

Salt: Discover the magic, but avoid the menace

Salt is so common, so cheap, and so available that we hardly give it a second thought. Yet salt performs such scientific and culinary wonders that it seems to have magical qualities. Even so, nutrition and health experts warn that consuming too much of it can endanger health.

Early childhood is an opportune time for children to start learning about this fascinating substance. They can begin to appreciate its wizardry while developing healthy eating habits that can stave off the threat of illness.

What is salt?

Ordinary table salt is **sodium chloride**, a compound represented by the chemical symbol NaCl. The sodium in salt is essential to life and health. It helps to regulate blood pressure and blood volume in the body and helps muscles and nerves to function properly.

Salt is vital not only to humans but also to animals.

In the wild, animals may lick a mineral deposit known as a salt lick or drink from briny springs to fulfill their need for sodium and other minerals such as calcium and iron. Today farmers and ranchers put out manufactured salt blocks for livestock to serve the same purpose.

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Today, surprising as it may sound, human food seasoning and agriculture account for only 12 percent of the salt produced. It's more widely used in commercial and industrial applications, such as softening water, deicing roads, and making glass, plastic, polyester, paper, dyes, and bleach, to name a few (Maldon Salt Company 2013).

To understand salt's various uses, we need to look at the science behind it, especially in geology, chemistry, and biology.

Geology. Salt is a mineral that occurs naturally in the earth. As rain falls, the water percolates through the soil, picking up salt and other minerals. This water may collect in underground aquifers that provide water for cities and irrigation. This fresh water may contain salt but not enough to be tasted. The rain that runs over the land and flows into rivers eventually ends up in the ocean. Over eons, this runoff plus minerals escaping from undersea volcanic eruptions as well as seepage from hydrothermal vents have made the oceans salty (Office of Naval Research n.d.).

Water **salinity** is measured by the number of

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grams of salt in 1,000 grams of water. One gram of salt in 1,000 grams of water, for example, is expressed as one *part per thousand*, or 1 ppt. The average ocean salinity is 35 ppt, compared to fresh water salinity of less than 0.5 ppt (Office of Naval Research n.d.).

Certain inland bodies of water, such as the Great Salt Lake in Utah and the Dead Sea in the Middle East, are saltier than seawater. Their water is so dense that a person can float on the surface. These bodies of water are salty because they have no outlets, no way for the water to leave except by evaporation, so the salt accumulates (Encyclopedia Britannica n.d.).

A SALT IS A SMALL BUT PERFECT THING.

For centuries people have harvested salt from coastlines where seawater evaporated as well as dry lake beds, salt marshes, and mineral springs. In time people set up their own evaporation ponds by the sea and boiled briny water to get the salt residue. The **sea salt** that has become a recent gourmet fad is evaporated from seawater and therefore contains trace oceanic minerals that give it flavor and color (Zeratsky 2013).

In some parts of the world, salt lies in a huge vein underground, much like coal. In other areas, natural forces have pushed salt upward to form a dome. This is rock salt, a mineral known by its geologic name as **halite** (Arizona State University n.d.). Salt is extracted from veins and domes by mining. The ancient Celts, for example, dug deep and elaborate salt mines in what is now Austria.

Domes of salt formed when surrounding rock of higher density shifted, pushing the salt toward the surface. Alongside the dome, meanwhile, decaying matter collected and turned into oil and natural gas. In 1901 a self-taught geologist, Patillo Higgins, drilled into a salt dome near Beaumont, Texas, and hit a gusher of oil that became known as Spindletop. The boom that followed gave rise to the modern oil industry, and salt domes became an indication of

potential oil and gas deposits.

Because salt is impermeable rock that can flow and seal cracks that might develop within it, salt domes have been used in recent years as depositories for hazardous waste (King n.d.).

Chemistry. Chemists use the word *salt* for any substance created by the reaction of an acid and a base. In the reaction an acid (which lacks an electron) combines with a base (which contains an extra electron). In table salt, the acid is chloride, and the base is sodium.

Mark Kurlansky in *Salt: A World History* (2003) calls this combination “a microcosm for one of the oldest concepts of nature and the order of the universe.” From the fourth century B.C. to the present, “there has always been a belief that two opposing forces find completion—one receiving a missing part and the other shedding an extra one. A salt is a small but perfect thing.”

Not all salts are edible. Magnesium sulfate, or **Epsom salt**, was discovered in 1618 by a farmer in Epsom, England, when his cow refused to drink water from a mineral water well. The farmer tasted the water and found it bitter. He also noticed that applying it to the skin healed scratches and rashes.

