Biopolymers Research

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Abstract

Biopolymer-based nanocomposites represent a promising approach for drug delivery systems, particularly in the fields of antimicrobial and anticancer therapies. This study explores the development of various biopolymer nanocomposites incorporating bioactive agents, assessing their efficacy and release profiles. The nanocomposites were synthesized using techniques such as solvent casting and electrospinning, allowing for the incorporation of drugs and other bioactive compounds into the biopolymer matrix. Characterization methods, including Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and in vitro drug release studies, were employed to evaluate their physical, chemical, and biological properties. Results demonstrated enhanced drug loading capacities, controlled release rates, and significant antimicrobial and anticancer activities. These findings suggest that biopolymer-based nanocomposites can be engineered to effectively deliver therapeutic agents, providing a sustainable and innovative strategy for modern drug delivery systems.

Keywords: Nanocomposites; Drug delivery; Antimicrobial activity; Anticancer activity; Electrospinning; Biocompatibility; Fourier-transform infrared spectroscopy ; Scanning electron microscopy

Introduction

The emergence of antibiotic resistance and the need for effective cancer therapies have heightened the demand for innovative drug delivery systems. Biopolymer-based nanocomposites offer a sustainable and biocompatible alternative to traditional materials, leveraging the inherent properties of natural polymers such as chitosan, alginate, and gelatin [1]. These biopolymers provide excellent biocompatibility, biodegradability, and the ability to incorporate a variety of therapeutic agents. Nanocomposites formed from biopolymers can be engineered to enhance drug loading capacity and enable controlled release profiles, making them suitable for targeted delivery applications. The combination of antimicrobial and anticancer agents within a biopolymer matrix not only addresses two significant health concerns but also offers the potential for synergistic effects that enhance therapeutic efficacy [2, 3]. This study investigates the synthesis, characterization, and evaluation of biopolymer-based nanocomposites designed for the simultaneous delivery of antimicrobial and anticancer agents. We aim to assess the release kinetics, antimicrobial properties, and anticancer efficacy of the developed nanocomposites, providing insights into their potential applications in modern medicine.

Methodology

Biopolymers (chitosan, alginate, gelatin) were sourced from reputable suppliers. Antimicrobial agents (e.g., silver nanoparticles, essential oils) and anticancer drugs (e.g., doxorubicin) were acquired for incorporation into the nanocomposite formulations.

Citation: Panola S (2024) Nanocomposites from Biopolymers Innovative Strategies for Antimicrobial and Anticancer Drug Delivery. Biopolymers Res 8: 232.