Biodegradable Polymers for Protein and DNA Drug Delivery

Butler, Ariel (School: Sibley East High School)

This study explored the potential of poly beta amino esters for the delivery of drugs, evaluating transfection efficiency, cell viability, and binding affinity. The polymer backbone consisted of 1,4-Butanediol diacrylate and the 5-amino-1-pentanol and Dodecylamine comprised the side chains. For the synthesis of the biodegradable polymers, the backbone molecule and sidechain molecules were reacted at a molar concentration of 1.24:1 (backbone: sidechains) to select for a chain length of ten to fifteen. To vary the hydrophobicity of the polymer, it was prepared with four different molar ratios of the hydrophobic (Dodecylamine) and hydrophilic (5-amino-1-pentanol) sidechains (9:1, 7:3, 3:7, 1:9). To characterize the polymers, they all underwent size exclusion chromatography (SEC) to determine their size and zeta potential to determine the surface charge density. Subsequently, all the polymers were mixed with RNA at 60 w/w polymer:DNA ratio, and then analyzed using gel electrophoresis to determine their binding affinity with DNA. The polymer with the 7:3 (hydrophobic: hydrophilic molar ration) had the strongest binding with DNA, while 1:9 exhibited the weakest attraction. The polymers that displayed the strongest binding with DNA had larger positive surface charges. Transfection Efficiency of the PBEs was evaluated on HeLa cells using the plasmid pCMV-XL5-hCD200. PBE-7:3 had the highest transfection efficiency at 85%. The more hydrophilic polymers had higher molecular weights and lower cell viability. The PBE-7:3 polymer has potential to treat diseases, such as retinolblastoma and cystic fibrosis.

Awards Won: