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Development of Novel Amphiphilic Block Copolymer of Renewable ε-Decalactone for Drug Delivery Application

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Abstract : The poor aqueous solubility is one of the major obstacles in the formulation development of many drugs. Around 70% of drugs are poorly soluble in aqueous media. In the last few decades, micelles have emerged as one of the major tools for solubilization of hydrophobic drugs. Micelles are nanosized structures (10-100nm) obtained by self-assembly of amphiphilic molecules into the water. The hydrophobic part of the micelle forms core which is surrounded by a hydrophilic outer shell called corona. These core-shell structures have been used as a drug delivery vehicle for many years. Although, the utility of micelles have been reduced due to the lack of sustainable materials. In the present study, a novel methoxy poly(ethylene glycol)-b-poly(ε-decalactone) (mPEG-b-PεDL) copolymer was synthesized by ring opening polymerization (ROP) of renewable ε-decalactone (ε-DL) monomers on methoxy poly(ethylene glycol) (mPEG) initiator using 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD) as a organocatalyst. All the reactions were conducted in bulk to avoid the use of toxic organic solvents. The copolymer was characterized by nuclear magnetic resonance spectroscopy (NMR), gel permeation chromatography (GPC) and differential scanning calorimetry (DSC).The mPEG-b-PεDL block copolymeric micelles containing indomethacin (IND) were prepared by nanoprecipitation method and evaluated as drug delivery vehicle. The size of the micelles was less than 40nm with narrow polydispersity pattern. TEM image showed uniform distribution of spherical micelles defined by clear surface boundary. The indomethacin loading was 7.4% for copolymer with molecular weight of 13000 and drug/polymer weight ratio of 4/50. The higher drug/polymer ratio decreased the drug loading. The drug release study in PBS (pH7.4) showed a sustained release of drug over a period of 24hr. In conclusion, we have developed a new sustainable polymeric material for IND delivery by combining the green synthetic approach with the use of renewable monomer for sustainable development of polymeric nanomedicine.

Keywords : dopolymer, ε-decalactone, indomethacin, micelles
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