No. 0742

Estimation of the Binding Constant of Oligosaccharide to Cation by Chromatographic Method

Shuji Adachi

Graduate School of Agriculture, Kyoto University

Summary

Chromatographic separation of saccharides using cation-exchange resin has been widely used in food industry as well as for analytical purpose. The separation is based on a ligand-exchange reaction between a solute and a counter-ion of cation-exchange resin. The adsorption isotherm of a solute onto a resin has been assumed to be linear in a wide concentration range of the solute. The linear isotherm is true at low solute concentrations, but usually not at high concentrations. The linear isotherm is characterized by the apparent distribution coefficient of the solute onto the resin. The coefficient is defined as the ratio of the solute concentration in resin phase to that in external solution phase. We have proposed an expression for describing the apparent distribution coefficient of the solute to the resin. The coefficient contains the swelling pressure of the resin Π and the binding constant between the solute and the counter-ion B as parameters. The Π value depends on the resin type but does not on the solute type. On the other hand, each solute has an intrinsic value to a specific ion and the value is common for the resins with various cross-linkages, which are usually expressed by the divinylbenzene (DVB) contents.

In this study, a method was proposed for estimating the Π and B values simultaneously from the apparent distribution coefficients of some solute onto cation-exchange resins with different DVB contents. In the method, swelling pressures of resins are assumed at approximate values, which might be obtained from the distribution coefficients of glucose because of its low affinity to sodium ion, and the B values of the solutes are estimated from the apparent distribution coefficients and the assumed Π values. Then, the Π values are optimized to minimize the relative standard deviations for the B values using Solver of Microsoft Excel®. The optimization enables us to get best estimates for both the Π and B values. The method was successfully applied to estimation of the Π of cation-exchange resins in sodium-ion form with the DVB contents of 4, 6 and 8%, and the B values of 8 pentoses, 6 hexoses, 16 disaccharides and 5 trisaccharides.