OSTEIS

Feed supplement in liquid form, intended to promote bone and joint health in cats and dogs

OSTEIS (Ό-STE-IS)
The name is inspired by the Greek word «ὀστέον», which means «bone»
Liddell HG, Scott R. An Intermediate Greek-English Lexicon. Oxford: Clarendon Press; 1889.

Osteoarthritis (OA) is a common cause of pain and dysfunction in senior cats and dogs. Clinical signs of pain can vary greatly among animals and are not always obvious. Examples include reluctance to jump into the car or climb stairs, lagging behind in walks, and slow to rise. Other clinical signs seen with OA may include stiffness of gait, lameness, joint thickening, joint pain, joint swelling, and crepitus. In cats, clinical signs are more subtle. Nutraceuticals such as oral glucosamine, chondroitin sulfate, collagen, hyaluronic acid, methyl-sulfonyl-methane (MSM), green-lipped mussel, bioflavonoids and other free radical scavengers like Se and vitamin E are marketed as sole feed supplements or as additives in diets. Silicon (Si) plays a crucial role in long bone development and mineralization through decreased bone resorption and increased osteoblast differentiation[1,2]. Through these effects and its role in increasing collagen synthesis[3], Si may influence the development and progression of OA, thereby reducing lameness. There is also growing scientific interest in Silicon (Si), with more and more studies reported in vitro and animal models that suggest how this element may be essential for bone formation and maintenance[4].

Silicon

Below pH 9, and at a total Si concentration below 2 mM, silicon is present predominately as $Si(OH)_4$ the most stable type at low Si concentration. This monomeric form of silica, 'monomeric silica', is water soluble and a weak acid, and is also known as 'monosilicic acid' or 'orthosilicic acid'. At neutral pH, this tetrahedral, uncharged species is relatively inert, but does undergo polymerization to form larger silica (polysilicic acid) species, especially at Si concentrations > 2-3 mM. Indeed, only in very dilute solutions the monomer will be found in its pure form, as often the dimer $[(HO)_3Si\text{-}O\text{-}Si(OH)_3]$ is also present (but never > 2%), even in solutions greatly below 2 mM Si[5]. Above 2 mM Si, $Si(OH)_4$ undergoes polymerization to form small oligomers and, at concentration much above 2 mM, small colloidal species will also be present, which upon aggregation will eventually results in the formation of an amorphous precipitate, which at neutral pH (pH 6-7) is a gel. Thus, polymerization of $Si(OH)_4$ reduces its solubility and hence bioavailability[5].

The major source of exposure for the majority of organisms is diet. Drinking water and other fluids provides the most readily bioavailable source of Si in the diet, since silicon is principally present as $Si(OH)_4$, and fluid ingestion can account for ≥ 20% of the total dietary intake of Si[6].

Natural levels of Si in food are much higher in plant derived foods than meat or dairy products. Plants take up and accumulate Si from soil and soil solutions that becomes incorporated as a structural component conferring strength and rigidity to stalks, for example, in grasses and cereals and also in some plants such as horsetail (*Equisetum arvense*) where Si is essential[7]. Plants produce biogenic (phytolithic) silica which is often associated with the polysaccharide components of the cell wall.

Si is also added to manufactured and processed foods as additives, increasing the Si content of these foods. Silicates are used as anticaking agents, thickeners and stabilizers, as clarifying agents in beer and wine, as glazing, polishing and release agents in sweets, etc. They are thought to be inert and not readily absorbed from the gastrointestinal tract[8].

Silicon is also available as a food supplement in tablet and solution forms.
These show varying bioavailability (<1 to >50%) and most show negligible-lo bioavailability. Biosil® or choline-stabilized orthosilicic is a concentrated solution of orthosilicic acid (2% solution) in a choline (47%) and glycerol (33%) matrix. Studies in man have suggested that it is a readily bioavailable source of Si and biologically active[9-10]. Silica+® is made from the dry extract of horsetail and contains 12 mg Si per tablet, which studies conducted in man have shown to be of low bioavailability[11]. Other supplements available over the counter include Silicea (silicon dioxide), Silicol (colloidal silica gel), Silica (silicon dioxide), Horsetail (horsetail extract) and G5 (monomethyl trisilanol in solution)[12]. Bioavailability of colloidals, gels, and plant-based silica is low, << 20% for most; Biosil (ch-OSA) has a bioavailability of around~30%; G5 (Monomethyltrisilanol solution) is at least 50% bioavailable[12].

Silicon is also present in some pharmaceuticals and cosmetics.

Some absorbed silicon is retained by the body as Si is present in all tissues. In addition, fasting serum Si concentration is increased with Si supplementation in rats and humans and in the rat bone Si level correlates with dietary Si intake. Tissue levels however vary. In the rat highest levels are found in bone and other connective tissues such as, skin, nail, hair, trachea, tendons and aorta and very much less in soft tissues. Silicon is suggested to be integrally bound to connective tissues and their components and to have an important structural role[13]. Vice versa, silicon supplementation has been reported to have beneficial effects on these tissues, especially bone[14,15].

Ovariectomized female rats represent a standard model for the study of postmenopausal bone loss. In a study on ovariectomized elderly rats[10], supplementation with orthosilicic acid stabilized with choline (chOSA -1 mg Si/kg body weight/day for 30 weeks) has been associated with significant increase in bone mineral content (BMC) and BMD at the femoral level.

Considering the hypothesis of a role of Si in bone mineralization, a double-blind randomized controlled trial (RCT) on mainly postmenopausal women investigated the oral use of orthosilicic acid stabilized with choline (chOSA) as a useful agent in the prevention and/or treatment of osteoporosis in combination with the administration of calcium and vitamin D[16].

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