Orthosilicic Acid:

Biologically Active Silicon Supports Bone and Joint Health

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Osteoporosis and arthritis currently are two of the most active categories of supplements sales. In general, bone, joint and connective tissue problems are amongst the most common health issues which trouble individuals as they age. Concern with these conditions obviously will increase as the "baby boom" generation matures. By the year 2010, almost a third of the population of the U.S. will be aged 50 years or older. Bone, joint and connective tissue problems also affect athletes and others who exercise regularly and vigorously.

Unfortunately, one of the most significant products for supporting the health of not only the bones, joints and connective tissues, but also that of the skin, hair and nails has remained largely unknown in the American market, despite its very strong appeal in Europe. This product is biologically active silicon, the form of silicon known as *orthosilicic acid.* (Stabilized concentrated orthosilicic acid is sold exclusively under the name BioSil™.)

Silicon, in its biologically active form orthosilicic acid, is intimately involved in the growth and repair of all of the structural tissues found in the body because of its role in the biosynthesis of collagen. Collagen fibers are constructed from chains of the amino acids lysine and proline woven together to form strands. These fibers are the primary structural proteins of the body and they take various shapes to match the body's needs. Thin layers form the skin, rope-like structures form the tendons and yet another shape supplies the basic scaffolding of the bones. As this suggests, collagen is the most abundant protein found in the body. It consists not only of amino acids but also of specialized sugars which influence its strength. In addition to these, the synthesis of collagen requires vitamin C and the minerals copper, iron, manganese, silicon and zinc.

The formation of collagen into support structures requires cross-linking through the activity of enzymes known as metallo-enzymes, because they are activated by metals. From detailed biochemical analyses it has been shown that silicon is present in collagen-based networks such as the mucopolysaccharide networks, as *silanolate.* Silanolate is a derivative of silicic acid. It is the silanolate which gives rise to the silicon-oxygen bridges that cross-link several mucopolysaccharide molecules to form three-dimensional networks. Supplementing with stabilized orthosilicic acid stimulates the synthesis of collagen and leads to enhancements in the repair of tissues based upon collagen. Although most people are unaware of it, enhanced collagen synthesis plays a significant role in bone mineral density and bone quality.

SILICON AND BONE HEALTH

Today scientists know that orthosilicic acid supplementation both increases the amount of calcium available in the circulation for deposit in the bones and increases actual bone density. However, such facts are not widely appreciated because this research is relatively new. It was first recognized (only about 30 years ago) that silicon is a factor in the calcification of bone. Since then the picture has been more fully worked out. Bone consists of crystals of the calcium-phosphorus mineral *apatite,* imbedded in a matrix of the fibrous collagen protein and associated amino sugars known as *glycosaminoglycans.* This combination produces a tissue of uniquely flexible strength which at the same time is capable of bearing weight. Approximately 28 percent of bone is collagen, mostly type I, and another three percent of bone is made up of several different types of glycosaminoglycans (also known as *mucopolysaccharides*). In the journal *Bone* a study was published in early 2003 which demonstrated directly that orthosilicic acid at physiological

THE FACTS ARE THESE:

First, where there is an experimentally-induced silicon deficiency, there also are found abnormalities in bone growth, with decreased amounts of collagen, calcium, magnesium, phosphorous and glycosaminoglycans in the bone and cartilage.

Second, supplementation with orthosilicic acid, in contrast, increases bone density in the femur (the bone in the leg running from the hip to the knee). In a clinical study of 53 women who had osteoporosis, silicon supplementation produced an increase in bone mineral density or an increase in bone mass. Indeed, silicon seemed to be the only thing that could alone help relieve the destructive process that results in osteoporosis.

Third, supplementation with orthosilicic acid (as BioSil) improves the concentrations of calcium found available in the serum. It has been shown that supplemental stabilized orthosilicic acid ingested by human subjects is highly bioavailable and that it stimulates the synthesis of collagen. This year, yet more data was presented showing that in a model in which one would not expect supplemental silicon to have any impact, BioSil stabilized orthosilicic acid that resulted in a significantly higher serum calcium concentration, a higher bone mass and a higher density in cortical and trabecular bone of the femur.

