Design and Characterization of Spray-Dried Proliposomes for the Pulmonary Delivery of Curcumin

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Abstract

Purpose
The goal was to directly deliver curcumin, a natural polyphenolic anticancer and anti-inflammatory compound, to the lung tissues with minimal systemic exposure through the fabrication of proliposomes, overcoming its poor aqueous solubility and oral bioavailability.
Methods
Nano-spray drying was employed to prepare proliposomes using hydroxypropyl beta-cyclodextrin as a carrier. Lecithin and cholesterol were used as lipids, stearylamine and Poloxamer 188 were added as positive charge inducer and a surfactant, respectively. Different characterization parameters were evaluated like percentage yield, entrapment efficiency, drug loading, aerodynamic particle size, in vitro release besides morphological examination. Cytotoxicity studies on cell line A549 lung tumor cells as well as in vivo lung pharmacokinetic studies were also carried.
Results
The optimized formulations showed superior aerosolization properties coupled their enhanced ability to reach deep lung tissues with a high % of fine particle fraction. Cytotoxicity studies using MTT assay demonstrated enhanced growth inhibitory effect on lung tumor cells A549 and significant reduction of proinflammatory cytokines such as tumor necrosis factor-Ŭ, interleukin-6 and interleukin-10 compared to the pure drug. Results of lung pharmacokinetic tests confirmed the superiority of proliposomal curcumin over curcumin powder in both, the rate and extent of lung tissue absorption, as well as the mean residence time within the lung tissues.
Conclusion
The pulmonary delivery of curcumin-loaded proliposomes as dry powder provides a direct approach to lung tissues targeting while avoiding the limitations of the oral route and offering a non-invasive alternative to the parenteral one.
Keywords: curcumin, proliposomes, cyclodextrin, dry powder inhalers, human epithelial cell line, pulmonary delivery

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