

Animal . . . Vegetable . . . MINERAL

Even those of us who make no claim to being nutritional experts have firm preferences about the meat and vegetable foods we consume — at least we know what we like. But there is a third element, as vital as the others, *and pervading them*, yet almost unknown to most of us — the minerals we eat, drink and breathe.

Strong bones, clear minds, good digestion and healthy heart action depend upon the proper supply of these minerals — and madness, pain, weakness and death may result from a deficiency of them.

Dr. Carl C. Pfeiffer, author of *Mental and Elemental Nutrients*, brings us the newest information on the roles of the twenty-two minerals in the human body, from essential zinc, iron, sulfur and phosphorus, to perilous copper, mercury and lead. Dr. Pfeiffer outlines the body's reactions to them and by listing the food and other sources from which we ingest them, shows each reader the way to regulate his or her own mineral intake for maximum good health. Here is new knowledge of a way to healthier living . . . *updated!*

Cover design: Merlin Incorporated

ISBN: 0-87983-169-3



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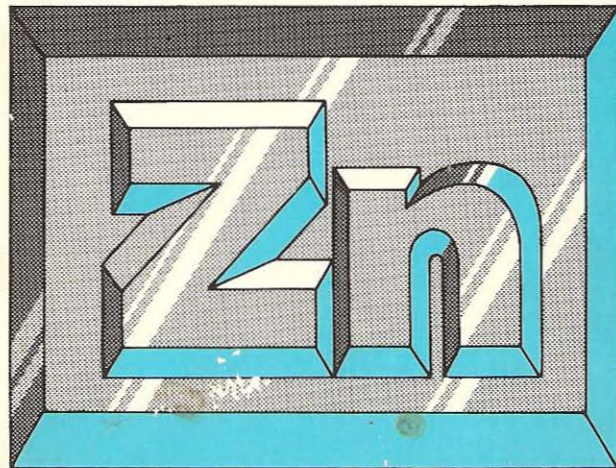
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Dr. Carl C. Pfeiffer's UPDATED FACT/BOOK ON



Zinc and Other Micro-Nutrients

The director of the famed Brain Bio Center and author of the best-seller, *Mental and Elemental Nutrients*, brings together the most recent findings on the minerals in our diet — how they help, heal . . . and even harm.

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CHAPTER 4

Sulfur: The Forgotten Essential Element

IN his comprehensive and recent book on trace elements in nutrition, E. J. Underwood does not discuss sulfur. (The two references to sulfur in his book are to its interaction with selenium.) Schroeder, in his several comments on sulfur as an essential element, indicates that for ordinary turnover in an adult body which contains a total of 140 gm, the daily requirement is 850 mg. Sulfur content is equalled by a potassium content (also 140 mg), and both sulfur and potassium content exceed that of sodium, which is only 100 gm. Yet we merrily salt our food each day, paying little heed to our sulfur and potassium needs.

The turnover of potassium and sodium is greater than that of sulfur. Both sulfur and potassium are found inside the cells, while sodium is found mainly outside the cells in the extracellular fluid. Every cell in the body contains sulfur, but the cells that contain the most are those of the skin, hair and joints. The horny layer of the skin, keratin, has a high content of sulfur as have the fingernails, toenails and hair. Sheep's wool and hair contain about 5 percent sulfur, and about 13 percent of sheep's wool is made up of the amino acid cystine. Since the curliness of hair depends on the sulfur-to-sulfur bonds of cystine, hair straighteners and curlers are designed to open up the S-to-S bonds and then set them in new arrangements, either straight-

chain or curled-chain. If the waving solution is too strong or the hair too fine, the hair can be entirely dissolved instead of curled.

Peculiar odors in biology are usually due to sulfur compounds. The odor of burned hair or wool is no exception; this characteristic odor indicates the high sulfur content of hair.

Dietary Sulfur

Most of man's sulfur must come from food protein which provides four sulfur-containing amino acids—cysteine, cystine, taurine and methionine. The first three can be made in the body as long as adequate amounts of the essential amino acid methionine are contained in man's diet. Elemental sulfur will also allow the building of the first three amino acids by the tissues of the body.

