


Gels Horizons: From Science to Smart Materials


Amit Kumar Nayak
Md Saquib Hasnain
Dilipkumar Pal *Editors*

Ionically Gelled Biopolysaccharide Based Systems in Drug Delivery

 Springer

Editors

Amit Kumar Nayak 
Department of Pharmaceutics
Seemanta Institute of Pharmaceutical
Sciences
Jharpokharia, Odisha, India

Md Saquib Hasnain 
Department of Pharmacy
Palamau Institute of Pharmacy
Daltonganj, Jharkhand, India

Dilipkumar Pal

Department of Pharmaceutical Sciences
Guru Ghasidas Vishwavidyalaya
Bilaspur, Chhattisgarh, India

ISSN 2367-0061

ISSN 2367-007X (electronic)

Gels Horizons: From Science to Smart Materials

ISBN 978-981-16-2270-0

ISBN 978-981-16-2271-7 (eBook)

<https://doi.org/10.1007/978-981-16-2271-7>

© Springer Nature Singapore Pte Ltd. 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

- 1 **Ionic Gelled Pectinates in Drug Delivery**
Amit Kumar Nayak, Md Saquib Hasnain, and Dilipkumar Pal
- 2 **Ionic Gelled Alginates in Drug Delivery** 2
Sreejan Manna, Mainak Mal, Sanchita Das, Dipika Mandal,
and Manas Bhowmik
- 3 **Ionic Gelled Gellan Gum in Drug Delivery** 5
Pritish Kumar Panda, Amit Verma, Shivani Saraf, Ankita Tiwari,
and Sanjay K. Jain
- 4 **Ionic Gelled Chitosan for Drug Delivery** 7
Supriyo Saha and Dilipkumar Pal
- 5 **Ionic Gelled Carboxymethyl Polysaccharides for Drug
Delivery** 9
Mohsen Khodadadi Yazdi, Mohammad Reza Ganjali,
Payam Zarrintaj, Babak Bagheri, Yeu Chun Kim,
and Mohammad Reza Saeb
- 6 **Polyelectrolyte Complex-Based Ionic Gelled Biopolymeric
Systems for Sustained Drug Release** 10
V. Ponnusami
- 7 **Ionic Gelled Polysaccharide-Based Interpenetrating
Polymer Network Systems for Drug Delivery** 12
Mohsen Khodadadi Yazdi, Mohammad Reza Ganjali,
Morteza Rezapour, Payam Zarrintaj, Sajjad Habibzadeh,
and Mohammad Reza Saeb
- 8 **Ionic Gelled Polysaccharide-Based Multiple-Units in Drug
Delivery** 13
M. D. Figueroa-Pizano and E. Carvajal-Millan

9 Ionically Gelled Polysaccharide-Based Floating Drug Delivery Systems 161
Siti Nor Syairah Anis, Ida Idayu Muhamad,
Suguna Selvakumaran, Aishah Mohd Marsin, Wen Ching Liew,
and Muhamad Elias Alamin Kamaludin

Chapter 1

Ionic Gelled Pectinates in Drug Delivery

Amit Kumar Nayak, Md Saquib Hasnain, and Dilipkumar Pal

Abstract Pectins are hydrophilic linear anionic polysaccharide extracted from plant cell walls. These are inexpensive, biodegradable and biocompatible in nature. Pectins are being employed as additives, thickeners and gelling agents in many foods, cosmetics and pharmaceutical applications. Since past few decades, pectins have widely been investigated for its unique nature of forming hydrogels (mainly, low methoxy pectin) by the influence of various divalent metal ions. These ionically gelled pectinate hydrogels are being investigated as potential carriers in controlled release delivery of many drugs. The current chapter deals with a comprehensive and functional discussion on the mechanism of ionically gelled pectinates and their potential uses for controlled drug release.

Keywords Pectin · Cross-linking · Ionic gelation · Hydrogels · Drug delivery

1 Introduction

At present, the socio-economic condition of the modern world has elevated the interest of natural polymers [1, 2]. Usually, low manufacturing cost of natural polymers related to their large availability in nature is recognized as the main advantage for their extensive uses in almost all aspects of daily uses [3, 4]. Besides these, biocompatibility and biodegradability are the two important advantages that favor their biomedical applications including delivery of drugs, proteins and peptides, tissue engineering, wound dressing, orthopaedics, dentistry, etc. [1, 5–8]. Among various

A. K. Nayak
Department of Pharmaceutics, Seemanta Institute of Pharmaceutical Sciences, Jharpokharia,
Mayurbhanj 757086, Odisha, India

M. S. Hasnain (✉)
Department of Pharmacy, Palamau Institute of Pharmacy, Chianki, Daltonganj 822102,
Jharkhand, India

D. Pal
Department of Pharmaceutical Sciences, Guru Ghasidas Vishwavidyalaya, Koni, Bilaspur
495009, Chhattisgarh, India

© Springer Nature Singapore Pte Ltd. 2021

A. K. Nayak et al. (eds.), *Ionic Gelled Biopolysaccharide Based Systems in Drug Delivery*, Gels Horizons: From Science to Smart Materials,
https://doi.org/10.1007/978-981-16-2271-7_1