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Electrospun poly(N-isopropylacrylamide) based tri-polymer system for thermo-responsive delivery of Diclofenac

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Electrospun thermoresponsive polymers have proven useful in biomedicine as wound dressing materials. Poly(N-isopropylacrylamide) (pNIPAM) is one such thermal responsive polymer that undergoes a sharp phase transition at a lower critical solution temperature (LCST) of 32 ºC in aqueous solution. When the temperature is raised above the LCST, pNIPAM rapidly changes from being hydrophilic (linear state) to hydrophobic (globular state) and enables thermo-responsive drug release. However, electrospinning pNIPAM alone is a difficult process. Therefore, in this work we have developed a novel polymer blend composed of poly(vinylpyrrolidone) (PVP), ethyl cellulose (EC) and pNIPAM to facilitate the spinning process. The addition of PVP helps to increase the spinning rate (2.0 ml h^{-1}, which is 4x faster than previously reported work from a bi-polymer PNIPAM /EC system) and fastens the spinning process to generate fibers. The model drug Diclofenac sodium (DICLO) was incorporated to different ratios of PVP/EC/pNIPAM. PVP weight percentage was optimized and fixed at 40% (w/w) for all electrospun formulations. The pNIPAM percentage was varied as 55, 45, 35 and 25% (w/w) for each formulation. The electrospun drug loaded fiber series was subjected to SEM and DSC characterization. *In-vitro* drug release studies for the mats carried out at two different temperatures, 37±0.5 °C and 25±0.5 °C, at pH 7.4 resulted in thermoresponsive DICLO release for all four formulations (n=3). After 24 h time duration, the highest drug release of 90.54% was observed from the mat containing the highest loading of pNIPAM at 25 °C and the lowest DICLO release of 38.30% was observed from the same formulation at 37 °C. Thus, the novel electrospun PVP/EC/pNIPAM system shows good potential as wound dressing materials with thermoresponsive DICLO release.

Keywords: Thermoresponsive, diclofenac, drug delivery, wound dressing, electrospining

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