An analysis of colloidal mineral claims.

by Alexander G. Schauss, Ph.D.

In recent years, a plethora of oral colloidal mineral solutions have appeared in the marketplace, sold as mineral/trace element supplements. The following discussion is not an indictment against the purveyors of colloidal minerals, but to highlight scientific evidence challenging many of the claims being made for these products. The natural products industry is under challenge from many sectors to provide the public with truthful and nonmisleading information about its products. If any sector of the industry is found to be misinforming the public, regulators will use these examples **as** evidence of why the industry should be restricted in the marketplace. Consumers can only determine what is best for them if they are informed.

Colloidal mineral manufacturers and distributors have aggressively informed the public about the importance of minerals and trace elements in health. For this effort, they are to be commended. Minerals and many essential and some still unproved trace elements play a crucial role in health, as do all the micronutrients, vitamins, essential fatty acids, and accessory nutrients. However, in their enthusiasm to inform the public about the importance of minerals and trace elements, they have made exaggerated and sometimes unfounded claims which lack scientific support and/or experimental evidence.

In an effort to locate scientific support for many of these claims, databases incorporating nearly 30 million papers published over the last 40 years were utilized, including the well-known Medline. Not a single reference could be located that could support claims made for these products.

This is not to say that individuals who have taken colloidal minerals may not have benefited from such products. However, this may involve some risk, even though the short-term benefits may be undeniable for some.

What are colloidals?

Basically "colloidal minerals" are a mixture of clay and water. When water, the dispersing agent, is mixed with clay, the dispersed colloid, a colloidal mineral is created. When an element is soluble, it is usually more absorbable than when it is insoluble. Calling the product colloidal makes the product insoluble by definition. If it was a soluble solution, it could not be colloidal. So, how can they cairn that a colloidal can be more absorbable? This is a question these purveyors are going to have to answer or stop making their claims.

How is sand, silt, and other compressed fine particles found in geologic formations different from clay? Sand grades down into silt and the sandstone grades down correspondingly into siltstone. The grains, like those of sandstone, form layers along which the stone readily splits and they are again composed of particles of quartz, feldspar, and mica.

The grains of silt grade down still further until they become very fine and form what is termed rock flour. The minuteness of the grains gives this material properties so distinctive that it deserves a different name: Once it becomes moist, it is known as clay. The various minerals in clay are not easy to identify without the use of an electron microscope as they may include silica, compounds of aluminum, iron oxide and small quantities of other materials; some may have the glint of mica, others the whiteness of kaolin. A mixture of clay and sand produces loam, while marl consists of clay and limestone.

Immense masses of clay were formed during the last Great Ice Age, about ten to twenty thousand years ago. As the glaciers traveled south, the ice smoothed the rocks it moved against. As the glaciers spread, these masses of rocks and rock flour spread across the land and drenched them with melt water. When temperature conditions returned to normal, much of the surface was left as a sheet of clay with various rock fragments embedded in it. In essence, clay is a glacial byproduct found throughout the United States, Canada, northern Europe and northern Asia, and most of the United Kingdom, as far south as the Thames River.

The minerals in clay come from secondary minerals that have been recrystallized in solution through geot--hermal forces from minerals primarily found in granitic rocks. Through a lengthy process involving glaciation and weathering, the clays form. Depending on the host rock source of the minerals, specific types of clay accumulate in the valleys. The most common examples are mont-

morillonite, a member of the Smectite Group, including nontronite and the better known mineral bentonite. Bentonite has been used for many years as a bowel-cleansing agent in the natural products industry. Montmorillonite is the dominant clay mineral in bentonite. Bentonite has the unusual property of expanding several times its original volume when placed in water.

According to *Dana's Manual of Mineralogy,* 18th Edition, a standard reference work since 1912 in geology, "Clay minerals are essentially hydrous aluminum silicates. In some, magnesium or iron substitute in part for aluminum, and alkalies **or** alkaline earths may be present as essential constituents."

Similarly, Vander's and Kerr's *Mineral Recognition* supports Hurlbut's definition of clay: "They (clays) are essentially hydrous aluminum silicates, and are usually formed from the alteration of aluminum silicates."

This explains why some "colloidal minerals" contain between 1,800 and 4,400 parts per million (ppm) of aluminum. By comparison, food rarely contains even 10 ppm, as bound aluminum complexes are difficult to absorb.

