JOURNAL OF TISSUE ENGINEERING AND REGENERATIVE MEDICINE
J Tissue Eng Regen Med 2012;**6:** 135–143.
Published online 24 February 2011 in Wiley Online Library (wileyonlinelibrary.com) **DOI:** 10.1002/term.406

RESEARCH ARTICLE

Development of porous chitosan–gelatin/hydroxyapatite composite scaffolds for hard tissue-engineering applications

C. Isikli[1], V. Hasirci[1,2,3,4] and N. Hasirci[1,3,4,5]*
[1]*Department of Biomedical Engineering, Middle East Technical University, Ankara, Turkey*
[2]*Department of Biological Sciences, Middle East Technical University, Ankara, Turkey*
[3]*European Institute of Excellence on Tissue Engineering and Regenerative Medicine*
[4]*METU, BIOMATEN Center of Excellence in Biomaterials and Tissue Engineering, Ankara, Turkey*
[5]*Department of Chemistry 06531, Middle East Technical University, Ankara, Turkey*

Abstract

Composite scaffolds prepared from natural polymers and hydroxyapatite (HA) are expected to have enhanced osteoconductive properties and as a result gained much attention in recent years for use in bone tissue-engineering applications. Although there are various natural polymers available for this purpose, chitosan (C) and gelatin (G) are commonly studied because of their inherent properties. The aim of this study was to prepare three-dimensional (3D) scaffolds using these two natural polymers and to add either non-sintered hydroxyapatite (nsHA) or sintered hydroxyapatite (sHA) to compare their influence on physical, chemical and mechanical properties of the scaffolds and on their affinities towards Saos-2 cells. For this purpose, nsHA and sHA were synthesized and characterized by X-ray diffraction (XRD), Fourier transform infrared (FTIR), scanning electron microscopy (SEM) and particle size analyses. Then nsHA and sHA particles, with average sizes of 16 μm and 6 μm, respectively, were added to the solutions of C and G during the preparation step and the resultant 3D scaffolds were characterized. Compression tests indicated that presence of nsHA or sHA increased the Young's modulus and compressive strength of the scaffolds, and the values were very similar to those of human spongy bone. MTS assays, confocal microscopy and SEM analysis showed that cell attachment and proliferation were higher on C–G/sHA composite scaffolds compared to the other scaffolds. It was shown that the scaffolds prepared from chitosan, gelatin and HA are appropriate cell carriers for bone tissue engineering, especially those with sHA incorporated. Copyright © 2011 John Wiley & Sons, Ltd.

Received 14 July 2010; Accepted 30 November 2010

Keywords chitosan; gelatin; hydroxyapatite; scaffold; Saos-2; bone tissue engineering

1. Introduction

Tissue engineering is a relatively new area of biomaterials science that aims to mimic the natural processes to repair damaged tissues. Scaffolds are among the key components of a tissue-engineered construct and affect the healing process, forming an environment for the cells similar to that of extracellular matrix (ECM). Natural polymers have great resemblance to natural ECM elements, especially in biocompatibility and biodegradability, and have therefore gained much attention as scaffold materials (Yang *et al*., 2009). Although there are many different polyprotein or polysaccharide structures used in scaffold preparation, chitosan and gelatin are receiving much attention because of their availability, easy handling and low cost.

Chitosan is a natural polysaccharide comprising glucosamine and *N*-acetylglucosamine obtained by the deacetylation of chitin. Since it is degraded by the

**Correspondence to: N. Hasirci, Department of Chemistry 06531, Middle East Technical University (METU), Ankara, Turkey. E-mail: nhasirci@metu.edu.tr*