Vegetarians may become deficient in sulfur, particularly if they do not eat eggs. Many adults may be deficient in sulfur because of the misguided warnings against egg eating—our widespread cholesterol phobia. (Two eggs per day raise blood cholesterol by only 2 percent, which is not sufficient to cause atherosclerosis.)

Egg yolk is one of two foods that will darken a silver teaspoon. Since the other is red-hot peppers, most of us will choose the egg yolk as a source of our sulfur. For those who cannot eat eggs in any form (because of sensitivity), the local druggist will, on a physician's order, fill No. 1 capsules with flowers of sulfur. This dose, taken once each day, will provide one-quarter of the daily need, or 200 mg, of pure elemental sulfur. The other 600 mg can be obtained from the sulfur-containing amino acids. Even egg albumen or white of egg is higher in sulfur (1.62 percent) than casein from milk (0.80 percent) and soybean protein (0.38 percent). Muscle protein (as in beef) approaches egg white with 1.27 percent sulfur. Smelly foods such as onions and garlic contain appreciable amounts of sulfur. Indeed, the tear gas from sliced onions is a simple

sulfur compound, and any blood-pressure-lowering effect of garlic is related to its "garlic" smell—one that is characteristic of an organic sulfur compound.

Cattle in feed lots lick on modern salt cakes made yellow with elemental sulfur. Chickens and pigs have sulfur added to their feed. Grandmother advocated sulfur and molasses each spring, and homeopathic physicians have continued to prescribe small doses of sulfur for many ailments. In early times some patients travelled to mineral springs or spas to drink regularly of the sulfur water, and even went so far as to bring home a jug of the medicinal waters for the rest of the family.

Sulfur water contains hydrogen sulfide. Ruminant animals such as sheep can make do with sulfur in the form of sulfate because the bacteria of their various stomachs will reduce the sulfate to sulfur. When man takes magnesium sulfate (Epsom salts) or sodium sulfate (horse physic), the sulfate is not absorbed but gathers water from the tissues and goes through the body with cathartic violence. When elemental sulfur was compared to sulfate sulfur in sheep (both at 0.5 percent level in the diet) either form produced better growth and better wool. The general dietary recommendation for sheep is for 0.2 percent elemental sulfur in the diet. The proper amount for man might be as little as 0.01 percent in cereal foods or a 100-mg scored tablet as a dietary supplement.

At present, dietary supplements containing sulfur are not available. One cannot give extra sulfur in the form of one of the amino acids since these often have adverse effects. For instance, methionine produces feelings of unreality. Simple organic sulfur compounds are not cleared for human use and all have a noticeable odor. One possible candidate for sulfur supplementation is the sulfur analogue of acetone called DMSO (dimethyl sulfoxide). This has the advantage of lipid solubility but has the disadvantage of being partially oxidized, so that the body may not be able to use it as a source of sulfur. Since DMSO is under careful clinical investigation, some answers may be forthcoming if the scientists remember to ask the crucial question:

does DMSO supply sulfur in a form usable by the body? The great lipid solubility of DMSO might get sulfur to the brain for the regrowth of nerves and treatment of epilepsy by allowing the brain to synthesize the stabilizing amino acid taurine.

Taurine and Epilepsy

Biochemical texts barely mention taurine; after all, it is not an essential sulfur amino acid like methionine. Taurine is a simple chemical with two carbon atoms separating a primary amino group and a sulfuric acid group. These chemical groups at both ends make taurine very water-soluble and thus hard to pass through the lipid membranes of the body. Taurine's function is to perch on cellular membranes, probably in neutralized form, and facilitate the passage of simple things such as the potassium and sodium ions and perhaps calcium or magnesium ions. Since taurine passes the blood-brain barrier very poorly, much of the brain taurine is probably built by the brain tissue.

