HEALTH

Drinking Water Quality and Health no. 9.307

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Quick Facts...

Water is our most essential nutrient.

Water contains different amounts of dissolved inorganic and organic compounds.

The Environmental Protection Agency regulates public water systems under the Safe Drinking Water Act.

The Colorado Department of Health regulates bottled or vended water if the water does not leave Colorado. The Food and Drug Administration regulates if the water is involved in interstate commerce.

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People can survive days, weeks or months without food, but only about four days without water. The body uses water for digestion, absorption, circulation, transporting nutrients, building tissues, carrying away waste and maintaining body temperature.

The average adult consumes and excretes about 10 cups of water daily. Adults should drink six to eight cups of liquids per day. Although most of this liquid should come from beverages, food supplies some water. Our bodies make water as a by-product in the breakdown of fats, sugars and proteins to energy.

Water is always two parts hydrogen to one part oxygen. Beyond that, its composition depends on where it comes from, how it is processed and handled. Water can be hard or soft, natural or modified, bottled or tap, carbonated or still.

Hard vs. Soft Water

The hardness of water relates to the amount of calcium, magnesium and sometimes iron in the water. The more minerals present, the harder the water. Soft water may contain sodium and other minerals or chemicals; however, it contains very little calcium, magnesium or iron. Many people prefer soft water because it makes soap lather better, gets clothes cleaner and leaves less of a ring around the tub. Some municipalities and individuals remove calcium and magnesium, both essential nutrients, and add sodium in an ion-exchange process to soften their water. The harder the water, the more sodium that must be added in exchange for calcium and magnesium ions to soften the water. This process has drawbacks from a nutritional standpoint.

First, soft water is more likely to dissolve certain metals from pipes than hard water. These metals include cadmium and lead, which are potentially toxic. Second, soft water may be a significant source of sodium for those who need to restrict their sodium intake for health reasons. Approximately 75 milligrams of sodium is added to each quart of water per 10 g.p.g. (grains per gallon) hardness. Finally, there is epidemiological evidence to suggest a lower incidence of heart disease in communities with hard water. The Environmental Protection Agency (EPA) doesn't set a mandatory upper limit for sodium in water, but suggests an upper limit of 20 milligrams per liter (quart) to protect individuals on sodium-restricted diets.

If you use a water softener, two ways to avoid excess sodium in drinking water are: 1) use low sodium bottled water, and 2) install a separate faucet in the kitchen for unsoftened water.

Giardia and Other Microorganisms

Along with differences in mineral composition, water contains different levels of microorganisms. Bacteriological tests are available to determine if water is bacteriologically safe for human consumption. Contact the county health department for information on how and where such tests are performed.

Chlorination and filtration are effective controls for most bacteria. However, a tiny one-celled parasite not readily killed by chlorination, *Giardia lamblia*, deserves special discussion. Giardia has become an increasingly common problem in rural and mountain communities with inadequate filtration systems. Giardia is mostly found in surface waters such as mountain streams and lakes, not groundwater. Because one cannot see, taste, or smell giardia, it is best not to drink water directly from mountain streams or lakes.

Once ingested, the giardia cyst develops into a trophozoite that attaches to the wall of the small intestine. Disease symptoms usually include diarrhea with cramping and gas, dehydration, weakness and loss of appetite. Symptoms may take seven to 10 days to appear and last up to six weeks. Most people are unaware at the time of ingestion that they have been infected.

Laboratory identification can confirm the disease by diagnosis of the organism in the stool. The disease is curable with prescribed medication. If untreated, the symptoms may disappear on their own and reoccur intermittently over a period of months. Treatment also can help prevent spread of the disease between people and between pets and people.

Prevention is the best solution. Always wash your hands after changing diapers and performing other hygiene activities. Wash children's hands frequently. Thoroughly clean change surfaces after diapering.

It's best to carry your own water on camping or backpacking trips. If this is not practical, the next best solution is to boil the water. Although giardia cysts are killed at temperatures of 131 degrees F, boiling for one minute at sea level and up to five minutes at 10,000 feet is recommended to eliminate other microorganisms that might be more heat resistant than giardia. Giardia also will not survive in water held at 59 degrees F for 30 minutes if one iodine tablet has been added per quart. Filters are available, but are expensive and inconvenient. Furthermore, many products marketed for backpackers are not effective in filtering out the tiny giardia cysts.

Dogs, like people, can get infected with giardia. Unless carefully controlled, dogs can contaminate the water and continue the chain of infection from animals to humans.

Fluoride

Fluoride is found naturally in Colorado water supplies in different amounts. The dental benefits of fluoridated water are well documented. Fluoride concentrations of 1.0 milligrams per liter or greater will reduce the incidence of dental cavities. However, concentrations over 2.0 milligrams per liter can darken tooth enamel causing fluorosis.

The American Dental Association and the American Medical Association endorse fluoridation. Yet, after more than 50 years of fluoridation, only two-thirds fo the U.S. population is served by drinking water with optimal levels of fluoride. Opponents have long argued that fluoridation violates individual rights, certain religious beliefs that ban medications, and does not prevent tooth decay. They also claim it promotes a variety of ills, including cancer. However, a recent study found a lower cancer incidence in areas with high fluoride concentrations in the drinking water.

Tooth decay is on the decline in the United States. The decline is occuring in fluoridated and to a lesser extent in non-fluoridated areas. Fluoride treatments, fluoridated toothpaste, dental sealants, better diets and improved oral hygiene are all factors.

Like most elements, fluoride appears to be both beneficial to health and potentially toxic. The goal is to determine the optimum level and then decide how best to achieve that level. The EPA currently sets the maximum allowable level of sodium fluoride in drinking water (natural or added) at 4 milligrams per liter (4 parts per million) and the maximum recommended level at 2 milligrams per liter. The EPA reviews drinking water standards every three years.

