

Review

Self-Assembled Polymers for Gastrointestinal Tract Targeted Delivery through the Oral Route: An Update

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Abstract: Gastrointestinal tract (GIT) targeted drug delivery systems have gained growing attention as potential carriers for the treatment of different diseases, especially local colonic diseases. They have lower side effects as well as enhanced oral delivery efficiency because of various therapeutics that are vulnerable to acidic and enzymatic degradation in the upper GIT are protected. The novel and unique design of self-assembled nanostructures, such as micelles, hydrogels, and liposomes, which can both respond to external stimuli and be further modified, making them ideal for specific, targeted medical needs and localized drug delivery treatments through the oral route. Therefore, the aim of this review was to summarize and critically discuss the pharmaceutical significance and therapeutic feasibility of a wide range of natural and synthetic biomaterials for efficient drug targeting to GIT using the self-assembly method. Among various types of biomaterials, natural and synthetic polymer-based nanostructures have shown promising targeting potential due to their innate pH responsiveness, sustained and controlled release characteristics, and microbial degradation in the GIT that releases the encapsulated drug moieties.

Keywords: self-assembled; polymers; oral delivery; biomedical applications; GIT targeting



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1. Introduction

In recent decades, there has been a global increase in the prevalence of intestinal diseases, including irritable bowel syndrome, colorectal cancer (CRC) [1], and inflammatory bowel disease (IBD), which comprises Crohn's disease and ulcerative colitis [2]. CRC is responsible for the highest number of cancer-related deaths in Europe, with over 200,000 deaths annually, while the incidence of IBD is rising at an alarming rate in previously low-incidence areas, such as Asia [2]. Moreover, ulcerative colitis has been recognized as one of the modern refractory diseases by the World Health Organization (WHO) [3]. Therefore, effective treatments of intestinal diseases have become major public health issues worldwide.

Oral administration is the most commonly used method for drug delivery due to its simplicity, high safety, and lower cost compared to intravenous injection. It also promotes strong patient compliance. Additionally, drugs administered orally can quickly reach the GIT, enabling accumulation in the target site of the intestine, which makes it an ideal delivery route for intestinal-targeted therapies [4]. However, effective treatments for intestinal diseases still present several challenges, such as poor oral absorption, difficult gut location, and inadequate drug delivery [5]. Expectations for accumulation in the targeted sites, multiple physiological barriers (including the enzymatic barrier, mucus layer barrier, and intestinal epithelial cells layer) in the GIT also hinder the effectiveness of drugs in the gut [6,7]. The enzymatic barrier, rooted in an abundance of digestive enzymes in the GIT, can cause the degradation of some drugs [8]. The mucus layer can hinder the

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