium by 40% in potato chips, 50% in french fries, and 25% in bread. One drawback, Hoffman acknowledges, is that Soda-Lo cannot be dissolved in water during food processing. The company is looking to expand the microsphere technique to help increase the leavening power of sodium bicarbonate, a source of sodium in some baked goods.

Food manufacturers are also on the lookout for ways to enhance the perception of sweet tastes. Although diet sodas have been around for decades, artificially sweetened drinks command only 11% of the beverage market. To get more consumers to adopt lower-calorie products requires a sweetener with a taste profile much closer to that of sucrose, the gold standard of sweeteners, says Paul Kim, technology manager at Celanese.

This year Celanese introduced a new blend of sweeteners, called Qorus, that's based on acesulfame potassium, a molecule that is 200 times as sweet as sucrose. Ace-K, as it is known, was discovered by Hoechst, Celanese's predecessor, in 1967. Ace-K is pretty close to sucrose in taste, but it has drawbacks that are common to high-intensity sweeteners. The perception of sweetness levels off as the amount used increases, while large amounts bring

BEYOND TASTE Salt and sugar have functional attributes as well.

Function	Salt	Sugar
Color	Controls color development in fresh meat and bread crust	Helps brown bread crust
Texture	Hydrates and binds proteins in meat, bread, and sauces	Adds bulk and mouthfeel to foods such as bread and ice cream; softens texture of bread
Preservation	Prevents microbial growth by decreasing water movement	Preserves foods such as jams and jellies; balances flavor of shelf-stable, high-acid foods
Fermentation	Regulates growth of yeast in bread dough	Fuels fermentation, allowing bread to rise

unwanted additional tastes such as bitter, metallic, licorice, or even salty. Some high-intensity sweeteners have a sweet after-taste that stays around too long.

Adding to the difficulty is significant genetic variability among people in their sensitivity to sweetness and to the bitterness of artificial sweeteners.

Those shortcomings are why high-

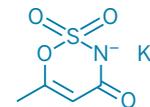
intensity sweeteners are often used in blends. Combinations of two or more can be much sweeter than one alone and often cancel out each other's weaknesses. Ace-K, for example, is almost always blended with sweeteners such as sucralose. To help its customers cut down on the guesswork involved in arriving at a successful blend, Celanese used high-throughput methods

to screen libraries of sweeteners and other flavor chemicals and identify blends suited for reduced-calorie soft drinks, flavored milk, and yogurt drinks.

"We have many products that have 40, 50, or even 60% sugar reduction, in some applications even 100%, and people could not tell the difference between the full-sugar and reduced-calorie versions," Kim reports. There is no need to label a product "diet" when a manufacturer has the right blend, Kim says. Qorus can be used to quietly reduce calories or even to cut costs.

IN FACT, ACCORDING to the market research firm BCC Research, the food and beverage industry is increasingly replacing sugar and corn syrup with artificial sweeteners. BCC predicts the market for high-intensity sweeteners will reach nearly \$1.9 billion in 2017, up from \$1.2 billion in 2012.

One new product, PepsiCo's Pepsi Next, is a reduced-sugar cola that does not advertise itself as a diet beverage. The label, in rather small type, reveals 60% less sugar than regular Pepsi. It is sweetened with a blend of high-fructose corn syrup, sugar, sucralose, and ace-K.



Acesulfame potassium

In the near future, Pepsi Next may share shelf space with Coca-Cola Life, a reduced-sugar beverage sweetened with rebaudioside A and currently marketed in Argentina. The adoption of rebaudioside A, the first no-calorie sweetener molecule derived from the stevia plant, took off starting in 2008 when it received a designation of generally recognized as safe from the Food & Drug Administration.