Because of the lack of research on the long-term effect of consuming aluminum-containing colloidal minerals, **it** is unknown whether they contribute **to** the increased incidence of neurode-generative diseases, such as Alzheimer's disease. Alzheimer's disease is characterized by progressive dementia and diffuse cerebral cortical atrophy, involving microscopic clusters of aluminum-contain ing neurofibri l lary tangles and granulovacuolar degeneration of the neurons. Researchers still need to determine what role, if any, aluminum plays.

To date, the only element among minerals that seems to protect the brain from excess levels of aluminum is magnesium. Yet characterizations of numerous colloidal minerals rich in aluminum often reveal low levels of this important element relative to its aluminum content. At present, aluminum is considered a "toxic" element. Questions as to the safety of colloidal minerals are unresolved. Long-term studies of the safety of colloidal minerals are needed in light of the health claims and benefits being made.

Colloidal mineral use

Basically, there is no research on colloidal mineral use in humans. A search of over 2,000 medical and scientific journals in Medline, a computer database found in every health science and medical library in North America, revealed not a single study on colloidal mineral intake in humans previous to 1996. Where is the evidence of its healing benefits?

Possibly some of the anecdotes regarding its benefits come from individuals who needed minerals—from any source, whether colloidal minerals, ionic mineral solutions, or mineral dietary supplements. When a person is deficient in a mineral(s), they may absorb a higher level of that mineral(s).

Colloidal mineral claims

One common claim made for colloidal minerals is their "superior" absorption in the human intestine. In actuality, when an individual needs a mineral, they will absorb a higher percentage of that mineral from food. If the mineral is in a charged or ionic state, absorption will be higher, since the small intestine absorbs many essential minerals/trace elements when in an ionic state. In the case of iron found in certain foods (i.e. red meat) bound to iron-rich complexes, the element may not be in an ionic state to be absorbed. However, if the iron is from a nonhemo-globin/myoglobin source, the iron also needs to be in an ionic state to be absorbed. Basically, minerals are absorbed via absorptive mechanisms that permit its regulated uptake into the bloodstream.

Examine another colloidal mineral claim: "The absorption rate is ... ten to 12 times greater than elemental minerals taken in tablet form." Where is the proof? Not one study illustrates that this is true. The implausi-bility of this statement comes from the fact that some minerals are absorbed at a rate of around ten percent of its total presence in a food or tablet. If one were to multiply this ten to 12 times, the amount would exceed 100 percent, which is impossible!

Still another claim is that colloidal minerals are "negatively charged, hence increase intestinal tract absorp-tion." The wall of the lumen of the small intestine, where many minerals are absorbed, when at a neutral pH of 7, is negatively charged. The wall is composed of mucopolysaccharides which negatively ionize at a pH of 7. For this reason, the intestinal walls would repel negatively charged colloidal clay particles, since similar charges oppose each other.

Another claim is that the minerals in their product are "95 percent" absorbed. Again, not one study demonstrates this is true. The human body has evolved various mechanisms to prevent excessive intake of many minerals and trace elements to avoid life-threatening imbalances. This is well-known for electrolytes, where the body constantly attempts to maintain a fine equilibrium. Otherwise organ failure would rapidly occur, as would the death of trill ions of cells, ultimately leading to a quick death. The greatest amount of any mineral found in some colloidal mineral products is sodium, a necessary but carefully regulated electrolyte.

Cells must also maintain a balance of certain trace elements needed to regulate enzyme reactions that contribute to efficient metabolism. To avoid imbalances of these trace elements, the body has evolved mechanisms to regulate the flow of trace elements in and out of cells. For example, in the case of zinc, a special metal protein carrier called metallotheionine I transports zinc to cells. Should the body's bloodstream suddenly become flooded by zinc, the liver can deploy an excretory metal protein which sends it back

into **the** intestinal tract. Products truly able to cause a "95 percent" absorption of such elements would be hazardous to your health. If such a product were available, given its risk of toxicity, it would probably be tested as a drug, and undergo extensive toxicity testing in animals and humans before being allowed in the marketplace.

Minerals are unquestionably essential to human health and metabolism. The issue is: Do colloidal minerals provide a safe and effective source of minerals and trace elements? We do not know, since we could find no research to support safety claims for these products. Also, no comparisons have been published to show it to be equal or superior to available mineral supplements, many of which have been extensively studied in humans.

The work of the United States Department of Agriculture's Human Performance Nutrition Center on minerals and trace elements reveals that decades of studies have been conducted on many forms of minerals and trace elements found in food, water or available as dietary supplements. This has allowed manufacturers and healthcare practitioners to give customers and patients guidance as to the safety of these products. Unfortunately, to date no such research exists on colloidal minerals.

