

STAYING SMART About



Salt plays a key role in preserving and enhancing food products. But its link to potential health problems has prompted ingredient suppliers and food manufacturers to explore creative new approaches to sodium reduction.



For centuries, the ubiquitous mineral salt has had economic, political, health, and religious importance, and has been a subject in mythology, literature, and warfare. At one time used as currency, a symbol of good luck, and to ward off evil spirits, salt's most identifiable role today is that of flavor enhancer and food preserver. It is a supermarket staple and something we find in every home cook's cupboard and on every restaurant table. The usefulness of salt goes beyond the kitchen; it serves other commercial and industrial purposes, as well—reportedly some 14,000.

Yes, we've revered it, but we've also vilified it. As important as salt was and is, controversy remains over the mineral's role in increasing hypertension, or high blood pressure, a risk factor for cardiovascular disease. Members of the medical and dietetic communities argue that added dietary salt, especially from processed foods, has contributed to health problems. Despite this, however, salt plays important roles in both health (regulation of body fluid levels, contraction of muscles, and conduction of nerve impulses) and food processing (flavor enhancement and food preservation).

This article will not discuss the reported risks of consuming too much salt or whether salt should be controlled in foods; rather, it will briefly

recognize the arguments from both sides and then move on to discuss the actions that ingredient suppliers and food manufacturers are taking to develop products that fit into a low-sodium lifestyle.

Shaking the Salt Habit

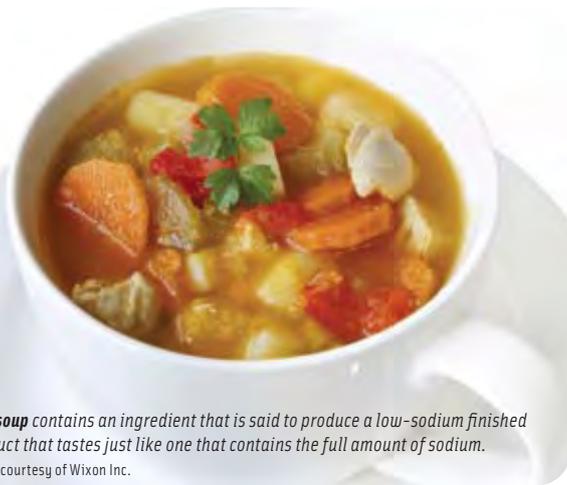
The *2005 Dietary Guidelines for Americans* published jointly by the U.S. Dept. of Health and Human Services and the U.S. Dept. of Agriculture recommend that adults limit consumption of sodium to 2,300 mg/day (the equivalent of about one teaspoonful of salt) and be aware of the amount salt added to processed foods or during food preparation, either at home or at restaurants. The American Heart Association makes the same recommendation. It is estimated, though, that people consume almost twice the recommended amount and get about 75% of their salt intake from processed foods.

Research conducted over the years has explored the links between over-consumption of dietary sodium and conditions such as high blood pressure, and much of it suggests that too much salt in the diet can lead to high blood pressure. Organizations such as AHA, the American Medical Association, and others have urged consumers to monitor salt intake to help prevent certain diseases. »»

Salt



STAYING SMART About Salt



This soup contains an ingredient that is said to produce a low-sodium finished product that tastes just like one that contains the full amount of sodium.

Photo courtesy of Wixon Inc.

There is still some argument over whether consuming too much salt contributes to health problems, and often those who question the link take issue with some of the very same studies that have shown a link. They mention that some of the studies are too limited, use a sample size that is too small, or are too short in duration. Morton Satin, Director of Technical and

Regulatory Affairs, Salt Institute, Alexandria, Va., which represents salt producers, urges leading research institutes to conduct a national cross-population study on the effects of low-sodium diets on health outcomes such as high blood pressure.

“A key role of sodium is to moderate osmotic pressure in the circulatory system, so it is no surprise, nor has it ever been denied, that sodium has an impact on blood pressure,” said Satin. For some people, he noted, high sodium consumption may elevate blood pressure, while for others, low sodium consumption may elevate blood pressure (due to increased rennin-angiotensin activity to conserve sodium). For the majority of the population, he explained, salt will have no effect on blood pressure.

Citing research that shows the relationship between diets that are high in sodium and increases in high blood pressure, the Food and Drug Administration permits packaging and label claims about how diets low in sodium are associated with a reduced risk of high blood pressure. Manufacturers may use the health claim, provided that it states that diets low in sodium “may” or “might” reduce the risk of high blood pressure; uses the term “high blood pressure” in specifying the condition; uses the term “sodium” in specifying the nutrient; does not attribute any degree of reduction in risk of high blood pressure to diets low in sodium; and indicates that development of high blood pressure depends on many factors (CFR, 2007b).

