Enhancing Drug Delivery Targeting and Efficiency: Controlled Delivery with Specific Biopolymer Coated Mesoporous Silica Nanoparticles

Jeffrey Pierce Bewlay, Alexis Johnson, and Mia Page, and Brian G. Trewyn

Colorado School of Mines, Golden, CO 80401

Should be considered for poster awards: Yes

Traditional drug delivery methods are unable to alleviate challenges associated with the administration of medicine, which include non-target site exposure, adverse effects, environmental impact, and unnecessary cost. In addition to continual drug development, it is equally or more important to consider new methods to use traditional drugs with higher efficiency. Mesoporous silica nanoparticles provide an alluring avenue towards a stimulus specific biomolecule and drug delivery system due to their high surface area (over 1,000 m2/g), biocompatibility, and chemical tailor ability. The well-defined pores of MSN materials can host and actively release drug molecules in a controlled manner, reducing non-target site exposure and adverse effects while improving patient compliance and overall treatment effectiveness. To achieve this, various materials have been explored as endcaps to trap payloads within the pores of MSN until reaching a specific stimulus that releases the therapeutic. The biological compatibility and relevance of the biopolymer amylose makes it an ideal candidate for pore coverage. Amylose nanoparticles have been pursued in literature for topical drug delivery and wound dressing. Few methodologies, however, report the formation of biopolymer coatings around porous nanoparticles for internal targeted drug delivery. The physiologically abundant enzyme amylase would degrade the amylose coat and initiate drug delivery appropriate for cases of dysphagia and pancreatitis. Herein we report initial findings and characterizations of an MCM-41 drug delivery system capable of uptake and sustained release of drug surrogate molecules mediated by concentration gradient and pH dependent electrostatics. Amylose displayed suitable surface interactions with bare MCM-41, yielding sufficient pore coverage. A 90% dimethyl sulfoxide solution (DMSO) with PBS was determined to be sufficient for amylose coating of MCM-41 due to amylose solubility in DMSO. Pore volume and pore size distribution of synthesized MCM-41 was determined by nitrogen adsorption. Thermogravimetric analysis was conducted on bare MCM-41, MCM-41 loaded with drug surrogate molecules, and amylose-coated MCM-41 loaded with drug surrogate molecules to calculate pore volume to surface area ratio. Further testing to identify the drug release rate of the amylose-coated MCM-41 in the targeted drug delivery system will be conducted.