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Assessment of an enteric nanoparticle-in-microparticle protein delivery system using confocal microscopy

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Purpose.

To prepare model drug loaded - and protein nanoparticle loaded- microparticles, and to assess the success of the microencapsulation technique using dissolution studies and confocal microscopy. Furthermore, to establish the ability of the enteric microparticles to release the nanoparticle under the appropriate pH conditions

Methods.

Microparticles (60-90µm) were prepared by a single-emulsion solvent evaporation process using one of two enteric polymers: hydroxypropylmethylcellulose phthalate grade HP50 and HP55 which dissolve above pH 5 and pH 5.5. The microparticles were loaded with (a) a model drug (prednisolone) or (b) protein loaded nanoparticles. The nanoparticles (~500nm) were prepared using a single-emulsion solvent evaporation process using poly (lactic-co-glycolic) acid and were loaded with fluorescein-tagged albumin (model protein). The drug loading and release of the drug-loaded microparticles was assessed by UV and dissolution studies. The ability of the microparticle system to encapsulate the nanoparticles was assessed using confocal microscopy. The nanoparticle release from the microparticle system under simulated gastric and intestinal pH conditions was assessed using light microscopy.

Results.

Prednisolone loaded HP50 and HP55 microparticles showed negligible drug release at pH 1.2, but allowed drug release at pH 5 and 5.5. The microencapsulation technique employed was able to successfully entrap nanoparticulate material, as well as a model drug, and this was exemplified by the confocal microscopy images. The nanoparticle loaded microparticles showed an ability to release the nanoparticles under the appropriate pH conditions.

Conclusion.

Nanoparticles were successfully encapsulated using the microparticle preparation technique, suggesting that the procedure is not only suitable for drug molecules, but for particulate material. Confocal microscopy proved a useful technique to demonstrate the encapsulation success. The formulation could be used to deliver nanoparticulate material to the small intestine or large intestine. The process could be adapted for drug/protein /vaccine delivery via nanoparticulate uptake in the gut with the enteric coating being used to bypass hostile conditions in the stomach and upper small intestine.