Lead

Lead is a toxic heavy metal known to turn up in drinking water. A 1986 EPA survey estimated that 40 million Americans (one in five) were using drinking water that contained potentially hazardous levels of lead. This finding led to changes in the Safe Drinking Water Act to require the use of "lead-free" pipe, solder, and flux in the installation or repair of home and commercial plumbing connected to public water systems.

Acute lead poisoning can cause severe brain damage and death. The effects of chronic, low-level exposure, however, are more subtle. The developing nervous systems of fetuses, infants, and children are particularly vulnerable. Recent studies show that lead exposure at a young age can cause permanent learning disabilities and hyperactive behavior. Low-level lead exposure also is associated with elevated blood pressure, chronic anemia, and peripheral nerve damage.

Natural water usually contains very little lead. Contamination generally occurs in the water distribution system or in the pipes of a home or facility. Lead pipes, brass faucets and lead solder used to join copper pipes are the culprits. If your home was built before 1986 when the nationwide ban on lead pipes and lead solder went into effect, it is likely to have lead-soldered plumbing.

The severity of lead contamination depends in part on how "corrosive" your water is. Soft or acidic water is more likely to corrode plumbing and fixtures, leaching out lead. According to the EPA, about 80 percent of public water utilities deliver water that is moderately or highly corrosive.

The EPA currently requires that public utilities ensure that lead levels at the customer's tap not exceed 15 parts per billion (ppb) in at least 90 percent of the homes sampled. Water systems that exceed such levels are required to implement corrosion control measures to reduce leaching of lead into water. Techniques such as adding lime (calcium oxide) to reduce water acidity can greatly reduce lead levels at the tap. Consumers can follow a number of simple practices to help reduce the level of lead at the tap.

1. Cook with and drink only cold water. Hot water tends to dissolve more lead from pipes.
2. Don't drink the first water out of your tap in the morning. Let the water run for about one minute until a change in temperature occurs.
3. For private wells, consider water treatment devices such as calcite filters that reduce acidity and make water less corrosive. Certain point-of-purchase treatment devices (e.g., some ion-exchange filters, reverse osmosis devices and distillation units) also can remove lead.
4. If lead levels remain high, consider bottled water for drinking and cooking purposes.

Nitrate

Nitrates may be found naturally in water or may enter water supplies through a number of sources (fertilizers, animal wastes, septic systems). High nitrate-containing water is a serious health concern for pregnant women and infants under the age of 6 months. Bacteria in the infants' digestive tracts may convert the relatively harmless nitrate to nitrite. In turn, the nitrite combines with some of the hemoglobin in blood to form methemoglobin that cannot transport oxygen. To protect those at risk, the Maximum Contaminant Level (MCL) for nitrate in water is 45 mg/l as nitrate (NO_3) or 10 mg/l measured as nitrogen (N). The MCL for nitrite is 1 mg/l measured as nitrogen.

A list of contaminants currently monitored by public drinking water systems, maximum contaminant levels (MCL), common sources and potential health effects from exposure above the MCL can be found at http://www.epa.gov/safewater/mcl.htm.

Sulfate

Sulfates occur naturally in groundwater combined with calcium, magnesium and sodium as sulfate salts. Sulfate content in excess of 250 ppm

Once groundwater is contaminated, cleanup of that groundwater is extremely difficult. If the water is unsuitable for human use, it also may be unsuitable for agricultural uses and alternative sources of water may need to be found.

(mg/l) may give water a bitter taste and have a laxative effect on individuals not adapted to the water.

Water that smells like rotten eggs has a high level of hydrogen sulfide gas. The gas may occur naturally in water near oil or gas fields or as the result of bacterial contamination. To test for bacterial contamination contact the county health department or a commercial testing lab.

Organic Chemicals

The term "organic chemical" includes such products as pesticides, herbicides, petroleum products and industrial solvents. Hundreds of different organic chemicals have been found in drinking water from accidental spills, improper disposal or non-point movement through soils to groundwater. Today, municipalities are required to monitor more than 50 organic chemicals under the Safe-Drinking-Water Act.

As with other contaminants, the danger from organic chemicals in water is hard to assess. In high doses these chemicals may cause various problems including increased risk of cancer, impaired nervous system or damage to the heart. In low doses, organic chemicals may have cumulative effects, but less is known about their nature or magnitude.

Radon

Radon is a radioactive gas, a decay product of uranium, that can dissolve into water supplies. The gas also is found in rocks and soils that contain granite, shale, phosphate, and pitchblende. It is odorless, colorless and tasteless.

The EPA considers radon to be a major potential health threat, causing an estimated 20,000 lung-cancer deaths each year. While most deaths are from radon accumulated in houses from seepage through cracks and holes in the foundation, some 160 deaths per year are attributed to radon from household water. Showering, dish-washing and laundering agitate water and release radon into the air.

Radon is most likely to be present in water from private wells or from small community systems. Large systems usually provide some kind of water treatment that aerates the water and disperses any radon gas that may be present.

Before you test your water for radon, test the air. If your indoor radon level is high and you use groundwater, test your water. If the air level is low, there is no need to test your water. Test results are expressed in picocuries of radon per liter of water (pCi/l). In general 10,000 pCi/l of radon in water contributes roughly 1 pCi/l of airborne radon throughout the house. EPA currently advises consumers to take action at total household air levels of 4 pCi/l. For waterborne radon, a simple step is to make sure your bathroom, laundry and kitchen are well ventilated. At moderate levels, this may adequately reduce your exposure to waterborne radon. However if you use a private well that has high levels of radon, water treatment devices such as granular activated carbon units and home aerators may be warranted.

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