Today Epsom salt is added to bath water to soak aching feet or relieve sore muscles. An Epsom salt bath can have the added benefit of increasing the body’s levels of magnesium and sulfate, nutrients essential for many biological processes. A paste of Epsom salt and water is also claimed to soothe mosquito bites, bee stings, poison ivy, and sunburn (Epsom Salt Council n.d.).

Other compounds classified as salts include calcium chloride, sodium bisulphate, magnesium chloride, and potassium chloride. The last salt in this list, combined with regular table salt, is sold as a salt substitute, such as Morton® Lite Salt™.

As mentioned earlier, a major use of salt is deicing roads. How does it work? Water ordinarily freezes at 32 degrees Fahrenheit, but salt lowers the point at which water freezes. Consequently spreading salt on a rain-slick road means the water will remain a liquid until the air gets much colder. Rock salt is often used because it’s inexpensive and effective at temperatures down to 15 degrees Fahrenheit and lower. In colder climates, however, other more expensive salts may be used. Magnesium chloride works down to 5 degrees Fahrenheit, for example, and calcium chloride works

down to minus 20 degrees Fahrenheit. The trade-off in using any salt for deicing, however, is that it can damage concrete and contaminate soil (Helmenstine 2010).

The action of salt on ice also explains why we add salt to ice when making homemade ice cream. Salt lowers the freezing point, thereby making the ice colder and helping the ice cream mixture in the inner canister to freeze faster.

Biology. In nutrition and health circles, the terms *salt* and *sodium* are often used interchangeably, but the sodium is what they're really talking about. In digestion, table salt separates into sodium and chloride, making the sodium available for use.

The body excretes sodium in sweat, tears, and urine. Because the body does not make sodium, it must come from the diet. Sodium occurs naturally in many foods and in some water sources.

Athletes and laborers, particularly in hot climates, need more sodium than others because they lose so much in sweating. They can replenish sodium by consuming a sports drink containing sodium, such as Gatorade®, or by eating high-sodium foods such as cheese, pickles, and pretzels before or after an event. (Salt tablets are not recommended unless directed by a doctor.)

In the 1920s, at government request, salt producers began fortifying table salt with **iodine**, a mineral found naturally in fish that helps the thyroid gland produce hormones needed for metabolism and brain development. Iodine deficiency during pregnancy and infancy can result in a child's low intellectual capacity and even mental retardation. Although the deficiency was once confined to developing countries in Asia, Africa, and South America, health experts think it may be rising in industrialized countries including the United States (Davis 2014).

A small amount of table salt, either iodized or plain, can be mixed with water for an effective home remedy for minor health problems. Gargling with the solution helps heal a sore throat (WebMD 2012), and cleaning gums with it helps prevent gum disease (Kennedy n.d.). Similarly, squirting a mild saline solution into nostrils helps relieve clogged sinuses (MelinePlus 2013); and soaking in an Epsom salt bath solution removes toxins from sore muscles (Decarbo 2012).

To understand how this works, sprinkle a little salt on the inside of a raw potato. Soon you will see

droplets of moisture forming. This is the biological process of **osmosis**. The water has moved from an area of high concentration (cells inside the potato) to an area of low concentration (air outside the potato) to reach equilibrium on both sides. Other examples of osmosis include the movement of water and oxygen into body cells and the movement of water and nutrients into the roots of plants.

Osmosis is a particular type of **diffusion**. Examples of diffusion include food coloring that spreads through water and air freshener that disperses throughout a room. What distinguishes osmosis from diffusion is that osmosis occurs through a permeable membrane, such as a plant or body cell (Muskopf n.d.).

Centuries ago, before scientists explained these processes, people discovered they could use salt to preserve food. Although modern canning and refrigeration have largely replaced salting, it's still used in curing ham and bacon and in making cheese. Salt preserves food by absorbing water and thus drying out the food so that bacteria and mold cannot survive.

What is salt's menace?

The sodium that the body needs for health is the same sodium—but in excess—that can damage health. In other words, too much of a good thing can have bad consequences.

When the kidneys cannot eliminate enough sodium, it builds up in the blood. This excess sodium “pulls fluids from the body's tissues and into the blood, which raises the blood volume and compels the heart to pump more forcefully. The result: high blood pressure” (Moss 2013).

High blood pressure, or **hypertension**, can overstretch blood vessels, contribute to a heart attack or stroke, and cause heart and kidneys to fail.

Ordinarily doctors have recommended limiting sodium intake to less than 2,300 milligrams a day. But the recommended limit for at-risk groups is 1,500 milligrams a day. At-risk groups include people who have high blood pressure, kidney disease, or diabetes, as well as people age 51 or older, and blacks.

