Biomimetic scaffolds based on oxidized polyvinyl alcohol for advanced therapies in tissue engineering

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Tissue engineering investigation is constantly searching for an ideal customizable scaffold to better fit the specific features of the tissue to be repaired. In this context, we recently developed a chemical modification of polyvinyl alcohol (PVA) by controlled oxidation with potassium permanganate to fabricate novel scaffolds with improved biodegradation rate and protein-loading capacity. This work investigated for the first time the use of halogens (bromine, chlorine and iodine) as less aggressive chemical agents to perform controlled PVA oxidation, in order to find the reaction conditions that allow for the minor degradation of polymer molecular size.

PVA solutions oxidized with potassium permanganate, bromine, chlorine and iodine were chemically characterized (i.e., viscosity measurements, moisture content, dinitrophenylhydrazine assay) before preparing hydrogels by physical cross-linking. Scaffolds were then characterized for their ultrastructural morphology, mechanical properties, swelling index, ability of absorption/release of bovine serum albumin and biodegradation rate.

Chemical investigations revealed that bromine and iodine allow for minor alteration of polymer molecular weight. Following cross-linking treatment, ultrastructural analysis demonstrated that the surface of PVA hydrogels exhibited a certain microporosity, which seemed to increase after chemical modification. Interestingly, uniaxial tensile tests showed that PVA mechanical properties can be customized through polymer oxidation. Analysing water uptake capacity, a significant increase of swelling index was detected owing to chemical modification. In parallel, the protein-loading study highlighted the possibility to modulate PVA absorption/release ability by using different oxidizing agents. Noteworthy, once implanted into the subcutaneous dorsal region of BALB/c mice, PVA scaffolds induced no serious inflammatory reactions and mild lympho-monocytic infiltration of the connective tissue surrounding the graft. In conclusion, chemical oxidation allowed to produce customizable PVA scaffolds for specific tissue engineering applications. Further *in vivo* studies will test oxidized PVA hydrogels for the reconstruction of different tissues (i.e., cartilage, gut, nerves) also in combination with bioactive extracellular matrices.