ENVIRONMENTAL Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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ARD-EHP-9 2005

Copper: Health Information Summary

Copper is a naturally occurring metallic element that occurs in soil at an average concentration of about 50 parts per million (ppm). It is present in all animals and plants and is an essential nutrient for humans and animals in small amounts.

The major sources of environmental copper releases include the mining, smelting and refining of copper, industries producing products from copper such as wire, pipes, and sheet metal and fossil fuel combustion. Water pipes are often made of copper and bath fixtures may be made from alloys containing copper (brass, bronze). The principal source of copper in drinking water results from the leaching of copper from pipes and bath fixtures due to corrosive (acidic) water. The blue-green stain left in some bath fixtures is a sign of the presence of copper in water.

Other releases of copper to the environment include agricultural use against plant diseases and treatments applied to water bodies to eliminate algae.

Health Effects

Absorption/Metabolism

Studies investigating oral absorption of copper have found the percentage absorbed ranging from 24-60 percent. Factors affecting the amount absorbed include the amount of copper in the diet and competition with other metals found in food such as iron and zinc. There are no studies examining inhalation exposure to copper. The amount of dermal absorption is also not known, but a few studies indicate that it is low.

Beneficial Effects

Copper is a component of several enzymes necessary for normal metabolic functions. The Recommended Daily Allowance (RDA) of copper for adults is 0.9 milligrams (mg). The median intake of copper from the typical U.S. diet ranges from 1 to 1.6 mg/day. The safe highest level of intake for an extended period of time (chronic exposure) is 10 mg/day. Food sources rich in copper include shellfish, organ meats, nuts, dried legumes, and cocoa.

Effects of copper deficiency can include anemia, low numbers of white blood cells, osteoporosis in infants and children, and defects in connective tissue leading to skeletal problems.

Short-Term (Acute) Effects

Acute poisoning from ingestion of excessive copper can cause temporary gastrointestinal distress with symptoms such as nausea, vomiting, and abdominal pain. Liver toxicity has been seen in doses high enough to cause death.

High levels of exposure to copper can cause destruction of red blood cells, possibly resulting in anemia.

Long Term (Chronic) Effects

Mammals have efficient mechanisms to regulate copper stores such that they are generally protected from excess dietary copper levels. However, at high enough levels, chronic overexposure to copper can damage the liver and kidneys.

Wilson's disease is an inherited (genetic) disorder in which copper builds up in the liver. Symptoms of liver toxicity (jaundice, swelling, pain) usually do not appear until adolescence.

Carcinogenicity (ability to cause cancer)

Although some studies of workers exposed to copper have shown increased cancer risks, they were also exposed in the workplace to other chemicals with carcinogenic potential. Increased cancer risk has not been found in animal studies. Copper is currently categorized by the EPA as a Group D carcinogen (inadequate evidence to classify).

Reproductive/Developmental Effects

There are no reports of developmental effects occurring in humans exposed to elevated levels of copper. Developmental effects have been observed in a few studies of animals given high doses of copper, including delayed growth and development, delayed bone formation, and decreased litter size and body weights.

Health Standards and Criteria

The EPA has established a Maximum Contaminant Level Goal (MCLG) for copper in public drinking water systems at 1,300 parts per billion (ppb). MCLGs are non-enforceable health standards for drinking water. MCLGs are set at a level at which no adverse health effects would be expected to result from the consumption of two liters (0.53 gallons) of contaminated water per day by a 70 kg (154 lb) adult. The MCLG is based on the ability of copper to produce gastrointestinal disturbances from acute exposure.

The EPA has also established a Maximum Contaminant Level (MCL) for copper in public drinking water systems. MCLs are enforceable drinking water standards determined by balancing the adverse health effects of a particular chemical against the feasibility and cost of treating contaminated water. The MCL is an "action level." The action level is defined as the level, which when exceeded, requires the installation of corrosion control technologies. These technologies attempt to reduce the level of copper that enters the drinking water from leaching of copper from pipes and other plumbing fixtures. Corrosion control technologies employ methods such as the addition of chemicals to either lower the acidity of the water or which coat the inside of the pipes, forming a barrier to reduce leaching. The action level for copper in drinking water is set at 1,300 ppb.

A Secondary Maximum Contaminant Level (SMCL) for copper has been established at 1,000 ppb based upon taste and staining of bath fixtures. SMCLs are guidelines for the protection of the aesthetic qualities of water such as taste, odor, and color.

Since excess copper in drinking water is usually due to it leaching from the plumbing system into water that has been sitting for several hours in the pipes, running the water for 30 to 60 seconds before using it for drinking or cooking will often significantly reduce copper levels.

The Occupational Safety and Health Administration (OSHA) enforceable standard (permissible exposure limit or PEL) for copper in workplace air is 0.1 milligram per cubic meter (mg/m3) as a fume and 1.0 mg/m3 as a dust or mist averaged over eight hours.

For more information, please contact the DES Environmental Health Program, 29 Hazen Drive, Concord, NH 03302-0095; (603) 271-4608.

Suggested Reading and References

Casarett and Doull's Toxicology: The Basic Science of Poisons, Fifth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co., Inc., New York, 1995.

Toxicological information on Copper. Integrated Risk Information System (IRIS). U.S. EPA, Office of Health and Environmental Assessment. Last significant revision September, 1988

Toxicological Profile for Copper (Update). Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. September, 2004.

DSG revision 10/05