Electrostatic Effects on the Restricted Diffusion of Serum Albumin

by

Donald Martin Glass

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Abstract

An experimental investigation has been conducted on the effect of electrostatic forces on the transport of bovine serum albumin through electrically charged fine pores. The restricted diffusivity of radio-labelled serum albumin was measured using a Nucleopore track-etch polycarbonate membrane with an average pore radius of about 21 nm, as determined from hydraulic permeability and tritiated water diffusion measurements. Exposure of the membrane to serum albumin reduced the measured average pore radius by an amount consistent with the adsorption of a continuous albumin monolayer. Albumin restricted diffusivities in 0.001 to 0.10 M sodium chloride solutions at pH 6 and 7 were found to decrease significantly with decreasing ionic strength, but no consistent variation with pH was observed.

A recently developed theoretical model for the effect of electrostatic forces on the restricted diffusion of polyelectrolytes with constant surface charge density was combined with earlier restricted diffusion models to model the restricted diffusion of serum albumin. Values of the pore wall surface charge density were obtained from streaming potential measurements, and used in the calculation of model predictions for albumin diffusivities at the conditions used in the diffusion experiments. The measured diffusivities were substantially higher than predicted, exceeding predicted values by a nearly constant amount at all conditions. The bulk of this discrepancy can be accounted for by the presence of small amounts of radioactive contaminant in the labeled albumin solution.

Thesis Supervisor: William M. Deen, Associate Professor of Chemical Engineering