Bio-silica and bio-polyphosphate: applications in biomedicine (bone formation)

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Bio-silica represents the main mineral component of the siliceous sponge skeletal elements (spicules), while bio-polyphosphate (bio-polyP), a multifunctional polymer existing in microorganisms and animals acts, among others, as reinforcement for pores in cell membranes. These natural inorganic bio-polymers which can be readily prepared, either by recombinant enzymes (bio-silica and bio-polyP) or chemically (polyP), are promising materials/substances for the amelioration and/or treatment of human bone diseases and dysfunctions. It has been demonstrated that bio-silica causes in vitro a differential effect on the expression of the genes OPG and RANKL, encoding two mediators that control the tuned interaction of the anabolic (osteoblasts) and catabolic (osteoclasts) pathways in human bone cells. Since bio-silica and bio-polyP also induce the expression of the key mediator BMP2 which directs the differentiation of bone-forming progenitor cells to mature osteoblasts and in parallel inhibits the function of osteoclasts, they are also promising candidates for treatment of osteoporosis.