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Biodegradable diblock copolymeric PEG-PCL nanoparticles: Synthesis, characterization and applications as anticancer drug delivery agents

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ABSTRACT

Poly (ethylene glycol) methyl ether-block-poly (ε-caprolactone) copolymers are useful biomedical materials owing to their amphiphilic nature, biodegradability, biocompatibility and also due to their semi-crystalline form having a low glass transition temperature. Due to their slow drug release profile, PEG-PCL copolymers are excellent candidates for sustained delivery applications over a period of time of more than a year. This unique property has provoked their relevance specially in the area of anticancer drug delivery applications in the form of various nanoaggregates like microspheres, nanogels, nanospheres, polymersomes, micelles, etc. A large variety of anticancer drugs/bioactives have been encapsulated in PEG-PCL copolymers for developing effective anticancer drug delivery systems and also for producing controlled drug release profiles. In recent times, PEG-PCL co-polymers based nanoparticles have shown tremendous advancements as anticancer drug delivery vehicles owing to their higher drug loading capacities of the hydrophobic drugs, enhanced bioavailability, keeping away from being overpowered by way of phagocytes, decreased blasted discharge, and also in increasing the scattering time of drug within the blood stream during their systemic inoculation. These nano-formulated drug delivery systems can be used for the delivery of anticancer drugs at a specific site in a targeted approach. The developed nano-formulations possess promising potential in the treatment of cancer with improved anticancer efficacy and reduced toxicity *in-vivo*. In the current review, our main focus is to highlight the development and synthesis of different types of PEG-PCL copolymers (both conventional and greener approaches) along with the physico-chemical characterization techniques used primarily for the PEG-PCL co-polymeric systems. We have also summarized the uses of PEG-PCL co-polymeric nano formulations with various anticancer drugs as drug delivery platforms in the area of anticancer chemotherapy.

1. Introduction

Two essential criteria for an efficient drug delivery system include both the quantity and the duration of drug presence inside it. Drug delivery systems are mainly concerned with site-targeting within the body and pose various systemic challenges, e.g. minimizing drug degradation and loss, increasing drug bioavailability, averting unfavorable side-effects by delivering the drug at appropriate targeted area, developing broadened medicated conveyance frameworks, etc. Various medications focusing on frameworks which meet these requirements are currently under different levels of development. In a drug delivery system, the drugs/bioactives are carried inside the body in water soluble vehicles like polymers, microcapsules, lipoproteins, liposomes, micelles, vesicles or microparticles, etc. comprising of biodegradable synthetic polymers [1]. These carriers could be efficiently molded for slow degradation, stimuli-reactive responses and for their targeted delivery approach. The drug targeting is the ability of the drug-loaded system to act directly at the site of interest. The approach of site-directed drug release systems is differentiated by two major mechanisms: (i) passive and (ii) active targeting. The significant ways for the development of successful formulations are controlled drug release and successive biodegradation. The release mechanism depends upon (i) a surface-bound or adsorbed drugs that are released from or through a surface; (ii) diffusion of drug through the carrier matrix; (iii) in nanocapsules, diffusion turn up through the

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