"Organic" colloidals

Plants rely on soil for minerals and trace elements essential to their growth. Plant physiologists have established that plants generally require about 15 minerals and trace elements to grow. When any of these minerals are lacking, it can have undesirable effects on plant growth or reproduction. Humans, by comparison, require many more trace elements than plants. Hence if a clay contains molecules of carbon and hydrogen from a plant source along with some 15 elements, it hardly qualifies as being better than other sources of trace elements from food, water, or dietary supplements.

Claims that minerals are absorbed in colloidal form by plants is unfounded. The single cells of plants responsible for the absorption of minerals, usually through root hair tissues, are adapted to absorb ionically charged minerals from soil. Colloids are too large to enter cells intact, as the lipid layers that are part of the cell prevent indiscriminate absorption of large molecules.

Some purveyors of colloidal minerals claim they are "organic" because the source rock is rich in carbon and hydrogen atoms. This may be due to the presence of humic (humus) clays which contain organic matter. Minerals are inorganic. It is inappropriate to call a mineral "organic," unless the proponents are simply implying that the mineral comes from nature. Suggesting that an organic mineral is somehow better absorbed or healthier is a different question. Where is the proof that "organic" colloidal minerals, containing decomposed plant material, is better absorbed, richer in minerals and trace elements, than other sources? The idea that "organic" minerals are better absorbed than inorganic minerals requires scientific proof.

All mammals are designed to absorb inorganic minerals from food and water as ionically charged elements through a process in the gastroin-testinal tract. For example, eight essen-tial minerals and trace elements, required by humans, must be in their ionic form (with the exception of iron, which can be absorbed when complexed as hemoglobin or myoglobin) before they can be absorbed intra-luminaly, after leaving the stomach. If they remain bound, they will be poorly absorbed, if at all. So it doesn't matter if the mineral is "organic," inorganic, a chelate, malate, picolinate, fumarate, ascorbate, etc., when consumed as food. In terms of the eight essential minerals/trace elements our bodies require to assist metabolisms and maintain health, each mineral is best absorbed when in its ionic state after entering the small intestine. It is also important to remember that a primary function of the hydrochloric acid secreted by the stomach, in response to the ingestion of food, is to help liberate minerals from the host complex. Then they become ionic prior to moving on to the small intestine, where most minerals are absorbed.

It also depends on the host's need for a mineral. For example, if people are deficient in magnesium, they may absorb up to 64 percent of the mineral from a food or supplement. But if they have adequate concentrations of magnesium in their body, they may absorb less than ten percent. The body, not the product, is the primary determinant of absorption (bioavailability) of the mineral/trace element.

Colloids are a mixture of two substances somewhere between a solution and a suspension. If the mixture is properly dispersed, the distribution of the particles will be uniformly distributed. Some examples of uniformly dispersed colloidal solutions are gelatin, glue, and butter. Since the clay particles are long, flat, elongated crystals in shape, they are too large and insoluble to fully dissolve, compared to salt which fully dissolves in water. The particles in colloidal are also too small to settle in solution, as with silt.

Editor's note: In part two of this series, Dr. Schauss will discuss how colloidal minerals are manufactured and teach readers how to evaluate colloidal products. References are available upon request.

Part two of a two-part series

An analysis of colloidal mineral claims.

by Alexander G. Schauss, Ph.D.

There has been a dramatic increase in the number of mineral supplements sold in recent years called "colloidal minerals."

As discussed in part one of this series, a colloidal mineral is basically a mixture of clay and water held in suspension, it is both interesting and deceiving to say that a colloidal mineral is more highly absorbed, since there is no evidence to support this. Also discussed in part one of this series is the lack of any studies to substantiate the health or bioavailability claims that are made for colloidal minerals. As was stated in part one, this is not to say that some people haven't benefited from taking these products. The problem is that there may be a long-term risk associated with their consumption.

Content of colloidal mineral products

You will find in Table 1 on page 5 analytical results of five different colloidal products, based on plasma emission (ICP) and graphite furnace atomic absorption spectroscopy, using standardized analytical procedures, for nearly 40 elements. This study was carried out simply to test the claims of those selling colloidal minerals that these products contain more than 70 elements.

In my recent work on minerals entitled/ *Trace Elements and Human Health,* 3rd Edition, I try to explain what is meant by the term "parts per million, billion or trillion," commonly used by analytical chemists to describe the quantity of an element detected in a sample.

