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JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 21)

by John Ferguson

29) Copper (Cu) - Copper is a common and very useful metal. It is used to make bronze and brass, copper coins, jewelry, cups and goblets to electrical wiring.

Copper is found in igneous rocks at 55 ppm, shale at 45 ppm, sandstone and limestone at 4-5 ppm, and very little in fresh water 0.0002 ppm and less in salt water. In most soils, it is found at 2-200 ppm as it is strongly absorbed by humus. Marine and land plants have 11-14 ppm, and marine animals 4-50 ppm.

The Egyptians as far back as 3,000 BC used the compound copper acetate ($C_4H_3CuO_4$) to treat diseases of the eye. The smelting of copper ore began around 5,000 BC, when copper was extracted from the green ore we call malachite which is a copper carbonate compound $Cu_2CO_3(OH)_2$.

Copper is an excellent conductor of heat hence is used to make pans, kettles and boilers. Copper is used in making bronze (copper-tin) which was used for weapons before iron was discovered (The Bronze Age). Brass is a copper zinc alloy.

Copper beryllium alloys are often used for the heads of golf clubs. We find that copper is used in hundreds of every day products. One of the most common uses of copper is to make electrical wire since it has excellent electrical conductivity and can easily be made into wire. Copper is malleable and ductile and with an electrical conductivity second only to silver (Ag).

Copper occurs in soils in two electrical states Cu^+ and Cu^{+2} , where the +2 form is the most stable. Most agricultural soils are now deficient in copper, hence copper deficiency is widespread, and copper deficiency diseases are very common.



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Deficiency symptoms in humans are premature white grey and silver hair, dry brittle hair, sagging tissue, hernias, varicose and spider veins, aneurysms, anemia, arthritis, ruptured discs in our back, violent behavior, learning disabilities, etc.

We now know that copper and estrogen utilization are tightly linked. Copper imbalances cause every conceivable female organ related difficulty such as premenstrual syndrome, ovarian cysts, infertility, miscarriages, sexual dysfunction, etc. Copper imbalance is also associated with mental deficiency, neurological dysfunction, and psychological disorders.

People with deficient copper in their diets have increased levels of cholesterol, higher blood pressure, and impaired ability to digest glucose. Copper is required for hemoglobin to function properly and in normal bone formation. A lack of copper is linked to aneurysms (ruptured cerebral aneurism), skin wrinkles, varicose veins, sagging tissues, as it is used in elastic fibers.

Adequate copper boosts the fat burning in humans hence a lack of copper in our food is contributing to obesity and diabetes (Journal of Nature Chemical Biology).

NOTE: "Micronutrient malnutrition is like a hidden hunger and now affects far more people than caloric malnutrition. Mineral deficiencies are estimated to afflict a third to one-half of the humanity, causing major health problems in both developed and undeveloped countries." From The Hidden Half of Nature -The Microbial Roots of Life and Health, D. Montgomery, PhD.

For example, the artificial sweetener "Aspartame" is a ligand (ties up or binds) for copper, which allows it to react and bind to our DNA, which makes it unavailable for other uses. Dietary interactions with sucrose or fructose inhibit copper absorption to varying degrees. Copper is essential to all species of life. There are more than 30 copper containing enzymes and it is used by over 300 enzymes. For example, the enzyme Cytochrome c oxidase is required by all cells to produce energy. Other enzymes that need copper protect against free radicals that induce inflammation and cancer.

Even though it is not as common, excess copper can also lead to health problems as too much copper interferes with iron and zinc usage in our bodies. Too much copper can be toxic,



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however vomiting generally starts if an excess of a copper compound is swallowed which acts to prevent acute toxic effects.

Copper is relatively immobile in soils and concentrates in the top layers where it is tightly bound to inorganic particles and organic matter. Some bacteria use copper to convert methane into the alcohol methanol.

Many microbes cannot live long on a copper surface particularly the MSRA bacteria which is often fatal to those with impaired immune systems. Some hospitals are now replacing all handles, doorknobs, rails, etc. with copper to reduce these types of infections. However, the microorganism called *Penicillium* can have 20,000 ppm (2%) copper in its tissues.

Gardening and Landscaping Problems Associated with Copper (Cu)

Copper is now recognized as essential for plant health. It functions as a nutrient that stimulates a plants natural immune system (disease prevention/resistance), and it is required for certain physiological processes such as enzyme and co-enzyme systems.

It is involved with carbohydrate and nitrogen metabolism, involved with lignin synthesis, vitally important to root metabolism, helps in formation of strong stalks, helps form compounds and proteins, amino acids and many other organic compounds, works as a catalyst, helps prevent chlorosis, rosetting and dieback.

Copper is involved with the creation of vitamin A and it is involved with regulating photosynthesis.

Copper plays many roles in plants, the two most common are in nitrogen utilization and lignum formation. Copper is also involved with the formation of proteins. Adequate copper levels helps grasses stand up straight and has been shown to reduce head blights in wheat.



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Plants absorb copper and is used throughout the plant but most of it remains in the root system. In above ground parts it is used in photosynthesis, carbohydrate distribution, cell wall metabolism, and especially in the production of DNA and RNA.

As increasing amounts of nitrogen are available to plants, the amount of copper in the plant must be increased accordingly for the plant to remain healthy.

Early symptoms of deficiency show up in youngest leaves and stems, dieback of stems and shoots, yellowing of leaves, stunted growth, distortion of young leaves and pale green leaves are often symptoms of copper deficiency. In trees, a deficiency may show up as white tip or bleaching of younger leaves and in summer dieback.

Plants deficient in copper have below average root mass and plants grown on soils with less than 2 ppm copper produce fewer seeds.

Excess calcium or nitrogen makes copper unavailable to plants. Hence, liming soils reduces plant ability to absorb copper (artificial fertilizers create acidic soil conditions which then are limed to increase the pH). Too much phosphorous (P) or potassium (K) will induce deficiencies of copper.

Organic matter like humus helps hold copper in the soils where plants can absorb it. Peat and muck soils are often deficient in copper as are soils that are low in organic matter.

It is rare but excess copper symptoms resemble iron deficiency. The use of sewage sludge (biosolids) can lead to an excess of copper in soils. Repeated use of poultry manure or poultry manure fertilizers can cause an excess of copper.

Note: Most Texas soils are deficient in copper.

Sources: seafoods (clams, oysters, crab, lobster), liver meats from lamb and beef, beans and nuts (walnuts and Brazil nuts), sunflower seeds, mushrooms, copper water pipes, basalt and granite sand.