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Ionic Trace Minerals—A Simple Solution for a Complex Body

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The body preferentially absorbs minerals in ionic form, while other mineral forms (organic, colloidal) are not as readily absorbed.

What is an Ion?

An ion is any atom or group of atoms that holds one or more positive or negative electrical charges. Positively charged ions are known as cations while negatively charged ions are called anions. Ions are formed by the addition of electrons to, or the removal of electrons from, neutral atoms, molecules or other ions. Additionally, ions are formed as a result of the splitting of the bond between two atoms such that a portion of the electrons shared by the previously joined atoms is now split between the two newly formed individual atoms. An example of this split association includes the reaction that occurs between a sodium atom and a chlorine atom to form sodium chloride (NaCl)—now comprised of a sodium cation and a chloride anion. Some important cations for human health are calcium, hydrogen, magnesium, sodium, and potassium, while the important anions are bicarbonate, chloride, and phosphate, to name a few.

Minerals are found throughout nature, although oftentimes the forms they are found in are not well utilized by the human body. In physiology, it is known that in order for an organism to properly and completely absorb minerals, they must have an electrical charge attached in order to penetrate cellular barriers. This cellular barrier, known as the cellular membrane, is the ultimate gatekeeper that decides exactly what enters and exits the cell. The fluid surrounding our cells is saturated with both cations and anions, as is the fluid inside of the cells. Because of this separation of atoms with specific electrical charges, an electrical gradient, or current, is formed across the cell membrane. Because of this current, the movement of the charged mineral particles that the cell requires tends to flow more easily across the cell membrane.

Ionic versus Colloidal Minerals

The chemical gradient results in the passive movement of ions from a region of higher concentration to lesser concentration. In humans, this process is achieved in the stomach where hydrochloric acid

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assists in splitting apart groups of atoms, leaving them in an ionic state which allows them to more easily penetrate the intestinal wall, where a large amount of absorption takes place. The body preferentially absorbs minerals in ionic form, while other mineral forms (organic, colloidal) are not as readily absorbed.

The term used to describe the condition in which materials are held in a stable, colloidal suspension is called the “dispersed phase.” In the dispersed phase, they are distributed evenly and uniformly throughout whatever medium they are suspended in. However, the problem with this medium is that the ability of colloids to be readily absorbed by the body is limited due to their size and that they are not charged. Without an electrical charge, minerals are not likely to penetrate the cell membrane.

Minerals found in the stable colloidal state are too large and insoluble to dissolve, but are also too small to settle out of the suspension. This fixed state of suspension occurs regardless of whether the substances are inorganic (metals) or organic (plant tissues). Colloids, by definition, cannot penetrate the semipermeable membranes that line our intestinal tract, mouth, and esophagus. Because of their relatively large particle size, it is difficult for most living tissues to directly absorb colloids.

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Ionic minerals are already in a form that the body recognizes and understands so they can be easily assimilated through the selectively permeable cell membranes. The colloidal minerals, on the other hand, must first undergo a process of conversion within the body prior to being absorbed, and then, only a certain percentage is utilized after the conversion process. The bioavailability of a mineral is influenced by the form in which it is consumed in the diet and by the presence of other factors in the food that enhance or depress mineral absorption and utilization.¹

Ions play an important role in the body. Larger minerals such as calcium, potassium, sodium, and chloride are some key ions that participate in the body's electrical conduction systems. Imbalances of any of these ions or certain trace ions in the body can negatively affect the transport of minerals across the cell membranes, leading to dysfunction. Meanwhile, trace minerals such as chromium, manganese, molybdenum, selenium, vanadium, and copper have very specific effects in the body, and have far-reaching health effects as evidenced by current research.

Chromium

Chromium (Cr) is implicated in maintenance of blood sugar, prevention of atherosclerosis, and control of cholesterol levels. Human studies suggest that a particular form of chromium, known as chromium picolinate, enhances insulin sensitivity, glucose removal, and may improve lipid ratios in obese and type 2 diabetics.² Additionally, it is suggested that chromium has a potential beneficial antioxidant effect in patients with type 2 diabetes when combined with zinc and copper supplementation.³ Chromium is found in some foods—in small amounts. Because of these findings, supplementation with chromium can have positive health implications.

Manganese

Manganese (Mn) is a component of several enzyme systems, including manganese-specific glycosyltransferases and phosphoenolpyruvate carboxykinase, and is essential for normal bone structure. Unrefined cereals, green leafy vegetables, and black tea are the richest dietary sources of manganese. Unfortunately, the refinement of grains has lead to widespread inadequacies in the daily intake of manganese from our diet. Manganese deficiency can manifest as transient dermatitis, hypocholesterolemia, and increased liver enzyme (alkaline phosphatase) levels.

Selenium

Selenium (Se) is a part of the enzyme *glutathione peroxidase*, which metabolizes free radicals formed from the oxidation of polyunsaturated fatty acids. Selenium is also a part of the enzyme that de-iodinates thyroid hormones, assisting the body's use of this hormone. Selenium functions as an antioxidant that works in conjunction with vitamin E. One study determined that head and neck cancer patients had serum selenium levels that were significantly lower compared with controls, and these levels decreased further as their tumor burden increased.⁴

Molybdenum

Molybdenum (Mo) is a transition metal that forms oxides and is a component of a coenzyme that is essential for the activity of xanthine oxidase, sulfite oxidase, and aldehyde oxidase.⁵ Molybdenum is derived principally from organ meats, whole-grain cereals, and legumes. Molybdenum may possibly retard degenerative diseases, cancer, and aging. Molybdenum acts as a detoxification agent in the liver as a part of the sulfite oxidase enzyme, which destroys sulfite, a common preservative in foods and drugs.

Vanadium

Vanadium (V) has a significant role in inducing the production of reduced glutathione content in the liver and specific extra hepatic tissues.⁶ Additionally, vanadium increases the activity of the detoxifying enzyme system *glutathione S-transferase* in liver and in several extra hepatic tissues.⁷ Because of vanadium's ability to induce an increase of detoxifying enzyme activity, vanadium might

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be considered a potential cancer chemopreventive agent. Vanadium appears to function like insulin by altering cell membrane function for ion transport processes, increasing insulin receptor sensitivity.⁸ Vanadium may also inhibit cholesterol synthesis in animals and humans resulting in decreased plasma levels.

Copper

Copper (Cu) is a universally important cofactor for many hundreds of enzymes. Copper functions as a cofactor and activator of numerous enzymes that are involved in the development and maintenance of the cardiovascular system. Copper is essential for the function of reduced lysyl oxidase activity, which causes a conversion of the connective tissue element pro-elastin to elastin. A copper deficiency can result in a decrease in the tensile strength of arterial walls, leading to aneurysm formation and skeletal maldevelopment.⁹ Other effects of copper deficiency are anemia (iron storage disease can result from chronic copper deficiency), poor hair keratinization, and hypopigmentation.¹⁰

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Summary

From the examples above, it is clear that maintaining a balance of ionic minerals in the body is essential to our health. Minerals provide much of the basic framework from which health is built and maintained, and mineral supplementation is an obvious choice for people who are interested in being proactive in their health.

As pointed out in the June 2002 edition of the *Journal of the American Medical Association*, everyone needs to supplement with extra nutrients beyond those found in their daily diets. This is not surprising since over the last 200 years, the average amount of top soil in the U.S. has dramatically declined from 21 inches to a mere six inches. Fueling your body with the sources of minerals and nutrients is essential to help maintain vibrant health.

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