Effect of Surface Modification of Biodegradable Poly(Lactic-Co-Glycolic Acid) Microspheres on Surface-Protein Interaction

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Purpose
The current project involves synthesizing surface modified microspheres which are coated with proteins as colloidal vehicles for the delivery of therapeutic protein drugs. By modifying the surface of microspheres, the loading amount of proteins onto the surfaces will be increased, which will result in better efficiency as a drug delivery system. Also, use of protein-protein interaction to load therapeutic proteins onto microspheres can decrease the degree of denaturation of the therapeutic protein.

Methods
Biodegradable PLGA microspheres were prepared using double emulsion method, and their physical properties were characterized. Size and surface charge were analyzed using dynamic light scattering (DLS) techniques, and density of carboxyl groups on the surface of the microspheres was determined using titration. The surface of PLGA microspheres was modified to enhance capacity for covalently bound surface ligands. PLGA microspheres were functionalized with bovine serum albumin (BSA) and bovine \( \beta \)-casein, and protein attachment was verified by micro-BCA assay for protein. Lastly, the interaction of PLGA microspheres with recombinant human growth hormone (r-hGH) was investigated using isotope dilution method with radioisotope of \(^{125}\text{I}\)-labeled r-hGH.

Results
The average size of the PLGA/PEMA microspheres was near 1000nm, and the average zeta potential of the microspheres was near -55mV. The density of carboxyl groups was high compared polystyrene particles. BSA and \( \beta \)-casein were conjugated onto the surface of PLGA/PEMA microsphere. The average amount of BSA and \( \beta \)-casein conjugated was 0.1µg and 0.25µg per cm\(^2\) of microspheres, respectively. Also, the size of protein conjugated microspheres was slightly higher than the one before conjugation. The binding study showed that as the concentration of r-hGH increased, the amount of r-hGH bound onto the microspheres increased as well. However, it did not reach a saturation point in the concentration range of 0.0125-0.75mg/ml. After overnight incubation at 37°C, about 80% of r-hGh was desorbed from microspheres.

Conclusion
PLGA/PEMA microspheres were successfully prepared using double emulsion method, and BSA and \( \beta \)-casein were conjugated onto the surface.