The following are two sample health claims provided by FDA: “Diets low in sodium may reduce the risk of high blood pressure, a disease associated with many factors,” and “Development of hypertension or high blood pressure depends on many factors. [This product] can be part of a low-sodium, low-salt diet that might

reduce the risk of hypertension or high blood pressure” (CFR, 2007b).

FDA also provides guidelines for sodium-reduction label descriptors. For a product to be listed as “sodium free,” it must contain less than 5 mg of sodium/serving; to be listed as “very low sodium,” it must contain 35 mg or less of sodium/serving; to be listed as “low sodium,” it must contain 140 mg or less of sodium/serving; to be listed as “reduced sodium,” the sodium level must be reduced by 25%; and to be listed as “unsalted,” “no salt added,” or “without added salt,” it must be made without any added salt during processing and without the amount of salt that is normally used in the product, but may still contain naturally occurring amounts of salt.

Call to Change Regulations

In November 2007, FDA held a public hearing, in part to discuss the agency’s policies regarding sodium in food, as well as to allow the public to comment on a citizen petition submitted in 2005 by the consumer advocacy group Center for Science in the Public Interest. The organization requested that FDA make changes to how it regulates sodium in foods, including, more specifically, revoking the GRAS status for salt, requiring limits on the amount of salt used in processed foods, requiring health messages, reducing the Daily Values of sodium from 2,400 mg/day to 1,500 mg/day, and reducing the amounts of sodium in processed foods sold to restaurants (CFR, 2007a).

“Very few people dispute that Americans get way too much salt from processed and restaurant foods and that that excess promotes hypertension, stroke, heart attacks, kidney failure, and early death,” said Michael F. Jacobson, Executive Director of CSPI, in a press statement. He added that it is difficult for FDA to ignore the calls made by the medical community to

Examining Taste Buds and Salty Taste

Researchers Michlig et al. (2007) are studying a network of molecules on the tongue said to affect salty taste. They analyzed the matrix between the cells of taste buds and discovered that claudins—which are a family of membrane proteins that function as a barrier by controlling the flow of other molecules through the space between the cells—are specifically arranged throughout the taste bud. They found claudins specific for the diffusion of sodium located around a subset of taste bud cells and concluded that salt moves through the claudins to activate this particular subset of taste bud cells.

“So far, we thought that individual taste cells are uniquely equipped with specific receptors sensitive to sweet, bitter, sour, or umami molecules only,” reported Johannes le Coutre, who heads the research team. “Our findings suggest that specific tastants may stimulate different cell groups, depending on the surrounding network of claudin molecules.”

The scientists hope that by learning more about the molecular physiology of salty taste, ingredients can be developed that do not contain sodium but still can activate the taste bud cells in the way that sodium does.

address high sodium levels in foods.

AMA representatives testified at the hearing, where Stephen Havas, Vice President for Science, Quality, and Public Health, AMA, said, “Americans don’t consume large amounts of salt because they request it, but often do so unknowingly because manufacturers and restaurants put it in food. The FDA has an opportunity to inform the public of the hazards of salt through better labeling and provide increased incentives for the industry to reduce the amount of salt added to food.”

Like CSPI, AMA wants FDA to regulate the amount of salt in processed foods and to educate consumers about the importance of incorporating a low-sodium diet into their lifestyles.

However, in comments that the Salt Institute submitted to FDA about a month after the hearing, the organization argued that “the use of salt to make foods more palatable is a millennia-old phenomenon and not the result of commercial promotion, nor does it result from low-cost and ready availability.” The organization also prepared a 40-page statement for the hearing in which it urged FDA to deny the CSPI petition to revoke the GRAS status for salt.

Developments for Low-sodium Applications

Responding to health concerns about diets high in sodium as well as to consumer requests for more low-sodium food choices, ingredient developers and food manufacturers are creating ingredients for use in reformulated food and beverage products. ConAgra Foods, Omaha, Neb., announced in December 2007 that it had removed 2.8 million lb of salt/year from Americans’ diets as part of a companywide initiative to reduce sodium levels in its products, including *Banquet*[®], *Chef Boyardee*[®], *Kid Cuisine*[®], *Marie Callender’s*[®], and *Orville Redenbacher’s*[®]. The

company developed a proprietary sodium ingredient for use in its *Orville Redenbacher’s SmartPop!* microwave popcorn that reduced the sodium content by 30% while maintaining taste parity with regular microwave popcorn. According to the company, this was one of its first ingredients developed for use in low-sodium applications, and more are planned.

According to the market research firm Packaged Facts, sales for what it calls “sodium content” foods, or low-, no-, and reduced-sodium foods, will continue to grow. Detailing its findings in the report, *Market Trend: Low, Reduced or No Sodium or Salt Foods and Beverages in the U.S.*, the company reported that for brands where data is available, the introduction of products with one or more stock-keeping units (SKUs) bearing a low-salt or low-sodium claim increased from 102 low-salt and low-sodium claims in 2002 to 209 such claims in 2007. The compound annual growth rate for products with these claims during this time period is 15.4%.

Health and wellness concerns—including those that relate to salt consumption—are greatly affecting the purchasing habits of consumers, said Tatjana Meeman, Publisher, Packaged Facts, commenting on the report. She added that she expects that the use of salt substitutes and salt-enhancing ingredients will increase.

At several of last year’s food industry-related exhibitions, including the IFT Annual Meeting and Food Expo, many ingredient suppliers showcased prototypes that featured new or recently developed ingredients for use in sodium-reduced applications, no doubt in response to the growing number of consumers who are watching what they eat.

All of the top food companies that are customers of Wixon Inc., St. Francis, Wis., have some type of sodium-reduction project ongoing or in development, said

Peter Gottsacker, President. “The technology has now caught up with the industry to deliver the second round of flavorful products without compromising taste and texture,” Gottsacker continued.

Reformulating without compromising taste and texture is a challenge faced by product and ingredient developers charged with the task of removing salt from foods and beverages. This is particularly true in developing topical applications where the salt crystals come into contact with your tongue right after you put the food into your mouth, said Mariano Gascon, Vice President of R&D, Wixon.

• **Masking Potassium Chloride.** Since salt enhances flavor and helps to improve texture, reducing usage levels can radically change the finished products. Gascon emphasized that salt affects physical



Processed foods contain too much sodium, say doctors and nutritionists. Companies such as Campbell offer some products with reduced-sodium formulations.

Photo courtesy of Campbell Soup Co.



Spices such as allspice, black pepper, and fennel seed—along with just a teaspoon of salt—help add flavor to these buffalo steaks. Photo courtesy of McCormick & Co. Inc.

and chemical properties such as boiling point, freezing point, and others, and that these change when salt replacers are used. This makes the act of replacing salt application specific. “It is not like replacing sugar or fat, where you can add several bulking ingredients to compensate for the replacement,” he said. “When you remove salt, you also need to alter the way that you manufacture the food.”

Potassium is commonly used in ingredients employed in reduced-sodium product formulations, but it reportedly imparts a metallic aftertaste. Other salts are useful but have limitations, as well. Gascon cited the example of calcium chloride, which has an extremely salty taste but is highly hygroscopic and has exothermic properties when in contact with water, making it unsuitable for use in dry applications. It currently is used in some sports drinks and

pickles. Magnesium chloride has a salty taste, but like potassium chloride, it does not have a clean taste, and the perception of saltiness is different than that of regular salt.

Several salt substitutes contain flavor blends and other ingredients designed to mask the metallic aftertaste associated with potassium chloride. When used in conjunction with potassium chloride, *SaltTrim*™ from Wild Flavors Inc., Erlanger, Ky., masks these aftertastes and enhances salty perception and mouthfeel as well as allows manufacturers to remove up to 50% of salt. This proprietary ingredient is heat-stable and can be blended with other dry ingredients. It debuted in the United States in 2005 and in Europe in 2007.

Wixon produces several ingredients designed for use in sodium-reduction applications. Its *Magnifique* line of taste modifiers solves specific flavor challenges and

consists of 15 products so far. This line of natural flavors made from botanical extractives offers three options for use in sodium-reduction applications: taste modifiers to mask the aftertaste of potassium chloride or other similar salts; taste modifiers to mask aftertastes that some yeast extracts may impart or to replace the use of yeast extracts by enhancing the umami perception; and *KClean Salt*, a 50%-reduced-sodium blend of salt, natural flavors, and potassium chloride.

“Even though you see potassium chloride in *KClean Salt*, the secret is that the potassium chloride is made using a patented process where we have bonded our taste modifiers with the potassium chloride, leaving off the bitter aftertaste and making the potassium chloride taste like regular salt,” Gascon explained.

