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Hydrophobic Drug Carrier from Polycaprolactone-b-Poly(Ethylene Glycol) Star-Shaped Polymers Hydrogel Blend as Potential for Wound Healing Application

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Abstract

Blending hydrogel with an amphiphilic polymer can increase the hydrophobic drug loading and entrapment efficiency of hydrogel-based formulations. In this study, a hydrogel formulation with star-shaped polycaprolactone-b-poly(ethylene glycol) (PCL-b-PEG) as the hydrophobic drug cargo is produced. The 4-arm and 6-arm star-shaped PCL are synthesized with different molecular weights (5000, 10,000, 15,000 g/mol) via ROP and MPEG as the hydrophilic segment is attached via the Steglich esterification. FTIR and ^{1}H-NMR analysis showed the presence of all functional groups for homopolymers and copolymers. M_n for all synthesized polymers is close to the theoretical value while GPC spectra showed a monomodal peak with narrow molecular weight distribution (PDI:1.01–1.25). The thermal degradation temperature and crystalline melting point of synthesized polymers increase with the increase in molecular weight and number of arms. All formulations possess high drug loading and entrapment efficiency (>99%) and increase with increasing molecular weight, number of arms, and amount of polymer in the formulations. All formulations showed a sustained drug release pattern with no initial burst, which follows the Korsmeyer–Peppas kinetic model. The polymer hydrogel formulations showed antibacterial activity against E. coli and S. aureus. The hydrogel containing 4-arm PCL_{15k}-PEG is chosen as the best formulation due to its high drug release, good antimicrobial activity, and morphology. © 2023 by the authors.

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amphiphilic system; hydrogel; polycaprolactone-b-poly(ethylene glycol); star-shaped polymer

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