Bioinspired, biomimetic, double-enzymatic mineralization of hydrogels for bone regeneration with calcium carbonate

Hydrogels are popular materials for tissue regeneration. Incorporation of biologically active substances, e.g. enzymes, is straightforward. Hydrogel mineralization is desirable for bone regeneration. Here, hydrogels of Gellan Gum (GG), a biocompatible polysaccharide, were mineralized biomimetically with CaCO3 using a double enzymatic approach. The enzymes urease (U) and carbonic anhydrase (CA) were incorporated in GG hydrogels. Hydrogels were incubated in a mineralization solution containing U substrate (urea) and calcium ions. U converts urea to ammonia (which raises pH) and CO2. CA catalyses the reaction of CO2 with water to form HCO3 −, which undergoes deprotonation to form CO3 2−, which react with Ca2+ to form insoluble CaCO3. All hydrogels containing U+CA were mineralized more with calcite and stiffer than hydrogels containing U. Mineralization with calcite promoted proliferation and spreading of osteoblast-like cells.

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