Development of High-Performance Elution of Proteins Adsorbed in Multilayers onto Porous Hollow-Fiber Membrane with NaCl Aqueous Solution

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Summary

Convection-aided recovery of proteins using the porous membranes immobilizing ligands has been suggested. This recovery method will enable a high-rate processing of the proteins because the diffusional path of the protein to the ligand immobilized by the polymer chain grafted on the pore surface of the porous membrane can be minimized due to the permeation, i.e., convective flow, of the protein solution through the pores. In addition, a linear scaleup of the protein recovery is demonstrated by bundling the single hollow-fiber membranes to form the membrane module.

Egg white contains various proteins applicable for pharmaceuticals. Here, ovotransferrin (OTf) (Mr; 76,600, pI; 6.1) and ovomucoid (OM) (Mr; 28,000, pI; 4.1) were selected as a model protein to clarify the adsorption and elution behavior during the permeation of the protein solution through the pores edged by the anion-exchange-group-containing polymer chains.

The polymer chains containing a diethylamino (DEA) and 2-hydroxylethylamino groups as an anion-exchange group were appended onto the pore surface of a porous hollow-fiber membrane. Breakthrough curves obtained for the permeation of a single protein solution showed that both proteins were bound in multilayers to the polymer chains expanding from the pore surface due to mutual electrostatic repulsion between the DEA groups. Subsequent elution with 0.5 M NaCl provided a high peak of the protein because of multilayer binding and negligible diffusional mass-transfer resistance.

A mixture of OTf and OM permeated through the pores of the membrane. An equilibrium overshooting, i.e., an OTf concentration in the effluent that is higher than that in the feed, indicates that OTf was displaced by OM. Overlapping of the adsorption curves for different flow rates of the OM protein solution demonstrates a negligible diffusional mass-transfer resistance of the proteins to the DEA group and instantaneous displacement of OTf by OM.