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Peptide-substituted alginate biomaterials

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Peptide-substituted alginates are commonly used as scaffold materials for cells in regenerative medicine and tissue engineering [1,2]. Alginates provide mild gelation conditions (with Ca^{++}), whereas covalently attached peptides enhance cell attachment and proliferation. We here present an alternative to the common carbodiimide method, using partial periodate oxidation followed by reductive amination [3]. Non-toxic picoline borane was used as the reducing agent. Compared to the carbodiimide method, higher and more precise degrees of substitution were obtained, with high reproducibility, and without formation of by-products. The coupling efficiency was to some extent dependent on alginate composition, being most efficient on mannuronan.

Three different bioactive peptide sequences (GRGDYP, GRGDSP and KHIFSDDSSE) were coupled to 8% periodate oxidized alginate. Cell adhesion studies of mouse myoblasts (C2C12) and human dental stem cells (RP89) to gels containing various amounts of GRGDSP coupled alginate demonstrated the bioactivity of the material where RP89 cells needed higher peptide concentrations to adhere.

Another aspect related to biomaterials is the degradation and disintegration in vivo. We here present novel data [4] for the influence of peptide substitution on the rate of (non-enzymatic) acid hydrolysis and β-elimination, the two major mechanisms operating in vivo.

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[2] T. Dvir, B.P. Timko, D.S. Kohane, R. Langer, Nanotechnological strategies for engineering complex tissues, Nat. Nanotechnol. 6 (2011) 13-22.
[3] M.Ø. Dalheim J. Vanacker, M.A. Najmi , F.L. Aachmann , B.L. Strand, B.E. Christensen. Efficient functionalization of alginate biomaterials. Biomaterials 80 (2016), 146-156.
[4] M.Ø. Dalheim, A-S. T. Ulset, I.B. Jenssen, B.E. Christensen. Manuscript in prep.

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