High blood pressure was once confined largely to adults, but in recent years, health experts have connected high blood pressure to high salt intake among children and adolescents. A 2012 study by the Centers for Disease Control found that on average children

consume 3,400 milligrams of sodium a day, or 40 percent too much. This study, of children 8 to 18 years old, also found that children who eat the most salt face twice the risk of high blood pressure than those who eat less salt. Furthermore, children who are overweight or obese face three times the risk.

These findings are worrisome because children with high blood pressure are likely to grow into adults with the condition and therefore face a greater risk for hypertension and heart disease.

Biggest sources of sodium

The recommended daily limit of 2,300 milligrams of sodium translates to only about a teaspoon of table salt. At first glance, one might think this is the amount we add to food at meals, and further that we can reduce sodium simply by easing up on the salt shaker. Too, one might remember that some foods, like ham and cheese, are high in sodium because of the way they are made. Reducing consumption of these foods may help, but not by much.

The real culprit is the salt added to foods during processing. According to the Harvard School of Public Health (2009), “Almost 80 percent of the salt in the American diet comes not from the salt shaker, but from processed and restaurant foods.”

Processed foods, as the term is used here, refers to such products as packaged breads, bagged chips, canned foods, frozen dinners, and boxed mixes. In processing, manufacturers add salt not just for seasoning, but to make food last longer and taste better.

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Salt helps mask the unpleasant tastes left by chemical preservatives and from reheating precooked meats (Moss 2013), for example.

Added salt is yet another strike against processed foods, which in the recent past have been criticized for containing added sugar, artificial sweeteners, fats, colorings, and various chemicals that are believed to contribute to obesity and play a role in cancer and other diseases. Ironically, the salt in processed foods is rarely iodized (NIH 2011).

To learn more about food additives and their hazards, see the list compiled by the nonprofit Center for Science in the Public Interest at www.cspinet.org/reports/chemcuisine.htm.

Processed foods dominate the top 10 sources of sodium consumed by children 2 to 19 years old, as identified by the CDC (2013). While reviewing the list below, keep in mind that if sodium consumption is limited to 1,500 to 2,300 milligrams a day, one meal cannot exceed 500 to 750 milligrams. It also helps to know that a food is considered low in sodium if it has 140 milligrams or less per serving (Busch 2014).

1. Pizza. One slice (1/6 of a pie) of a four-cheese pizza roughly 12 inches in diameter contains 790 milligrams of sodium. The same size serving of a pepperoni pizza contains 880 milligrams. Pile on more cheese, sausage, and olives, and the sodium soars.

2. Bread and rolls. Bread doesn't taste salty, yet one white hot dog bun contains 220 milligrams. Whole wheat won't necessarily lower the sodium. Two slices of whole wheat bread contain 300 milligrams, and a whole wheat hamburger bun has 310. One flour tortilla has 210 milligrams of sodium, and two small multi-grain waffles from the freezer case contain 390 milligrams. Unfortunately, salt isn't removed from breads because it's necessary for taste and texture.

3. Packaged poultry products. Three nugget-type pieces of fully cooked, breaded chicken breast contain 570 milligrams of sodium. A 2-ounce serving of deli-style turkey contains 420 milligrams, and the version labeled low sodium is not much less, with 390 milligrams. A cup of cooked Texas Ranch Chicken dinner from the freezer case contains 970 milligrams.

4. Cold cuts and cured meats. A slice of beef bologna contains 350 milligrams, while 2 ounces of deli-style honey ham has 420 milligrams.

5. Sandwiches. Much of the sodium in sandwiches comes from bread and cured meats, noted above. Spread a tablespoon of mayonnaise on the bread for another 90 milligrams. Eat one sandwich with a slice of cheese (see below), a few potato chips (see below), and a whole dill pickle (210 milligrams), and you've consumed nearly half the day's limit.

6. Savory snacks. Seven low-fat pretzels contain 360 milligrams of sodium. Some chip snacks fall into the medium-sodium category (11 potato chips have 160 milligrams, and 32 corn chips contain 170 milligrams), but do we stop at those amounts?

7. Commercially prepared soups. A cup of canned soup (condensed, water added) ranges in sodium by type: beef vegetable 850 milligrams; vegetarian vegetable 1,520 milligrams; and chicken noodle 1,840 milligrams.

8. Cheese. An ounce of cheddar has 180 milligrams, and the 2-percent-milk version, 220 milligrams. A slice of vegetarian cheddar also has 220 milligrams. Processed cheeses and cheese spreads have even more.

