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Hybrid materials consisting of hydroxyapatite and bio-based polymers used as scaffolds for bone tissue engineering

Large bone defects require fabricated bone constructs that consist of three main components: an artificial extracellular matrix scaffold, stem cells with the potential to differentiate into osteoblasts, and bioactive substances, such as osteo-inductive growth factors to direct the growth and differentiation of cells toward osteogenic lineage within the scaffold. Scaffolds provide a 3D environment for cell seeding and proliferation as well as filling bone defects while affording mechanical competence during the process of bone regeneration. Today, scaffold development is focused on inorganic-organic composites (hybrids), mainly prepared using natural and synthetic polymers (i.e. collagen, polysaccharides), and inorganic hydroxyl-apatite (HA), tricalcium phosphate (TCP). In recent years, tissue engineers used various modifications such as addition of bioactive molecules or nanoparticles to enhance attachment and proliferation of stem cells on the scaffold. Thus, the application of so called "smart scaffolds" enhances osteogenic differentiation of stem cells. In Purinergic receptors, P2X and P2Y play a key role in osteogenic lineage commitment of human mesenchymal stem cells (MSCs) via addition of corresponding P2X/Y receptor ligands (agonists, antagonists) the differentiation process can be triggered towards osteoblast formation. The focus of this contribution is the correlations between scaffold structures, both bulk and surface and corresponding cell behaviour, i.e. adhesion and differentiation. The human MSCs were gained through isolation of jar bone chip and liposuction material harvested during surgeryintervention. Scaffold structure analysis to investigate scaffold hybrid materials (human, bovine, artificial) provides information on their chemical composition, 3D bulk and surface structure. Thus, FTIR spectroscopy, X-ray diffraction (XRD), small angle X-ray scattering (SAXS), scanning electron microscopy (SEM) and zeta potential measurements will be discussed to explain the hybrid structure-property relationships. Three scaffold materials (collagen, bovine, artificial) were analysed regarding their chemical composition, 3D bulk and surface structure. Administration of selective P2Y1 antagonists led to an enhanced matrix mineralization thus confirming the functional role of P2X7 during osteogenesis.

Biography

Margit Schulze has received her PhD at Institute for Organic Chemistry from TH Merseburg/Martin Luther-Universität Halle-Wittenberg in 1990. She hold various position in her career as a Researcher at Martin Luther University Halle-Wittenberg in 1986, Project Leader at Max-Planck-Institute for Polymer Research Mainz in 1994, Senior Lecturer at Royal Institute of Technology (KTH) Stockholm in 1996, Head of Industrial Oils, Degussa/Evonik, Darmstadt during 1998-2000 and since 2001 she holds Professorship (C3) for Organic Chemistry and Polymers at Bonn-Rhein-Sieg University. She has received Research Award of the Hochschule Bonn-Rhein-Sieg together with Edda Tobiasch for "Optimaix Bone Regeneration.

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