Finally, another study mentioned in the journal *Bone* 2003 reveals that the dietary intake of silicon is a major determinant of bone mineral density in men and in premenopausal women.

concentrations stimulates collagen type 1 synthesis in human osteoblast-like cells (bone-forming cells) and enhances osteoblastic differentiation.

SILICON AND THE JOINTS

Similar to the bone, the cartilage of the joints is composed of 20 to 25 percent collagen and proteoglycans, compounds which are themselves made up of glycosaminoglycans. Many of the same factors that protect the health of the cartilage of the joints will influence the health of the bones and vice versa. Silicon is required for the production of the collagen structural units and collagen is the initial "building block" for the connective tissues. Chondroitin sulfate requires silicon to construct the *chondrocytes,* the cells that make up the sponge-like material in the joints that nourishes cartilage components involved in joint movement. In fact, silicon, in the form of silanolates, actually connects the chondroitin sulfate molecules in joint tissues responsible for fluid balance. Increased hydration promotes connective tissue elasticity and cushioning. When there is a nutritional silicon deficiency, the joints are malformed and there is a decreased content of articular cartilage.

SILICON AND THE HEART

A substantial amount of the body's connective tissue lines the veins and arteries. Clinical studies show that silicon progressively declines in the artery wall. In seniority and heart disease, silicon in the aorta is only 15 percent of that found in childhood. Silicon makes the inner lining of arterial tissue (the *tunica intima*) less permeable. Since arterial damage is usually the first step in plaque formation that eventually can clog an artery and lead to surgical consequences, researchers are beginning to think that a silicon deficiency may predispose individuals toward certain types of cardiovascular disease.

SILICON FOR THE SKIN, HAIR AND NAILS

To improve skin health, there are two primary approaches that can be taken. The first is to speed the rate at which the skin is renewed. The second is to reduce the rate at which the skin is destroyed through processes such as inflammation and degradation by enzymes. A powerful means of improving skin regeneration is through supplementation with orthosilicic acid. Orthosilicic acid supplementation (as BioSil) in animal studies has been shown to increase the collagen concentration in the dermis by up to 12.5 percent. Because silicon is crucial for the activation of the enzymes responsible for the cross-linking in collagen, supplementation not only speeds the regeneration of this protein but also increases its strength and elasticity. The result is better skin with fewer wrinkles. Similar benefits are realized with the hair and nails, as well.

SILICON VS. ALUMINUM

Silicon may protect against aluminum toxicity. Aluminum is widely suspected of playing a role in certain age-related reductions in mental functioning.

Whereas it is quite clear that biologically active silicon is an important element, it is much less clear how silicon can be added to the normal daily diet. We no longer regularly consume many of the best food sources of silicon. Moreover, dietary silicon compounds, whether from plants and other foods or from mineral water, are all polymerized forms of orthosilicic acid. The only bioavailable form of silicon is orthosilicic acid [$Si(OH)_4$], not silica [SiO_2]. Silica is silicon dioxide, which is not bioavailable. Silicon found in food (and horsetail) as silicates likewise are not bioavailable. To become bioavailable, all dietary silicon first must be dissolved in the stomach into orthosilicic acid, the monomeric (single unit) correct form of silicic acid, which is absorbed and used by the body. Silicic acid, however, is unstable. In concentrations over 1 ppm (the amount typically found in mineral water), orthosilicic acid readily polymerizes into long chains, converting in the process back into a non-bioavailable silicate.

Inasmuch as orthosilicic acid is the primary form of silicon found in the bloodstream, clearly not only rich food sources but also a strong digestion are required for optimal utilization from dietary sources. The obvious weakness here is that the production of the stomach acid that is required to solubilize dietary sources of silicon declines markedly with age. In fact, by age 65 some 30 to 35 percent of individuals are deficient in their ability to produce stomach acid. Therefore, supplementation is especially important as individuals enter their later years.

BioSil is the only supplement that supplies orthosilicic acid in its biologically active form, plus it is highly concentrated. One bottle of BioSil contains the amount of silicon found in 600 bottles of mineral water. Orthosilicic acid from BioSil can be absorbed directly through the stomach wall and from the gastrointestinal tract into the bloodstream. ❧