Optimizing the Process of Protein Encapsulation for Potential Applications in Intranasal and Oral Drug Delivery

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Currently, the market for protein and peptide-based drugs accounts for over 40 billion U.S. dollars - the equivalent of 10% of the pharmaceutical market. Using peptide therapeutics is of growing interest in the field of nanomedicine. However, there are challenges to overcome with administering peptide-based drugs intranasally and orally, the latter being the preferred method of drug administration due to its safe, needle-free and convenient approach. The research conducted in this study aimed to model the solution through fabrication of negatively charged pepsin (model protein utilized) nanoparticles and subsequent coating with cationic chitosan, via polyelectrolyte deposition, to form a nanocapsule (preferred size of ≤ 300 nm). Nanoparticles were created via nanoprecipitation, coated, and finally characterized to assess suitability for intranasal and oral drug delivery. Results indicated that the proposed hypothesis was supported to a certain extent; optimal conditions for nanoprecipitation and coating include: 2.50 mg/mL pepsin dissolved in pH ~6.78 deionized water, 2 mL of acetonitrile added at a constant rate of 120 mL/hr and coated with 1.00 mg/mL chitosan solution at a ph of ~5. Uncoated pepsin nanoparticles had 79.7 +- 31.3 % mean enzymatic activity of pepsin. The coated nanoparticles had a mean size of 332 +- 91.0 nm, PDI of 0.405 +- 0.135 nm, positive surface charge, 94.6 +- 8.2 % encapsulation efficiency, and 8.4 +- 0.32 % loading capacity. Therefore, further optimization is required; release profile and cell culture studies, surface modification, and the use of imaging agents can expand the scope of applications.