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Surface modification of PLGA particles using chitosan for drug delivery applications

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Design and synthesis of new biomaterials for drug delivery applications is a promising, but challenging research area. A number of polymeric biomaterials have been extensively studied in the past few years based upon the properties of biodegradability and biocompatibility. Poly (lactic-co-glycolic acid) (PLGA) is a biocompatible, biodegradable and FDA approved polymer. When PLGA is developed for systemic applications, its surface is typically protected by other hydrophilic polymers such as poly (ethylene glycol) (PEG) and poly (vinyl alcohol) (PVA) to help prolonged circulation and enhanced cellular uptake. But PEG and PVA can interfere with the interactions between drug carriers and target cells and negatively influence the therapeutic outcomes. To overcome this challenge, we proposed a design to use chitosan as an alternative surface coating of PLGA. We hypothesized that our design provides a sustainable drug delivery system, improves delivery efficiency and reduces toxic side effects. Magnesium gluconate (MgG) was encapsulated in PLGA as a model drug. MgG encapsulated and chitosan modified PLGA particles were synthesized using modified double emulsion solvent evaporation technique. The core objective of this project was to test the particles with respect to the physical and chemical properties, cell-particles interactions, drug loading and drug delivery. The particles were found to be several hundred nanometers in size and spherical in shape with smooth surface. Quantification of chitosan was analyzed using ninhydrin assay and the amount of chitosan adsorbed on PLGA was found significant for prolonged circulation and enhanced cellular uptake. The drug release curve showed sustainable release profile.

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Spironolactone-loaded SLN versus NLC: Physicochemical characteristics, stability and *in vitro* release

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Spironolactoe (SP), a synthetic steroid diuretic is a poorly water-soluble drug with a low and variable oral bioavailability. Regarding the good solubility of SP in lipid materials, SP loaded solid lipid nanoparticles (SP-SLNs) and nanostructured lipid carrier (SP-SLNs) were thus prepared in this work for accelerating dissolution of this drug. The SP loaded NLC with stearic acid (SA) as solid lipid and different oleic acid (OA) as liquid lipid content and SLN without OA were prepared by probe ultrasonication method. With increasing the percentage of OA from 0 to 30 wt% in SLN/NLC, the average size and zeta potential of nanoparticles fell down and entrapment efficiency (EE%) rose dramatically. The obtained micrograph particles showed pronounced spherical shape with smooth surface. Differential scanning calorimeter (DSC) measurements indicated that the presence of OA reduced the melting temperature and melting enthalpy of solid lipid in NLC structure. The results reflected good long-term stability of the nanoparticles and the measurements show that the particle size remains lower in NLC compare to SLN formulations, 6 months after production. Dissolution of SP-SLN and SP-NLC was about 5.1 and 7.2 times faster than raw drugs in 120 min respectively. These results indicated that the SP loaded NLC containing 70:30 solid lipid to liquid lipid ratio is a suitable carrier of SP with improved drug EE and steady drug release properties.

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