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PULMONARY INHALATION PERFORMANCE OF CHITOSAN NANOPARTICLES ADMIXED WITH LACTOSE-POLY ETHYLENE GLYCOL MICROPARTICLES

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ABSTRACT

Nanoparticles are characterized by poor pulmonary inhalation performance as they are exhalation prone, in addition to their tendency to form agglomeration due to large surface area to volume ratio thereby hindering their deep lung deposition. Coarse carriers commonly used in dry powder inhaler cannot be used to deliver nanoparticles to the lung. The nanoparticles will be attach strongly to them and deposit in the throat, or they will detach, enter the lung and be exhaled. This study aimed to develop a platform where the nanoparticles were distributed over the microparticles for pulmonary delivery of nanoparticulate system. The chitosan nanoparticles of varying size, size distribution, zeta potential, crystallinity, shape and surface roughness were prepared by spray drying technique through employing chitosan of different molecular weight, surfactants, and changing the parameters of processing conditions. The lactose-polyethylene glycol microparticles of different geometric size, aerodynamic size, size distribution, specific surface area, density, crystallinity, shape and surface roughness were prepared using the same technique with polyethylene glycol of varying molecular weights and the introduction of ethanol. The inhalation performance of chitosan nanoparticles was assessed by mean of andersen cascade impactor method as a function of the physicochemical properties of nanoparticles and microparticles using a blend of nano-to-microparticles weight ratio of 1:9. The inhaled fine particle fraction of the chitosan nanoparticles was dictated by their shape and z-potential. An increase in the sphericity and z-potential of the chitosan nanoparticles decreased their tendency to agglomerate and improved their dispersion and inhalation performance. The specific surface area of the lactose-polyethylene glycol microparticles had a significant influence on the aerosolization performance of the chitosan nanoparticles. An increase in the specific surface area of lactose-polyethylene glycol microparticles increased their capacity to accommodate more nanoparticles and decreased the chances of nanoparticles being deposited at deep lung as a result of increasing the mass of nanoparticles-loaded microparticles. The analysis of FTIR spectra of powder collected at each stage of the cascade impactor suggested that the attachment force between chitosan nanoparticles and lactose-polyethylene glycol microparticles was strong enough to survive for deep lung deposition. The chitosan nanoparticles were successfully delivered to the deep lung utilizing the lactose-polyethylene glycol microparticles in a coarse carrier-free dry powder system.

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