Synthesis and Characterization of Chitosan Nanoparticles for Oral Delivery
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Introduction and Objective
Chitosan nanoparticles (CS-NPs) are promising vehicles for oral drug delivery, offering a means to increase the bioavailability of therapeutic agents which may otherwise be limited by their low intestinal absorption and instability in the gastrointestinal (GI) tract. (Chen et al., 2013) Chitosan (CS), a polysaccharide derived from the deacetylation of chitin, is known for its biocompatibility, nonreactivity, and mucoadhesivity. In nanoparticle form, CS’s properties only improve, allowing for greater interaction with the surrounding microbial environment. (Landriscina et al., 2015)

Techniques and Skills Learned
CS-NP synthesis via ionic gelation
Method based around the electrostatic interactions between CS’s positively charged amine groups and triplyphosphate (TPP) anions, commonly used as a cross-linking agent due to its nontoxic nature. (Mohammadpourdougghi, 2009)

Dynamic light scattering (DLS)
A technique used to characterize the size distribution of particles suspended in solution.

Microplate reader
A machine that can read samples in a 96-well plate to measure absorbance, fluorescence, luminescence, etc. Gained valuable troubleshooting skills while working with this instrument.

Nanoparticle reader
Wrote procedure for the NanoDrop, a UV-Vis spectrophotometer that can read 1-2µL samples (ex: DNA, RNA, protein).

Methods and Results
Effects of varying the molecular weight of chitosan on chitosan nanoparticles
1. Synthesized 2mg/mL chitosan nanoparticles via ionic gelation using both low and medium molecular weight chitosan, observed chitosan nanoparticles using TEM. (see Fig. 5)

2. Measured size distribution of chitosan nanoparticles using DLS, averaged results from each run to find average diameter.

Effects of varying the concentration of chitosan on chitosan nanoparticles
1. Synthesized 0.5mg/mL, 2mg/mL, and 3mg/mL chitosan nanoparticles using low molecular weight chitosan.

2. Measured size distribution of chitosan nanoparticles using DLS, averaged results from each run to find average diameter.

Calculating encapsulation efficiency of metformin in 2mg/mL low molecular weight chitosan nanoparticles

Encaps. efficiency = \( \frac{\text{total mass} – \text{free mass}}{\text{total mass}} \)

Data is still in the process of being collected, but we expect metformin’s encapsulation efficiency to be around 67% (the encapsulation efficiency previously found from encapsulating fluorophores within CS-NPs).

Impact of Professor’s Research
The Chung Lab uses nanomedicine and tissue engineering to address clinical limitations, aiming to design self-assembling, peptide amphiphile micelle nanoparticles to target diseases such as atherosclerosis and autosomal dominant polycystic kidney disease (ADPKD), and also to serve as contrast agents to enhance imaging techniques such as magnetic resonance imaging (MRI) and positron emission tomography (PET). Other goals include combining stem cell technology with citric acid-based scaffolds for regenerative purposes.

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