

Silicon (also known as silicium) is the second most abundant element in the earth's crust, after oxygen, making up much of the rocks, clays and soils of the planet's surface. Its commonest soluble form, orthosilicic acid, is found in ground water, lakes, rivers and oceans. Silicon should not be confused with silicone, a synthetic polymer used in surgical implants, sealants and cookware. Some plants use silica (an oxide of silicon) to strengthen their stems and leaves and to form hard structures such as thorns. Grasses and cereal crops, in particular, depend on silica for their rigidity<sup>1</sup>

All about...

# SILICON

## a misunderstood mineral

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For most animals, silicon is a minor, though vital, mineral. It has a structural role in hair, nails, cartilage and bone, and in connective tissues in the skin, aorta, trachea and tendons. As well as contributing to the solidity, strength and elasticity of these and other tissues, silicon regulates calcium deposition in the bones and is needed as an enzyme co-factor, for instance in the formation of collagen.

The silicon from plant foods cannot be directly absorbed in the gut and must be dissolved by stomach acid to orthosilicic acid in order to be available to the body. Individuals whose diets are low in whole grains and vegetables or who have low stomach acidity (a common condition in the elderly) may have low levels of silicon. Silicon deficiency has been shown to lead to deformities in the skull and peripheral bones, poorly formed joints, reduced production of cartilage and collagen, and disruption of the mineral balance in the femur and vertebrae<sup>2</sup>.

### Skin, hair and nails

In a study carried out in Brussels, 50 women with sun-damaged facial skin were given 10mg of silicon per day, or placebo, for 20 weeks<sup>3</sup>. Skin wrinkling reduced by up to 19 per cent in the supplement group, who also experienced improvements in skin elasticity, while wrinkles got worse in the placebo group. In another placebo-controlled trial, in which women with fine hair were given additional silicon for nine months, hair thickness, tensile strength and elasticity all increased significantly<sup>4</sup>. A study at Columbia University Hospital, New York, also found that supplemental silicon was an effective treatment for brittle nail syndrome, a condition that affects around 20 per cent of the population<sup>5</sup>.

### Bone health

Silicon is valuable in the prevention and treatment of osteoporosis, according to research carried out in 2008. In a double-blind, placebo-controlled trial, doctors gave

184 women with diagnosed bone loss either a silicon supplement, calcium and vitamin D or dummy supplements, for 12 months<sup>6</sup>. Blood tests were carried out to determine levels of marker substances indicating bone formation and resorption (the process by which cells called osteoclasts break down bone and release the minerals into the blood). At the end of the study, not only was bone formation greater in the supplement group than in the placebo group, but the addition of silicon gave greater benefits than calcium and vitamin D on their own.

### Cardiovascular system

There is some evidence that silicon could help protect against heart disease. Experiments with rabbits fed a high-cholesterol diet demonstrated that supplementation with silicon prevented the development of atherosclerosis, or hardening of the arteries<sup>7</sup>. Silicon is a vital structural component of arteries, but the silicon concentration of arteries declines with

age, which is thought to increase the risk of atherosclerosis through the accumulation of cholesterol plaques.

### Cognitive function

Several epidemiological studies have suggested that the silicon content of drinking water may protect against decline in cognitive function. Studies in France have shown that performance in cognitive tests correlated positively with silicon consumption and that the risk of Alzheimer's disease was

medication containing magnesium trisilicate were also used for comparison. Absorption was estimated from urinary excretion of silicon.

The study found that, among the dietary supplements, absorption was greatest from monomethyl silanetriol (64 per cent of dose), followed by choline-stabilised orthosilicic acid (17 per cent) and colloidal silica (one per cent). Among the foods, alcohol-free beer scored highest at 64 per cent, followed by green beans (44 per cent) and bananas (four per cent). The speed of absorption was also

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reduced in subjects who had the highest daily silicon intake<sup>8</sup>. The role of silicon in cognitive function and Alzheimer's disease requires further investigation.

### Bioavailability

Silicon occurs in a wide range of chemical forms, some of which cannot be used in the biology of life and others of which are highly bioavailable. The inorganic forms of silicon include silica, colloidal silica, orthosilicic acid and silicates. Organic silicon compounds, in which silicon and carbon are bonded together, may also include other organic chemical groups.

The absorption of different forms of silicon by humans, from foods and supplements, was investigated in a study at London's St Thomas's Hospital<sup>9</sup>. The foods used were alcohol-free beer, bananas and green beans, while the dietary supplements contained choline-stabilised orthosilicic acid, monomethyl silanetriol and colloidal silica. Orthosilicic acid solution and an antacid

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### Where can silicon be obtained?

The silicon content of foods is not a reliable indicator of its availability; for instance, bananas are high in silicon but little of it is absorbed by the body<sup>10</sup>. The best food sources of available silicon are whole grains and grain products, green beans and

raisins. Silicon is also found in drinking water as orthosilicic acid, but the concentration varies greatly depending on location. It can be difficult to obtain sufficient silicon from foods, without munching one's way through a lot of grains and vegetables.

Ageing skin, thinning hair and brittle nails may be signs that your body needs more silicon. Vegetable juices can be a good way to increase silicon intake, but some people may prefer to take a supplement, in which case using the most bioavailable

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