Table 1 reports on those elements identified by atomic absorption techniques at the part per million (ppm). A part per million is best conceived by thinking of a typical metal paper clip (which weighs approximately 1,000 milligrams, or one gram) divided into one thousand pieces. Each piece is one milligram, equivalent to one part per million. If, however, you want to detect the presence of one part per billion of an element found in a sample, this would be like looking for that same paper clip somewhere within 50 football fields averaging 40 by 120 yards each! Hence, when a colloidal mineral analysis reports the elements present in their product at the part per billion concentration, you have to really ask yourself if such a minute amount would really matter to your health, especially when you consider what you are paying for the product.

But the illustration gets even more interesting. Some colloidal mineral analyses I have read report that they have virtually all of the elements found among the first 92 elements in the periodic table based on their position that their laboratory analytical report shows some of them to exist in the product at the part per trillion level (picograms/deciliter). How small a concentration is this, compared to a part per billion? If the report is accurate, and I doubt it is, it would be like trying to find that paper clip somewhere within the state of Indiana, which is more than 36,000 square miles. My skepticism comes from the fact that even if the analysis is done by mass spectrophy, using very expensive and highly sophisticated equipment, it would not even be worth the paper it was written on unless the environment in which the analytical procedure is conducted in a very expensive "clean room" following very precise analytical procedures that demand years of experience to conduct. Data printed out by a computer on a sheet of paper does not mean the data is accurate.

The important thing to remember is, we have more cells in our body than there are stars in the universe. We need to nurture all of our cells, not just those at the end of our big toe.

The results are in!

When measuring a sample in parts per million, however, we can report the results with a higher degree of confidence that the elements we are attempting to detect do actually exist in the sample we are testing. With this information as background, let's examine the results of the five popular brands of colloidal minerals tested.

Product A

You will note that Product A is primarily sodium, with 11 other elements detected at the one part per million or more level of detection. Sometimes the amount of an element is not always so obvious. In this case, the company reporting the laboratory's results showed the sodium level

TABLE 1 * 1: COLLOIDAL MINERAL PRODUCTS TESTED (PPM)

	Product A	Product B	Product C	Product D	Product E
Sodium (Na+)	22995.8	81	328	55.3	218.8
Potassium (K+)	97.4	13	339	ND	26.4
Calcium (Ca++)	ND	505	1180	488	517.6
Magnesium (Mg++)	ND	500	245	402	694.6
Lithium (L)	0.218	5.564	ND	ND	5.7
Trace Elements					
Antimony (Sb)	ND	ND	ND	ND	ND
Berylium (Be)	ND	0.368	ND	ND	ND
Boron (B)	18.8	2.31	ND	ND	8.5
Chromium (Cr)	ND	0.841	ND	ND	0.132
Cobalt (Co)	ND	4.167	ND	ND	2.1
Copper (Cu)	1.3	2.71	0	2.63	0.554
Germanium (Ge)	ND	ND	ND	ND	ND
Iodine (I)	ND	ND	ND	ND	0.006
Iron (Fe)	1.3	958.2	330	329	50.3
Manganese (Mn)	ND	12.42	ND	ND	20.1
Molybedenum (Mo)	ND	1.921	ND	ND	1.3
Nickel (Ni)	ND	9.044	ND	ND	2.6
Phosphorous (P) as P04-3	9.7	ND	ND	ND	10.5
Selenium (Se)	ND	ND	ND	ND	ND
Silver (Ag)	ND	ND	ND	ND	ND
Vanadium (V)	ND	1.232	ND	ND	0.602
Zinc (Zn)	ND	32.81	3.8	27.4	13.7
Toxic Trace Elements					
Aluminum (Al)	18.2	2741	388	2290	4339.4
Arsenic (As)	ND	1.18	ND	ND	2.2
Barium (Ba)	ND	ND	ND	ND	ND
Cadmium (Cd)	ND	0.71	ND	ND	ND
Lead (Pd)	ND	0.955	ND	ND	0.006
Mercury (Hg)	ND	ND	ND	ND	ND
Other Trace Elements					
Bromide (Br)	ND	ND	ND	ND	3.4
Silicon (Si)	146.9	23.8	42.2	26.2	2.6
Strontium (Sr)	0.2	1.011	ND	ND	78297.8
Sulphur (S)	98.1	5908	ND	ND	ND
Tin (Sn)	0.002	ND	ND	ND	0.09
Zirconium (Z)	ND	0.18	ND	ND	ND
Fluoride (F)	ND	ND	ND	ND	ND
Total Number of	12	24	8	8	24

*ND = Non-detectable at ppm

in their analytical report to be at around 20 grams per liter, rather than as milligrams. Hence, it would be difficult for the consumer to know that the primary ingredient in the product is sodium unless they were careful to note that some of the ingredients are reported in milligrams, while sodium was reported in grams. This would obviously be important information for those who are monitoring their sodium intake, especially if they plan to consume more than the dosage recommended on the label.

