Polymeric Micelles – The Future of Oral Drug Delivery

Isaac Godfroy

Department of Chemical and Biomolecular Engineering
University of Notre Dame, Notre Dame, IN 46556

Abstract

This work examines current advancements in polymeric micelles as a method for oral delivery of poorly water-soluble drugs. The oral route presents several barriers to drug delivery that the chosen vesicle must overcome. Polymeric micelles have several physical properties, including molecular weight and copolymer block composition, which can be tailored to alter the vesicle structure and overcome these barriers. Examination of current research demonstrates the ability of polymeric micelles to respond to external stimuli, such as pH, allowing for controlled release of encapsulated drugs in the gastrointestinal tract. Lastly, with patients preferring the oral drug delivery route to the intravenous delivery route, it was shown that polymeric micelles can achieve the same desired pharmacological dose via either delivery method. These factors make polymeric micelles appear to be a viable option for future oral drug delivery applications.

1. Introduction

1.1 Clinical Relevance

Advances in current medicine have made it necessary to develop novel drug delivery systems (DDSs). Medication can be administered in several ways, with 112 routes for administration approved by the FDA [1]. Currently, it is rare for a pharmaceutical product to enter the market without its own specific delivery system [2]. The newest products in the market are biologics, such as peptides and proteins, because of the ability to provide highly selective, effective, and potent action in treatment of multiple diseases [3]. However, most biologic drugs are administered intravenously because of the multiple barriers posed by the gastrointestinal tract (GIT). These barriers include physiochemical conditions of the GIT, low levels of penetration across the transepithelial membrane, and poor bioavailability due to low drug solubility in the GIT lumen [4].

Oral DDSs are widely used for non-biologic medical treatments because it is the easiest and most convenient method of delivery when repeated or routine administration is required [5]. This route is favored because of increased patient compliance, less stringent quality control, improved safety, lower costs, and no requirement for trained professionals to administer injections [4]. A patient with multiple sclerosis, for which the only current treatment is a weekly injection, said "If I could take a pill, I almost wouldn't mind the disease," eliminating the syringes "would make it a lot more tolerable" [6]. These benefits lead to the fact that oral products account for nearly 70% of the value in the US pharmaceutical market and 60% of the DDSs used [2]. With such a large market