This spring, Wixon showcased its *KClean Salt* in “Floribbean” marinated beef tenderloin with a Mandarin orange Chantilly sauce at the Research Chefs Association Annual Conference and Expo in Seattle. At the Snaxpo Exhibition and Conference in San Antonio, Texas, salty snack chips formulated with *KClean* were available for sampling.

• **Mineral Salt Blends.** A blend of mineral salts can reduce the sodium content of some processed foods by up to 50% without losses in taste. Manufactured by Jungbunzlauer AG, Basel, Switzerland, and introduced in 2007, *sub4salt*® has similar salty taste characteristics and no metallic off notes. When used as an almost 1:1 replacement of salt in soups, the ingredient reduces sodium by 40%. In bakery products, *sub4salt* reduces sodium by up to 35%. Additionally, it regulates the fermentation process and biochemical reactions during dough fermentation to help produce products that are not different in taste or appearance from products that do not contain

the ingredient. The company also has demonstrated sodium reduction levels of at least 30% in meats and some snack products.

Mastertaste, Teterboro, N.J., launched its flavor-modulation line of proprietary mixtures, one of which is said to allow food and beverage processors to reduce the level of sodium by up to 50% in certain products. Its *Salt Modulators* flavor systems are designed to enhance the perception of saltiness while providing an overall increase in the flavor profile in applications where reduced-sodium finished products are desired. According to the company, the ingredient does not have a residual aftertaste, does not contain added MSG or HVP, is readily water-soluble, and is thermally stable. Depending on the application, there are several different modulator systems avail-

able that contain ingredients such as maltodextrin, salt, potassium chloride, and autolysed yeast extract.

• **Taste Potentiators.** Cargill Inc.'s, Wayzata, Minn., *SaltWise*[™] sodium reduction system is a proprietary blend of ingredients that mimics the characteristics of salt—water soluble, heat- and acid-stable, and easily flowing. “The combination of ingredients work together to provide the same great salty taste consumers crave without leaving any aftertaste while delivering a reduction in sodium of 25–50%,” said George Lutz, Quality Assurance—Technical Service Manager. “All ingredients are generally recognized as safe (GRAS), but due to the patent-pending status of the system, we are keeping the formulation confidential at this time.”

Cargill debuted *SaltWise* at the 2007 IFT Food Expo, showcasing it

in tortilla chips and ranch dressing. A few months later, at the 2007 Worldwide Food Expo, the company offered reduced-sodium beef sticks formulated with the ingredient.

Givaudan SA, Vernier, Switzerland, develops ingredients for use in sodium replacement and sodium reduction applications under its *TasteEssentials*[™] for Salt Reduction Program. The company's scientists work with the food or beverage product at its base level, customizing a solution that is specific to the product, because the best solutions are not universal fits for all applications, said Jeffrey S. Spencer, Director, Flavor Creation. They have identified several trace components with taste-modifying properties that affect sodium perception such as those from bonito extract (lactate derivatives) and chicken broth (derivatives of sulfurated dipeptides). They have



Seasoning potato chips with more spices adds flavor and is a way to compensate for using less salt.

Photo courtesy of Kerry Ingredients U.S.

Spices Flavor Low-sodium Foods

Product formulators seeking to boost the flavor of foods *without* relying on salt might consider spicing things up with ingredients like oregano, various chile pepper powders, cumin, garlic powder, sage, allspice, grains of paradise, and more. The approach works for home cooks, too.

“The spice aisle is much more diverse than ever before, making it easy to go beyond salt, pepper, and a little garlic to spice up comfort foods,” noted Laurie Harrsen, Director of Consumer Communications, McCormick & Co. Inc., in a press statement regarding the company’s 2008 Flavor Forecast.

In its yearly *Flavor Forecast*, the company shares predictions about the flavors that will grow in popularity with chefs, home cooks, and product developers; suggests the top 10 flavor pairings, which include flavors from spices, seasonings, and other ingredients like fruit, wood, alcohol, and flowers; and suggests recipes in which the ingredients can be incorporated. Food formulators might also take a cue from these flavor pairings and use some of the seasonings and other ingredients to replace some of the added salt in foods and to enhance the flavor. Orange peel and natural wood, vanilla bean and cardamom, rubbed sage and rye whiskey, and poppy seed and rose are examples of ingredients that can help spice up foods that have reduced-sodium levels.

At last year’s IFT Food Expo, Kerry Americas featured a low-sodium prototype—*Lower-Sodium Chili-Lime Potato Chips*—that was made so just by reducing the salt content with a low-sodium seasoning blend of lime juice powder, chilies, vinegar, and other savory notes.

also developed masking systems that are effective at up to 40–50% replacement of sodium with potassium and have removed up to 35% of sodium in many applications, using a combination of botanicals and fermentation technology.

