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Synthesis and Characterization of Ciprofloxacin Loaded Star-Shaped Polycaprolactone–Polyethylene Glycol Hydrogels for Oral Delivery

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Abstract
The administration of poorly water-soluble drugs represents a relevant problem due to the low body fluids transport efficiency through hydrophilic hydrogels. Star-shaped co-polymers, i.e., amphiphilic polymers such as those with a hydrophobic core and a hydrophilic outer shell, can be used to improve weak interactions with drugs, with relevant benefits in terms of administration and controlled delivery. In this work, two different co-polymers, four-arm star-shaped PCL–PEG and six-arm star-shaped PCL–PEG, were synthesized via ring-opening polymerization to be loaded with ciprofloxacin. 1H-NMR and FTIR analyses confirmed that PCL arms were successfully grafted to the mPEG backbone, while DSC analysis indicated similar crystallinity and melting point, ranging from 56 to 60 °C, independent of the different co-polymer architecture. Therefore, both star-shaped PCL-PEGs were investigated as cargo device for ciprofloxacin. No significant differences were observed in terms of drug entrapment efficiency (>95%) and drug release, characterized by a pronounced burst followed by a slow sustained release, only slightly affected by the co-polymer architecture. This result was also confirmed with curve fitting via the Korsmeyer–Peppas model. Lastly, good antibacterial properties and biocompatibility exhibited in both star-shaped PCL–PEG co-polymers suggest a promising use for oral delivery applications. © 2023 by the authors.

Author Keywords
ciprofloxacin; drug delivery; hydrogels; PCL arms; star co-polymers

Index Keywords
Antibiotics, Biocompatibility, Body fluids, Controlled drug delivery, Crystallinity, Curve fitting, Efficiency, Hydrogels, Hydrophilicity, Polyethylene oxides, Ring opening polymerization, Targeted drug delivery; Ciprofloxacin, Co-polymers, Lower body, Oral delivery, PCL arm, Polymer architecture, Poorly water-soluble drugs, Star co-polymer, Star-shaped, Synthesis and characterizations; Polyethylene glycols

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