Andre Barbeau, a dynamic physician at the Clinical Research Institute in Montreal, has studied taurine's role in animal and human epilepsy. The distribution of taurine in the human brain is similar to that of zinc and GABA (gamma-aminobutyric acid), both of which play an important calming role in nerve action. The injection of zinc in trace doses produced stretching and yawning in Barbeau's animals, as did GABA (which is monosodium glutamate with the one acid group removed). Because serum zinc is low and copper high in epileptics, Barbeau theorizes that seizures may occur when the zinc-to-copper ratio falls suddenly in the absence of adequate taurine, which cannot reach the brain easily and must be built in the brain. He believes that oral doses of taurine may help epileptics (but then, the other dietary forms of sulfur have not been tried—these are, of course, elemental sulfur or methionine or cysteine). We have found that elemental sulfur taken by mouth increases man's urinary taurine excretion.

Taurine is a stabilizer of membrane excitability and thus could control the onset of epileptic seizures. Taurine and sulfur could be factors in the control of many disorders, including the known biochemical changes in the aging process. Disorders of the skin and nails might improve with added sulfur in our diet. (In 1899, the *Journal of the American Medical Association* published an article on the use of sulfur in psoriasis.)

Previous Uses of Sulfur in Therapeutics

In the nineteenth century, elemental sulfur was used to treat many disorders because no better remedies were available. If these uses are reviewed with the thought that sulfur deficiency may perhaps occur in man as well as in animals, then some of the old uses of sulfur make good sense.

Psoriasis is a scaly condition of the skin which, in mild cases, occurs on the elbows and knees or behind the belt buckle—i.e., at pressure points. The scales may disappear in summer with sunlight, but return quickly in winter. Large doses of zinc are helpful, and small oral doses of sulfur may also help. The normal formation of melanin pigment requires two amino acids and sulfur plus sunlight. Nutrients which help the skin to tan (pigmenting process) should help psoriasis. These would be adequate protein, vitamin B-6, zinc and sulfur. Patients with psoriasis are more likely than others to get arthritis or joint diseases.

Rheumatoid arthritis patients seem, as a rule, to dislike eggs—at present, our only good source of sulfur. Since yolks turned grandmother's silver spoons black (because of silver sulfide) grandma had special little bone spoons for eating soft-boiled eggs long before the fad of throwing plastic spoons away. In the 1920s, colloidal sulfur was given intravenously or intramuscularly to arthritic patients without adequate control as to the possible benefit. Sulfur in oil was also given in both arthritic and mental patients. The joints are high in sulfate-containing compounds. The most common is chondroitin sulfate of the cartilages. All patients with

rheumatoid arthritis would do well to eat at least two eggs per day to provide adequate sulfur for their needs.

The use of sulfur in large doses as a laxative dates back to antiquity. With bacterial action, hydrogen sulfide is formed in the intestine and (as with most intestinal gas) is absorbed. The local hydrogen sulfide is reported to promote peristalsis of the large bowel and facilitate daily bowel movements. Modern studies on sulfur as a laxative have yet to be done. Hydrogen sulfide was thought to be useful in heavy metal poisoning, but here again, modern data are not available. (The sulfur and molasses of grandma's day was probably given for the laxative effect.)

The physician frequently wishes to normalize the flora of the intestine after antibiotic therapy. Acidophilus tablets or buttermilk is sometimes suggested. Certainly egg yolks, with their high sulfur content, or elemental sulfur could be used to normalize the flora or change an unwelcome yeast or fungal flora.

Lack of Sulfur in Soil

The soil in many areas of the world is deficient in sulfur. The glaciated areas are known to have lost sulfur, selenium, iodide and zinc. Commercial fertilizers seldom restore these trace elements to the soil. Plants depend on the soil for sulfur in the form of the sulfate ion. This is taken into the plant, where enzymes convert the sulfate into the many organic sulfur compounds which both plants and animals need. In most instances, the major sources of animal dietary sulfur are the two amino acids, methionine and cysteine. From these the body builds the essential compounds coenzyme A, heparin, glutathione, lipoic acid and biotin. The flora of the world build with sulfur the various penicillins and the characteristic odors of garlic, onion and mustard—not to mention horseradish.

