3D-printing of alginate aerogels for tissue engineering applications

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ABSTRACT
3D-printing is a disruptive technology that allows automated and reproducible production of customized functional constructs with complex geometries and compositions by depositing materials layer-by-layer with high-precision. Namely, the manufacturing of reproducible gel-based 3D-scaffolds made of biocompatible materials with well-defined internal structure, good mechanical properties, bioactivity and dual-interconnected porosity is possible by 3D printing and essential for tissue engineering.

Few materials and in a narrow concentration range are suitable for their use as bioinks for the processing of 3D-gel scaffolds. A suitable bioink must be printable, be biocompatible and result in gels with attractive structural and mechanical properties. Alginate is a natural polysaccharide commonly employed as bioink to form 3D-hydrogels due to its biocompatibility, biodegradability, non-toxicity, non-immunogenicity and low cost. Bioactive compounds of relevance for tissue regeneration can be trapped in the alginate gel matrix, but still able to diffuse (Axpe and Oyen, 2016).

The processing of gel scaffolds with well-defined internal structure and dual-interconnected porosity is essential for tissue engineering and feasible by 3D-printing (Boga et al., 2018). In this work, 3D-printed alginate aerogel scaffolds were obtained by combination of 3D-printing of gels and supercritical CO_2 drying for bone regeneration purposes aimed to personalized regenerative medicine. The effect of alginate concentration and scaffold infill density on the gel scaffold stability was assessed. Then, the 3D-aerogels were obtained after solvent exchange to ethanol and supercritical drying. The obtained aerogels were evaluated regarding textural (specific surface area, porosity) and mechanical properties.

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