Spencer added that his company’s greatest success in sodium-reduction and sodium-replacement applications was with sauces, gravies, and soups. Givaudan also applies the technology to marinades, batters, and breadings, and recently began applying it to grain applications, such as bars and ready-to-eat cereals.

A blend of a yeast-based extract and non-sodium salts from DSM Food Specialties, Delft, Netherlands, is said to reduce salt by up to 50% in dairy foods, particularly processed cheese, and in bakery products. The ingredient, *Maxarite™ Delite*, has a neutral taste and helps to boost the overall flavor intensity of the finished product.

• Phosphate Ingredients.

All of the ingredients mentioned so far were specifically designed to replace some of what we call table salt in products. The recent development of certain phosphate ingredients allows for the reduction of other sources of sodium, such as sodium bicarbonate. ICL Performance Products LP, St. Louis, Mo., offers two such phosphate-based ingredients: *Levona™*, a sodium-free calcium-acid pyrophosphate leavening agent, and *Benephos™*, a mixed-cation polyphosphate.

“For many manufacturers, the initial focus was to look at salt from three different angles: Reduce it, remove it, or replace it,” said Barbara Heidolph, company spokesperson. “The problem with this approach is that salt is a critical ingredient. Now we are seeing that more of our customers are interested in looking at all sources of sodium.”

In chemically leavened products, the three key sources of sodium are sodium chloride,

sodium bicarbonate, and leavening acids. The first two can be replaced with potassium chloride and potassium bicarbonate, respectively.

“Before the introduction of *Levona*, sodium-free leavening acids provided a fast reaction rate, going off during mixing, or the acids offered very slow leavening, which would react during the late phases of baking,” said Heidolph. “And in some applications, the acids leavened after the product set.” Instead of reacting before baking or toward the end of baking, *Levona* provides the leavening reaction during the critical phases of baking, when volume development occurs, which can help to improve the final flavor, volume, and texture of the product.

The level of sodium in *Benephos* has been reduced by 70% and replaced with potassium. It often replaces sodium polyphosphate in beverages.

Low-sodium Products in the Marketplace

The 10 leading food companies involved in low-sodium product development, according to Packaged Facts, are Amy’s Kitchen Inc., Campbell Soup Co., ConAgra Foods, Del Monte Foods Co., General Mills Inc., H.J. Heinz Co., Hain Celestial Group Inc., Hormel Foods Corp., Kraft Foods Inc., and Unilever. Sodium content claims are made for a wide variety of products, including soups, canned foods, condiments, snack foods, beverages, and meat and fish, and the preceding companies offer many of these products across their portfolios.

For consumers looking to purchase products that are lower in sodium, the number of offerings is increasing. Morton Salt, Chicago, Ill., offers three products directly to consumers who are monitoring their salt intake. Two of the products—*Salt Balance™ Salt Blend* and *Lite Salt™ Mixture*—are blends of sodium and potassium chloride that contain 25% and 50% less sodium, respectively, than regular table salt.

The third product, called *Salt Substitute*, is straight potassium chloride for use by consumers on a doctor-recommended sodium-restricted diet.

The J & B Group, St. Michael, Minn., this year will begin offering steak, chicken, and pork products formulated with Cargill's *SaltWise* under its *No Name*[®] brand of meats. Responding to consumer interest in reduced-sodium meat products, the companies jointly developed the products with a 33% reduction in sodium.

Campbell Soup Co., Camden, N.J., in February 2008 announced that it has reformulated 48 soups to contain 480 mg of sodium/serving and will debut these products later this year. Of the 48, 36 will be marketed under the *Campbell's Select Harvest* brand. The other 12 varieties are what the company calls "kids' favorite soups" such as *Campbell's Chicken & Stars*. The addition of these products brings the total number of Campbell's low- and reduced-sodium soups to more than 85.

The company began its sodium-reduction initiative in 2006, with the introduction of 32 new or reformulated soups with 25–45% less sodium. Thus, low-sodium products are not new additions to the Campbell portfolio, but using newer blending techniques, flavors, and ingredients has allowed the company to create products that it says are likely to be better received by consumers.

Salt has played an important role in history and continues to be an important ingredient in food formulation. Consumer concerns about salt intake have led the food industry to develop ingredients and products for the low-sodium market. As more consumers choose low-sodium foods, or as their doctors recommend that they do so, suppliers will continue to develop ingredients for use in low-sodium applications. These ingredients promise to produce tasty products similar to their full-sodium counterparts. **FT**

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