9. Mixed pasta dishes. A cup of macaroni and cheese made from a package contains 610 milligrams of sodium, mostly from the cheese and sauces. Make whole wheat spaghetti with bottled marinara sauce, and you get zero sodium from the spaghetti (2 ounces) and 360 milligrams from a half cup of sauce.

10. Frankfurters and sausage. A single beef frank has 550 milligram of sodium. A 2-ounce serving of breakfast sausage has 400 milligrams, and 3 ounces

of mesquite-smoked sausage, 380 milligrams.

What's not on this list are canned vegetables, perhaps because they're consumed in smaller quantities by children. But checking sodium amounts in canned vegetables can be instructive. Sodium amounts for a half cup of canned vegetables are as follows: pinto beans 460 milligrams; green beans 290; corn 300; and tomatoes 180.

The sodium content of the foods above comes from a survey of house-brand products noted on a walk through an Austin HEB grocery store. You can do the same in your favorite store, looking for the items and brands you usually buy. You may also learn the following:

- Different brands of the same food may have different quantities of sodium.
- The serving size may be unrealistic or difficult to picture in one's mind (what does 2 ounces look like?).
- Even foods that are considered healthy or labeled *organic* can have lots of sodium.
- Sugary foods and soft drinks may be high in sodium.
- Nutrition labels on small items appear in small type. A magnifying glass may be helpful.

A handy source for checking sodium amounts is "The Sodium Content of Your Food" published by Texas A&M AgriLife Extension. The 28-page online publication contains hundreds of common foods; it's downloadable at http://fcs.tamu.edu/food_and_nutrition/pdf/sodium-content-of-your-food-b1400.pdf.



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You can also check sodium quantities by going to a food company's website. If you eat out, check the website of the restaurant. You will find that a Big Mac® contains 970 milligrams of sodium and a Taco Bell® bean burrito, 1,050 milligrams. Asian food may be flavor-enhanced by monosodium glutamate (MSG), a tablespoon of which has 1,476 milligrams of sodium.

Tips for reducing sodium in preschoolers

Research has shown that infants are born with a preference for sweet. Children acquire a taste for salt as they are introduced to it.

Incidentally, the taste for salt is not confined to a single part of the tongue. The diagram that you may have learned in health class showed four taste zones: sweet on the tip of the tongue, salty and sour on the sides, and bitter at the back. More current research suggests that all the tongue's taste buds react to many flavors, which are then interpreted by the brain.

In addition, Japanese scientists have identified a fifth primary taste, *umami*, which loosely translates as *meaty*. It is elicited by glutamate, an amino acid found in meat, fish, and beans. This is the same glutamate in MSG (Smith and Margolskee 2001).

With salted foods, the more the exposure, the greater the likelihood of developing a craving. We can help prevent that craving by lowering the sodium in what we feed children. How to do that?

- When grocery shopping, avoid the middle aisles with all the packaged foods. Foods in boxes and cans as well as frozen meals are typically the ones with added salt.
- Look for the American Heart Association's Heart-Check symbol on foods, a mark that indicates the food has been certified to meet nutritional criteria for heart-healthy foods.
- Check the nutrition labels on foods before you buy. Instead of corn flakes (1 cup, 210 milligrams of sodium), choose old-fashioned oatmeal (zero sodium) for breakfast cereal, for example.
- Buy low-sodium versions of foods. Choose "unsalted tops" saltine crackers (five crackers, 80 milligrams) over regular saltines (170 milligrams). Instead of the ordinary canned green beans (290 milligrams in a half cup), buy the "No salt added" type (15 milligrams).
- Prepare fresh or frozen vegetables and fruits. Fresh

and frozen green beans have zero sodium, for example. But check the nutrition label anyway. A 3-ounce serving of frozen French fries has 280 milligrams of sodium.

- Cook soups, pasta sauces, beans, rice, and meats from scratch. Avoid recipes that call for canned soups, such as mushroom and tomato.
- Serve open-faced sandwiches with only one slice of bread. Use low-sodium meat or cheese, and top with plenty of fresh vegetables such as lettuce, spinach, tomatoes, cucumbers, cabbage slaw, and radishes.

CHECK THE NUTRITION LABELS ON FOODS BEFORE YOU BUY.

- For snacks, serve fresh fruit, hard-boiled eggs, raisins, graham crackers, plain or fruit yogurt, plain popcorn, peanut butter, and tofu. Avoid buying or serving chips. If you participate in the Child and Adult Care Food Program (CACFP), always be mindful of reimbursement guidelines. Find more information at www.fns.usda.gov.
- In cooking, use iodized rather than plain salt
- Educate your staff and parents about salt—the magic and the menace.