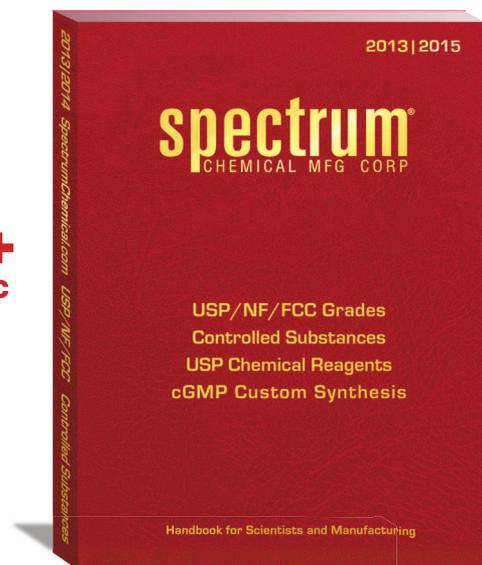
But the major food brands are still learning to work with rebaudioside A and have yet to fully embrace it. "From a marketing standpoint, it's perfect because it comes from nature," says Andrew Daniher, platform director for sweet delivery at the flavors and fragrances firm Givaudan, "but it is bringing a lot of baggage with it." It has a bitter side taste and a lingering sweetness, and its sweet level tops out at the equivalent of an 8% sucrose solution, short of the "maximum sweetness" of 12% sucrose.

Givaudan uses its expertise in sensory science and high-throughput screening to help customers work with high-intensity sweeteners, including natural ones like rebaudioside A. One way is by finding companion molecules that block bitter taste receptors.

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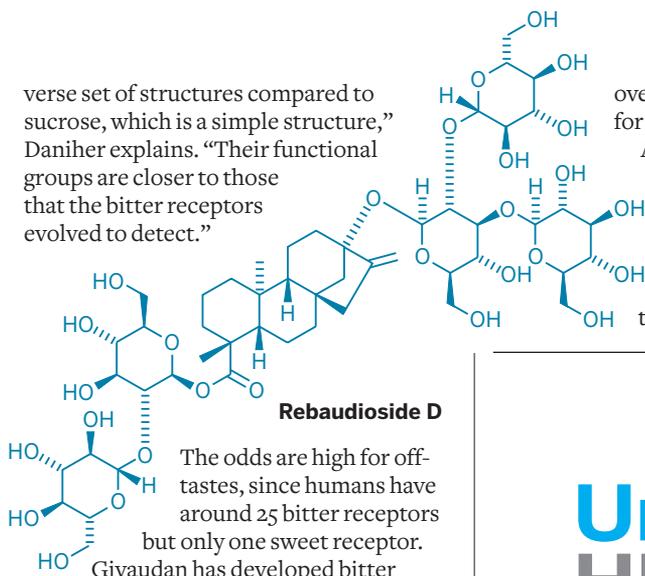
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verse set of structures compared to sucrose, which is a simple structure,” Daniher explains. “Their functional groups are closer to those that the bitter receptors evolved to detect.”



The odds are high for off-tastes, since humans have around 25 bitter receptors but only one sweet receptor.

Givaudan has developed bitter blockers for ace-K, saccharine, and sucralose and has found the bitter receptor to which rebaudioside A binds.

Stevia sweetener firm PureCircle has a different strategy for improving Stevia’s performance. According to Jason Hecker, the company’s vice president for global marketing and innovation, the stevia plant’s many sweet glycosides each have a distinct taste profile. Rebaudioside D, for example, works well to impart the high sweetness levels needed for soft drinks. Blending glycosides can “allow for deeper calorie reductions and can provide a superior taste profile with more complete sweetness,” Hecker says. Last year, PureCircle partnered with Coca-Cola to develop a new sweetener called rebaudioside X.

ARRIVING AT HIGHLY SWEET products through the use of low-calorie sweeteners may not put consumers on the road to a healthy diet, however. “As a nutritionist that’s my concern, because people get used to the supersweet, and then a banana doesn’t taste sweet to them,” comments Katherine Zeratsky, a nutritionist and educator at the Mayo Clinic. “If artificially sweetened products truly helped reduce calories to where they reduced people’s weight, that would be a good thing. But the evidence really is not there.”

Zeratsky works with people who need to adjust their diets for health reasons. In her experience, the subset of people that read food labels and recognize how much sugar and salt is added to food is smaller than the group that shops by habit and does not understand important aspects of nutrition labels such as serving size. On the other hand, she admits, “the realities of our lifestyles and the world we live in mean we are

overscheduled. Convenience for many is a must.”

As to food manufacturers’ efforts to add less sugar and salt, Zeratsky says, “I applaud the fact they are trying to do it better. They are looking at how their products are made and

how to do it in a more nutritious manner and still maintain a safe food product.”

She stresses that the responsibility for healthy food is shared between food manufacturers and consumers. “I think the consumer’s responsibility is to find that balance of how they use processed foods in their diet,” Zeratsky says, “and I think it’s a good thing that changes are happening.” ■

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