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Research paper

Degradation of polysaccharide hydrogels seeded with bone marrow stromal cells

*Shiva H. Jahromi, Liam M. Grover, Jennifer Z. Paxton, Alan M. Smith**

School of Chemical Engineering, University of Birmingham, Edgbaston, Birmingham, UK

ARTICLE INFO

Article history:
Received 6 December 2010
Received in revised form
16 March 2011
Accepted 22 March 2011
Published online 28 March 2011

Keywords:
Alginate
Gellan gum
Pectin
Bone
Polysaccharide
Rheology
Mesenchymal stem cells
Materialization

ABSTRACT

In order to produce hydrogel cell culture substrates that are fit for the purpose, it is important that the mechanical properties are well understood not only at the point of cell seeding but throughout the culture period. In this study the change in the mechanical properties of three biopolymer hydrogels alginate, low methoxy pectin and gellan gum have been assessed in cell culture conditions. Samples of the gels were prepared encapsulating rat bone marrow stromal cells which were then cultured in osteogenic media. Acellular samples were also prepared and incubated in standard cell culture media. The rheological properties of the gels were measured over a culture period of 28 days and it was found that the gels degraded at very different rates. The degradation occurred most rapidly in the order alginate > Low methoxy pectin > gellan gum. The ability of each hydrogel to support differentiation of bone marrow stromal cells to osteoblasts was also verified by evidence of mineral deposits in all three of the materials. These results highlight that the mechanical properties of biopolymer hydrogels can vary greatly during *in vitro* culture, and provide the potential of selecting hydrogel cell culture substrates with mechanical properties that are tissue specific.

1. Introduction

The development of suitable scaffolds for the three-dimensional (3D) culture of osteogenic cells is important for the successful treatment of bone defects using tissue engineering. A number of biomaterials have been used in tissue engineering of bone (Langer and Vacanti, 1993; Salgado et al., 2004) ranging from synthetically derived materials to naturally occurring biopolymers (Hubbell, 1995; Langer and Tirrell, 2004). Biopolymer hydrogels in particular, have received much attention as potential tissue engineering scaffolds (Hunt and Grover, 2010), as they offer several advantages over synthetic polymers and inorganic scaffolds. Biopolymer hydrogels provide a 3D environment and morphology similar to the extracellular matrix (ECM) of native tissue. These gels can homogeneously suspend cells, growth factors and other bioactive compounds. They generally have mild sol–gel transitions facilitating 3D encapsulation (Mao et al., 2001), have a high water content allowing rapid diffusion of hydrophilic nutrients and metabolites whilst producing little to no cytotoxic by-products (Fedorovich et al., 2007). Biopolymer hydrogels can also be designed to exhibit similar mechanical prop-

* *Corresponding address:* School of Applied Sciences, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, UK. Tel.: +44 1484 472 305; fax: +44 1484 472 182.
E-mail address: a.m.smith@hud.ac.uk (A.M. Smith).

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doi:10.1016/j.jmbbm.2011.03.025