Product B

Product B's primary ingredient is aluminum, followed by iron. Based on the manufacturer's claim of 95 percent absorption, you have to wonder what the benefit would be of absorbing 95 percent of 2,741 ppm of aluminum,

an amount well above that encountered by consumers in their diet, if taken above levels recommended on the label.

There is a considerable controversy surrounding the consumption of excessive levels of aluminum. First, most of the aluminum found in the diet is highly insoluble and hence not absorbed. So, even though a can of soda may contain aluminum, it may be in a highly insoluble form. The same would be true for antacids that contain aluminum. The aluminum is in the form of a hydroxide which is highly insoluble and unabsorbable. Nevertheless, even poorly absorbed aluminum can be a problem if the person consuming it suffers from impaired renal function or renal failure. Aluminum can be toxic to patients on kidney dialysis.

Aluminum uptake into the brain has been shown by recent animal studies to significantly increase in the presence of a calcium and silicon deficient diet. We still do not know what causes Alzheimer's disease, but one thing is for sure: Whenever a patient dies from the disease and the brain tissue is tested in the area related to the disease, aluminum is found concentrated in the tissue in that region. This does not mean that aluminum causes the disease, but it must make one wonder what role it plays in this insidious and crippling disease.

The controversy around aluminum also centers around the possibility that a very small amount of aluminum may be needed in the body. This is based on a limited number of studies on chickens and goats. But these studies have been criticized recently by experts on trace elements as inconclusive and needing confirmation by other researchers. Since aluminum is the third most abundant element found in the earth's crust, it is hard to fathom widespread aluminum deficiency, given its pervasiveness in food and in the soil. Hence, any claim that aluminum is just fine to consume at the levels found in Product B demands proof.

Product C

Product C, although containing nearly a tenth or less of the aluminum found in Products B or D, is basically devoid of many of the minerals and trace elements needed by the human body.

The independent analysis found only eight elements. Tap water could contain more trace elements than were found in this product.

Product D

Product D also contains a considerable amount of aluminum, at 2,290 parts per million, but little else. The question would have to be, "Why buy this product?" For its aluminum?

Product E

Product E contains nearly double the amount of aluminum as was found in Products B or D, while being remarkably rich in strontium, at 78,297.8 parts per million! What benefit this may have for the consumer remains unknown, based on the scant evidence of the benefits of strontium. Again, what is the point of consuming so much aluminum or stromium?

Better choices?

Overall, the average of the five colloidal mineral products tested revealed an average of 15 elements. This conflicts significantly with the claim that these products contain 70 or more elements.

It is important to state that our study encompassed products sold as "colloidal minerals." Possibly this report and many other recent criticisms of these products may result in some manufacturers distancing themselves from the colloidal label by stating their product is from "organic," "plant-derived," or "humic shale" deposits. Needless to say, these products sold as such will have to provide independent certificates of analysis on the content of their product, as well as assure the consumer of the safety of consuming such products.

If appreciable aluminum concentrations are also found in these products, as they may be, then it should be demonstrated by the manufacturers and marketers of these products that the levels are safe to consume because of poor absorption. The question would then be, "If it is so poorly absorbed, then why are the other more beneficial elements highly absorbed, as claimed?"

You can't have it both ways! It would benefit everyone to know what happens to the aluminum consumed. Simply citing that someone took them for years without ill health makes about as much sense as telling us that those who smoked for years and died at age 85 benefited from smoking cigarettes. But what about those who died much earlier?

Methods do exist today in the research community that would allow for proper testing of these products. Until we learn more about these earth-based mineral solutions, healthcare practitioners, health food stores and consumers should consider colloidal minerals only after carefully examining the results of truly independent laboratory analyses and a review of the evidence for their benefit.

Numerous dietary supplements exist in the marketplace that have been clinically and experimentally studied to determine their safety and efficacy.

Fortunately, until studies are published documenting the benefits and safety of colloidal minerals, many other products are available in the marketplace that offer consumers a safe and beneficial alternative. In the interim, I hope that studies will begin soon to help us understand why these products have benefited some consumers, as claimed by those promoting their consumption.

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