Chapter 10
Preparation and Characterization of Biopolymeric Nanoparticles as Drug Delivery Vehicles: A Comparative Study

Sai S. Sagiri  
National Institute of Technology Rourkela, India

Suraj K. Nayak  
National Institute of Technology Rourkela, India

S. Lakshmi  
Bharatiyar University, India

Kunal Pal  
National Institute of Technology Rourkela, India

ABSTRACT
In recent years, the use of biopolymeric nanoparticles as vehicles for drug delivery has increased exponentially. In the present study, chitosan and gelatin nanoparticles were prepared by ionic gelation and desolvation methods, respectively. Salicylic acid was used as the model drug. The nanoparticles were characterized using SEM, XRD analysis and FTIR spectrophotometric studies. In vitro drug release experiments were carried out to understand the mechanism of drug release. SEM micrographs showed the formation of spherical nanoparticles. XRD studies indicated a higher crystalline nature of the chitosan nanoparticles as compared to the gelatin nanoparticles. FTIR studies indicated the presence of salicylic acid within the drug-loaded nanoparticles. Drug release studies indicated that the developed nanoparticles may be used as carriers for various bioactive agents.

DOI: 10.4018/978-1-5225-3023-7.ch010

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INTRODUCTION

In the recent years, there has been an exponential increase in the use of nanoparticulate delivery vehicles for controlled drug delivery (Manzoor, et al., 2012; Probst, Zrazhevskiy, Bagalkot, & Gao, 2013). The various nanoparticulate drug delivery vehicles include solid-lipid nanoparticles (Makwana, Jain, Patel, Nivsarkar, & Joshi, 2015), liposomes (Kraft, Freeeling, Wang, & Ho, 2014), magnetosomes (Deng, et al., 2013) and biopolymeric nanoparticles (Nitta & Numata, 2013). This increase may be attributed to the advancement of research technologies and the advantages of the nanoparticulate delivery vehicles (Couvreur, 2013; Parveen, Misra, & Sahoo, 2012). The advantages of the nanoparticulate delivery vehicles include their ability to incorporate both hydrophobic and hydrophilic compounds (Aryal, Hu, Fu, & Zhang, 2012), ability to cross blood-brain-barrier (Kreuter, 2013; Wohlfart, Gelperina, & Kreuter, 2012) and increased residence time in the systemic circulation (using stealth technology) (Amoozgar & Yeo, 2012; L. Li, et al., 2013). The above-mentioned properties have helped in designing controlled delivery system using nanoparticulate systems (Coco, et al., 2013; Pathak & Thassu, 2016). Of the various types of nanoparticulate delivery vehicles, the use of biopolymeric nanoparticles is on the rise (Lohcharoenkal, Wang, Chen, & Rojanasakul, 2014; Zhen, et al., 2013). This may be attributed to the easy method of preparation, stability of the vehicle, biodegradable/bioresorbable and minimum antigenic properties associated with the biopolymers (Elzoghby, Samy, & Elgindy, 2012a; Sundar, Kundu, & Kundu, 2016). The various biopolymers which have been commonly used for devising nanoparticulate delivery vehicles are alginate (Nesamony, Singh, Nada, Shah, & Kolling, 2012; Paul, Shelm, & Sharma, 2013), chitosan (Bernkop-Schnürch & Dünnhaupt, 2012; Garrait, Beyssac, & Subirade, 2014), dextran (Foerster, et al., 2016), hyaluronate (Z. Chen, et al., 2013; Yoon, et al., 2013), cellulose (Abeer, Amin, Iqbal, & Martin, 2014; Rescignano, et al., 2014), albumin (Elsadek & Kratz, 2012; Elzoghby, et al., 2012a), collagen (M.-M. Chen, et al., 2015; Kasoju, Ali, Dubey, & Bora, 2013), heparin (Liang & Kiick, 2014; She, et al., 2013), and gelatin (Elzoghby, Samy, & Elgindy, 2012b; Hu, et al., 2015).

In the present study, attempts were made to develop and characterize chitosan and gelatin based nanoparticles. Chitosan is prepared from chitin, one of the natural and commonly available polymers (Araki, Yamanaka, & Ohkawa, 2012; Zikakis, 2012). Chitosan is a linear polysaccharide with random distribution of deacetylated β-(1-4)-D-glucosamine and N-acetyl-D-glucosamine which has been prepared by the deacetylation of chitin (Zong, Kimura, Takahashi, & Yamane, 2000). Chitin is found in the exoskeleton of crustaceans like crabs and shrimps (Arba, Arba, Adour, & Amrane, 2013; Kaya, et al., 2014). Crustacean shell is the major waste from shrimp industry and has the potential to become the foremost of chitin and chitosan (Anand, et al., 2016; Karthik, Manigandan, Saravanavan, Rajesh, & Chandrika, 2016). On the other hand, gelatin is mainly obtained from animal skin and bones (C. Coester, Kreuter, von Briesen, & Langer, 2000). It is one of the most commonly used biopolymer with improved biocompatibility and biodegradation (H. Wang, et al., 2013). Sodium carboxymethyl cellulose (SCMC) was used as a copolymer for the preparation of gelatin nanoparticles.

BACKGROUND

The field of drug delivery technology is an inter-disciplinary field, which requires the expertise of materials science, medical science and cell biology (K. K. Jain, 2014). Research on novel drug delivery systems can help in saving a lot of effort of the pharmaceutical companies, which are involved in synthesizing...
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