WOODHEAD PUBLISHING SERIES IN BIOMATERIALS

POLYSACCHARIDE-BASED NANOCOMPOSITES FOR GENE DELIVERY AND TISSUE ENGINEERING

Edited by
SHOWKAT AHMAD BHAWANI
ZOHEB KARIM
MOHAMMAD JAWAID

ELSEVIER

Woodhead Publishing Series in Biomaterials

Polysaccharide-Based Nanocomposites for Gene Delivery and Tissue Engineering

Edited by

Showkat Ahmad Bhawani
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia

Zoheb Karim
MoRe Research AB, Sweden

Mohammad Jawaid
Biocomposite Technology Laboratory, Institute of Tropical Forestry and Forest Products (INTROP), University Putra Malaysia (UPM), Serdang, Selangor, Malaysia

WP
WOODHEAD PUBLISHING
An imprint of Elsevier

Woodhead Publishing is an imprint of Elsevier
The Officers' Mess Business Centre, Royston Road, Duxford, CB22 4QH, United Kingdom
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, OX5 1GB, United Kingdom

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-0-12-821230-1

ISBN: 978-0-12-823218-7

Publisher: Matthew Deans
Acquisitions Editor: Glyn Jones
Editorial Project Manager: Rafael G. Trombaco
Production Project Manager: Vignesh Tamil
Cover Designer: Miles Hitchen

Typeset by SPi Global, India

Chitosan magnetic nanocomposites for gene delivery

14

Vannessa Lawai and Zainab Ngaini
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Sarawak, Malaysia

14.1 Introduction: Gene therapy

Gene therapy is a treatment or prevention of serious disease by repairing, replacing, or regulating the malfunctioning gene using a therapeutic gene by transferring it into a specifically targeted cell nucleus [1, 2]. Approaches in gene therapy include replacing a mutated gene with a healthy gene, inactivating a malfunctioning gene, and introducing a new gene to assist the treatment of the disease [3]. Nowadays, gene therapy is studied and applied in the treatment of genetic diseases, cancers, acquired immune deficiency syndrome (AIDS), cardiovascular disease [4], and heredopathia [5]. In general, the gene therapy process includes the identification of a mutated or defective gene, followed by cloning of an identical healthy gene called a transgene. The next step is loading the therapeutic gene into a vector that delivers the therapeutic gene into the nucleus. The delivered therapeutic gene is integrated into deoxyribonucleic acid (DNA) followed by the correction of the defective or mutated gene [6].

14.1.1 Gene delivery systems

There are three main gene delivery systems: viral vector (e.g., adenovirus, herpes simplex virus, retrovirus, lentivirus, and smallpox virus), nonviral vector (e.g., cationic liposome, a cationic polymer, and nanoparticles), and electroporation [7]. The viral vector method is known to have a high transfection efficiency of 80%–90% due to the ability to enter the cells naturally and express their own protein [3]. There are some limiting factors in using viruses as vectors such as the risk of toxicity, safety, acute inflammatory response, cellular immune response, and integration of nucleic acid sequence into the host genome, which leads to inadequate expression of the gene. Other limitations are the number of genes carried by the virus, high cost of production, unsuitability for large-scale production, insertional mutagenesis, and oncogenic effects in in vivo application [8].

Gene delivery systems via nonviral vectors have low transfection efficiency of 20%–30%. However, nonviral vectors have good cell viability of 80%–90%, indicating safe transfer of larger DNA molecules [3]. Gene delivery via nonviral vectors

Polysaccharide-Based Nanocomposites for Gene Delivery and Tissue Engineering
https://doi.org/10.1016/B978-0-12-821230-1.00016-5