WOODHEAD PUBLISHING SERIES IN BIOMATERIALS

POLYSACCHARIDE-BASED NANOCOMPOSITES FOR GENE DELIVERY AND TISSUE ENGINEERING

Edited by
SHOWKAT AHMAD BHAWANI
ZOHEB KARIM
MOHAMMAD JAWAID

ELSEVIER

Contents

Hyaluronic acid-based hydrogel for tissue engineering

5

Maya Asyikin Mohamad Arif
Faculty of Resource Science and Technology, University Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia

5.1 Introduction to tissue engineering

The past 30 years have seen increasingly rapid advances in the field of tissue engineering, an interdisciplinary field that involves biomaterials science, cell biology, cell-material interaction, as well as surface characterization. Tissue engineering plays an important role in the restoration, preservation of damaged tissues or whole organs, as well as in the construction of new tissues to replace the lost tissues. Restoration or creation of new tissues normally involves four components, which are progenitor or stem cells, biomaterial scaffold, signaling proteins, and bioreactors. To develop a tissue, usually, the stem cells are first isolated from the tissue of interest, normally obtained from patients' small tissue biopsy. The isolated cells are then cultured and harvested in vitro. The isolated cells are then loaded into a three-dimensional biomaterial scaffold that has similar properties with the normal extracellular matrices (ECMs) of the selected tissues. Subsequently, the cell-implanted scaffolds are injected into the patient either through a needle or other minimally invasive delivery procedure. The fabricated tissue can also be transplanted into a patient's body through surgery. Of all the key components, the design of biomaterial scaffold with optimum characteristics is very crucial to ensure success in tissue engineering. Over the years, the role of hydrogels as a biomaterial scaffold in tissue engineering has received increased attention thanks to their desirable framework for cell growth and survival, on top of their unique properties and resemblances with the natural extracellular matrices (ECMs).

5.2 Overview of hydrogel

A hydrogel is referred to as three-dimensional (3D) cross-linked polymer scaffolds that form a macromolecular network capable of maintaining high water content. The hydrogel can be prepared from natural polymers such as collagen, gelatine, alginate, hyaluronic acid, and chitosan [1], as well as from synthetic materials such as polyethylene glycol (PEG) [2, 3], polyacrylamide (PAA) [4–6], polydimethylsiloxane (PDMS). Hydrogels can either be formed through physical or chemical cross-linking methods. To mimic the ECM and regenerate new tissue, the design of hydrogel must adhere to several criteria. For instance, a hydrogel scaffold should contain 3D

Polysaccharide-Based Nanocomposites for Gene Delivery and Tissue Engineering
https://doi.org/10.1016/B978-0-12-821230-1.00006-2