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JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 6)

by John Ferguson

13) Aluminum (Al) - Aluminum is the third most common element on the planet; it comprises 12% of the earth's crust and is the most common metal found in the crust. Aluminum is found in igneous rocks at 5,000 ppm, in shale's at 82,000 ppm, sandstones at 25,000 ppm, 4,200 ppm in limestone, and 71,000 ppm in clays. Aluminum can be found in every plant grown in soil, including common food crops, squash, wheat, grapes, etc. One cannot eat any grain, fruit, nut, or vegetable without taking in quantities of aluminum.

Aluminum is found in land plants at 500 ppm but only 60 ppm in marine plants. In marine animals, it is found at 19-50 ppm and in mammals the highest levels occur in the hair and lungs. It is now considered an essential nutrient for humans in small amounts. For example, it is used to activate the enzyme succinic dehydrogenase and it increases the survival rate of newborn babies.

Aluminum does not occur as a free or pure metal in nature, but only in combination with other elements. It is the second most used metal after iron. It can be found in many common items from bicycles and airplanes to cooking utensils. It is used in disinfectants and pesticides as well as vaccines. Aluminum production uses 5% of the electricity produced in the USA each year. Another source of aluminum pollution is from chemtrails from airplanes that have been found to have high levels of aluminum in them.

Aluminum oxide (Al_2O_3) is used in many industrial applications and forms the mineral known as corundum. If we add a few atoms of iron (Fe) to this molecule, we get the gemstone topaz, if we add cobalt (Co) we get blue sapphires, and if we add chromium (Cr) we get red rubies. Only 30 mg is the amount of aluminum typical in a human body at any one time. Average daily intake of Americans is between 20-40 mg.



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The name Aluminum is from the Latin name "alumen" which means bitter salt. Today we use the word Alum to refer to aluminum sulfate ($\text{Al}_2(\text{SO}_4)_3$).

Aluminum sulfate is used in water purification, as it is soluble in water and is mainly used as a flocculating agent that causes contaminating particles to clump into larger, more easily trapped particles. It is used in paper manufacturing and repeated application of using newspaper as mulch can lead to aluminum toxicity in ones soil. Some water systems add aluminum compounds to make the drinking water clearer.

Aluminum is used in anti-perspirants/deodorants and is added to American cheese to make it melt easier on hamburgers. It is found in many of the food dyes used to color candy for children. A 2013 study found that over 30 brands of baby formulas were contaminated with high levels of aluminum. The majority of soft drink cans are made of aluminum, which dissolves when exposed to acids like those in soft drinks.

Potassium aluminum sulfate, aluminum oxide, aluminum chlorohydrate, sodium aluminum phosphate are in baking powders, cheeses and other food products. The European Parliament banned these additives in 2008 due to the health problems they cause, both carcinogenicity and damage to DNA.

Even though it was debated for decades, a recent article in the Journal of Alzheimer's Disease concluded that aluminum significantly contributes to this disease and may be the single largest factor.

Most aluminum passes through our digestive system without being absorbed. Prevention is caused by the presence of silicon (Si), however, once inside our body it is very difficult to remove aluminum. Aluminum hydroxide is used in anti-acids and it is added to vaccines, as it is believed to make the vaccine more effective. The Journal of Inorganic Biochemistry recently had an article that concluded that aluminum in vaccines was linked to the rise of autism. Aluminum is used as an adjuvant in vaccines along with mercury (thimerosal). Aluminum salts like aluminum hydroxide ($\text{Al}(\text{OH})_3$) has been shown by research to be a major factor in macrophagic myofasciitis (MMF) as well as autism.



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If one drinks fluoridated water (public water systems) the absorption of aluminum is much higher.

Note: Fluoride in drinking water increases the aluminum ions absorbability 10 fold.

Aluminum has only one oxidation state that is +3 which allows it to substitute for yttrium (Yt) which also has a +3 oxidation state, in epi-genetic studies. High aluminum and a low magnesium/calcium ratio are associated with Amotrophic Lateral Sclerosis (ALS) and Parkinsonism dementia. The presence of aluminum in our diet or bodies can cause trigger a suppression of probiotic organisms. This may be a contributing factor as to why so many people have microbe problems in their guts.

Gardening and Landscaping Problems Associated with Aluminum (Al)

Aluminum influences plant growth but all the effects are not fully understood. It is found predominantly in the green leaves of plants hence there may be an association between aluminum and chlorophyll.

Hydrangeas are the best know users of aluminum to gardeners and the gorgeous blue color is caused by aluminum. However, like selenium (Se), aluminum (Al) is toxic to animals and that is why we seldom see insect damage on hydrangeas.

In some plants such as "tea", the bushes absorb a lot of aluminum and alum is used as a fertilizer. Wheat has developed a gene that creates a molecule that binds to aluminum rendering it harmless, which allows wheat to grow on soils with high levels of aluminum. Grasses often accumulate aluminum in their tissues reaching 1% concentrations.

Aluminum toxicity in plants is indirect, affecting root growth, uptake of essential nutrients, particularly phhosporous (P), and it causes antagonistic calcium-magnesium issues. If soil becomes acidic below a pH of 4.5 then the solubility of aluminum increases and absorption increases, reducing root growth and phosphate uptake by plants. High aluminum levels occur in plants when the soil is anaerobic and the roots are exposed to these conditions. In anaerobic conditions, microbes produce organic acids that can drop the pH to 2.0 or less at a microscopic level around the root zone.

Aluminum toxicity often occurs on soils fertilized with ammonium nitrate fertilizers, which acidify the soil, and is one of the most limiting factors in production.



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It is well known that aluminum ions (Al^{+3}) inhibits plant growth at very low concentrations. Excess aluminum in plants interferes with cell division and prevents some enzymes from working properly. It can also affect the uptake of several nutrients such as phosphorus (P), calcium (Ca), magnesium (Mg), potassium (K) and nitrogen (N).

Elevated aluminum levels in the soil (acidic conditions) will delay or prevent the formation of nodules full of nitrogen fixing bacteria. High levels have been shown to reduce or prevent many enzymes produced by soil microbes from working. This reduces their disease fighting ability and reduces their ability to breakdown organic matter. As a result, gardeners see more insect and disease problem if one uses artificial fertilizers like aluminum nitrate, or aluminum sulfate.

In general, in soils with lower levels of aluminum, plants grow better.
Sources: clay, granite sand, artificial fertilizers, coal ash.