A Bound Form of Silicon in Glycosaminoglycans and Polyuronide (polysaccharide matrix/connective tissue)

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ABSTRACT

Silicon was found to be a constituent of certain glycosaminoglycans and polyuronides, where it occurs firmly bound to the polysaccharide matrix. 330-554 ppm of bound Si were detected in purified hyaluronic acid from umbilical cord, chondroitin 4-sulfate, dermatan sulfate, and heparan sulfate. These amounts correspond to 1 atom of Si per 50,000-85,000 molecular weight or 130-280 repeating units. 57-191 ppm occur in chondroitin 6-sulfate, heparin, and keratan sulfate-2 from cartilage, while hyaluronic acids from vitreous humor and keratan sulfate- 1 from cornea were Si-free. Large amounts of bound Si are also present in pectin (2580 ppm) and alginic acid (451 ppm). The bound Si is not dialyzable, does not react with ammonium molybdate, is not liberated by autoclaving or 8 M urea, and is stable against weak alkali and acid. Strong alkali and acid hydrolyze the Si-polysaccharide bond. Free, direct-reacting, dialyzable silicate is obtained. Enzymatic hydrolysis of hyaluronic acid or pectin does not liberate silicic acid, but leads to products of low molecular weight still containing Si in bound form. It is concluded that Si is present as a silanolate, i.e., an ether (or esterlike) derivative of silicic acid, and that R1-O-Si-O-R2 or R1-O--Si-O-Si-O-R2 bridges play a role in the structural organization of glycosaminoglycans and polyuronides. Thus, Si may function as a biological crosslinking agent and contribute to architecture and resilience of connective tissue.