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Sulfur Update 1978

Onions and Garlic

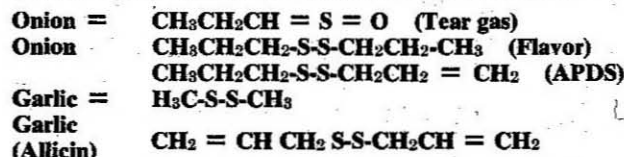
Nutritionists and doctors are beginning to re-emphasize the importance of garlic and onions in health care, for these sulfur-containing foods may be important sources of reduced sulfur in the body. They alleviate various disorders of the stomach, circulatory system and sinuses, and theoretically, such sulfur compounds should help remove our body burden of heavy metals such as copper, cadmium, mercury and lead.

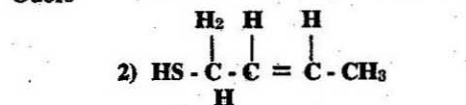
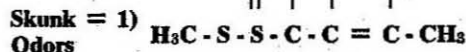
Throughout history garlic has been said to have medicinal properties. Since World War I, extensive research has been carried out on garlic in many regions of the world, partly as a result of its successful use as an antiseptic in the prevention and treatment of gangrene and other serious infections. Garlic also helps control pus formation. In addition, the growth of *Mycobacterium tuberculosis*, *Staphylococcus aureus* and

Brucella abortus is inhibited by a garlic juice concentration of 0.02 percent or by application of garlic paste. The anti-bacterial effect of garlic has been attributed to allicin (Table 4.1).

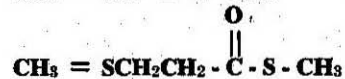
TABLE 4.1

Sulfur Scents


 NH_2

 $\text{O H}_2 \text{ H H}$
 $\parallel \quad | \quad | \quad |$

 $\text{CH}_3\text{-H}_2\text{-H}_2$

Asparagus urinary odors are caused by:



The original compound in asparagus is odorless and has not yet been identified.

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Garlic lowers high blood pressure and may protect against increased serum cholesterol and arteriosclerosis. In one study, ten healthy young volunteers fed four slices of bread with 3½ ounces of butter had a sharp rise of cholesterol levels within four hours. When garlic, either raw or cooked, was consumed with the fatty meal, cholesterol levels stayed low. Garlic also slows blood coagulation time because it causes blood platelets not to clump together as quickly. For hemophiliacs this would be dangerous, but for the majority of people whose blood clots too quickly garlic could be helpful.

Garlic promotes free breathing and as an expectorant clears up mucous congestions. In one study, a solution of garlic oil administered as 10 to 25 nose drops cleared up the congested nostrils of a large group of patients within thirteen to twenty minutes. Garlic pills (with the active ingredient allicin) have been successful in treating diarrhea, nausea, gas, nervous stomach and belching.

The onion has many properties similar to those of garlic. Onions slow blood coagulation and prevent a rise in serum cholesterol when ingested with a high-fat meal. The onion also has a hypoglycemic effect. Administering APDS (see Table 4.1) to diabetic rabbits reduced their insulin requirement. A dosage of 0.123 g/kg body weight taken by six fasting normal volunteers resulted in a fall in blood glucose levels and a rise in serum insulin. Onions, whether boiled, fried or as a juice extracted from crushed bulbs, all have the same beneficial effects because the sulfur compounds are relatively water insoluble.

The effects of garlic extend to other members of the genus ~~Allium~~—leeks, chives and shallots—but to a lesser degree. Thus far, the beneficial effects of all these foods can be attributed to the detoxification of the sulfur compounds.

Asparagus also provides simple sulfur compounds which, when excreted in the urine, provide the typical odor.

We should not depend on proteins for our sulfur

compounds when nature has provided numerous vegetables with appreciable sulfur content.

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1/porjolek
2/raistok
3/schalottenlok