Studies on Protein Stability in Sodium Alginate Solution

Authors: Fuyue Li, Yinyan Zhao, Michael T. Harris
Affiliation: School of Chemical Engineering, Purdue University, 480 Stadium Mall Drive, West Lafayette, IN47907-2100 USA

Alginate is a naturally occurring polysaccharide, composed of (1→4) linked β-D-mannuronate residues and its C-5 epimer α-L-guluronate residues. There has been increasing interests in utilizing alginate as an effective encapsulation material for delivery of biopharmaceutical compounds. Therefore, the understanding of protein stability in sodium alginate solution and the investigation of protein-polysaccharide interactions have been important issues in this application. In this research, the effects of sodium alginate on the model protein's (Bovine Serum Albumin, BSA) stability were investigated. Several analytical techniques were used to monitor the physiochemical property changes of BSA. The hydrodynamic radius of sodium alginate solution and BSA-alginate mixture was characterized by using Dynamic Light Scattering (DLS) over a 6 day period. DLS results show there was no significant change of the coil size during this observation period. Different concentrations of BSA and BSA-alginate mixture were prepared in water at 25ºC and the secondary structures of BSA were characterized using Fourier Transform Infrared Spectrometer (FT-IR) equipped with Attenuated Total Reflectance (ATR). The FT-IR spectra show that the characteristic peaks of BSA at 1654 cm^{-1} and 1638 cm^{-1} which are due to the α-helix and β-sheets structures respectively did not shift after mixing BSA with the sodium alginate solution. This indicates that the secondary structures of BSA were not significantly damaged by the electrostatic interactions between the alginate chains and the protein coils. The effect of alginate on the hydrophobicity of BSA was further analyzed using High Performance Liquid Chromatography (HPLC). Therefore, this study provides insight into the potential pharmaceutical applications of alginate as a carrier for protein drugs delivery where the proteins retain their original characteristics and activity.

Fuyue Li is a junior in Chemical Engineering, Purdue University. li71@purdue.edu
Yinyan Zhao is a PhD student in Chemical Engineering at Purdue University. zhao15@ecn.purdue.edu
Michael T Harris is a professor in Chemical Engineering and Associate Dean of Engineering for Undergraduate Education at Purdue University. mtharris@purdue.edu