References

References

- American Heart Association and American Stroke Association. 2012. Facts: Salt, reducing sodium in the diets of American children, www.heart.org/idc/groups/heart-public/@wcm/@adv/documents/downloadable/ucm_464343.pdf.
- Arizona State University. n.d. What is a mineral? Rock Around the World, http://ratw.asu.edu/aboutrocks_whatsamineral.html.
- Busch, Sandi. 2014. What is considered low sodium on a nutrition panel? Demand Media, Hearst Newspapers, <http://healthyeating.sfgate.com/considered-low-sodium-nutrition-panel-8847.html>.
- CBS News. Sept. 17, 2012. Kids eat too much salt and it's raising their blood pressure, CDC study finds, www.cbsnews.com/news/kids-eat-too-much-salt

-
- and-its-raising-their-blood-pressure-cdc-study-finds. Centers for Disease Control. March 2013. High sodium intake in children and adolescents: Cause for concern, www.cdc.gov/salt/pdfs/children_sodium.pdf.
- Davis, Jeanie Lerche. 2014. Salt: Don't ban it entirely, WebMD, www.webmd.com/diet/features/salt-dont-ban-entirely.
- Decarbo, Beth. April 9, 2012. Quick Cures/Quack Cures: Is Epsom worth its salt? *Wall Street Journal*, <http://online.wsj.com/news/articles>.
- Encyclopedia Britannica. n.d. Great Salt Lake, www.britannica.com/EBchecked/topic/243671/Great-Salt-Lake#ref215015.
- Epsom Salt Council. n.d. Benefits of bathing with Epsom salt, www.epsomsaltcouncil.org/health.
- Harvard School of Public Health. Fall 2009. Public health takes aim at sugar and salt, *HSPS News*, www.hsph.harvard.edu/news/magazine/sugar-and-salt.
- Helmenstine, Anne Marie. Dec. 9, 2010. What is the best deicer? About.com Chemistry, <http://chemistry.about.com/b/2010/12/09/what-is-the-best-deicer.htm>.
- Laszlo, Pierre. 2001. *Salt: Grain of Life*. New York: Columbia University Press.
- Kennedy, Karen Kirkpatrick. n.d. Does saltwater work as a mouthwash? HowStuffWorks.com, <http://health.howstuffworks.com/wellness/oral-care/products/saltwater-as-mouthwash1.htm>.
- King, Hobart. n.d. Salt domes, Geology.com, <http://geology.com/stories/13/salt-domes/>.
- Kurlansky, Mark. 2003. *Salt: A World History*. New York: Penguin Books.
- Maldon Salt Company. 2013. The many uses of salt, www.maldonsalt.co.uk/About-Salt-The-many-uses-of-Salt.html.
- Mayo clinic staff. May 30, 2013. Sodium: How to tame your salt habit. www.mayoclinic.org/healthy-living/nutrition-and-healthy-eating/in-depth/sodium/art-20045479.
- MedlinePlus. Aug. 12, 2013. Stuffy or runny noses: Adult. U.S. National Library of Medicine, National Institutes of Health. www.nlm.nih.gov/medlineplus/ency/article/003049.htm.
- MedlinePlus. n.d. Sodium in diet, U.S. National Library of Medicine, National Institutes of Health. www.nlm.nih.gov/medlineplus/ency/article/002415.htm.
- Mortonsalt.com. 2014. Salt facts, www.mortonsalt.com/salt-facts.
- Moss, Michael. 2013. *Salt Sugar Fat: How the Food Giants Hooked Us*. New York: Random House.
- Muskopf, Shannan. n.d. Diffusion and osmosis, Biology Corner.com, www.biologycorner.com/bio1/notes_diffusion.html.
- National Institutes of Health. 2011. Iodine: Facts for consumers, <http://ods.od.nih.gov/factsheets/Iodine-QuickFacts/>.
- Office of Naval Research. n.d. Ocean water: Salinity, www.onr.navy.mil/focus/ocean/water/salinity1.htm.
- Smith, David, and Robert F. Margolskee. March 2001. Making sense of taste, *Scientific American*, http://cf.linnbenton.edu/mathsci/bio/wheatd/upload/making_sense_of_taste.pdf.
- WebMD. June 11, 2012. Q. What's the best treatment for my sore throat? WebMD.com, <http://answers.webmd.com/answers/1181543/what-the-best-treatment-for-my>
- Zeratsky, Katherine. Jan. 17, 2013. Sea salt vs. table salt: What's the difference, Mayo Clinic. www.mayoclinic.org/sea-salt/expert-answers/faq-20058512. ■
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