THE EFFECT OF THE PRESENCE OF CROWN ETHER ON ION TRANSPORT ACROSS THE LIPID BILAYER

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One of the most valuable features of many of the ionophores is their ability to complex selectively with various cations. Crown ethers, which were discovered by Pedersen in 1967, are excellent ligands for complexing alkali ions. A comparison of the hydrophilic cavity sizes of various crown ethers and the diameters of unsolvated ions of a few alkali and alkaline earth metal ions shows that [12]crown-4 and Li⁺, [15]crown-5 and Na⁺, and [18]crown-6 and K⁺ are well matched [Weber, E. and Vogtle, F. Host Guest Complex Chemistry I. Crown-Type Compounds. Akademie Verlag. Berlin 1982]. The theoretically predicted spatial relationships with interiorly-directed oxygen atoms are quite in keeping with an ion-ball model of the [18]crown-6-K⁺ complex. The measured complexation constant confirms the excellent “fit” of K⁺ into the [18]crown-6 ring [Hilgenfeld, R. and Saenger, W. Host Guest Complex Chemistry II. Structural Chemistry of Natural and Syntetic Ionophores and their Complexes with Cations. Akademie Verlag. Berlin 1982].

The purpose of this study was to examine the effect of dibenzo[18]crown-6 incorporated by a lipid bilayer on ion transport. The impedance measurement method was applied. A Model 273A set from PAR was used. During the measurements, the membrane was polarized with an alternating voltage of 4 mV amplitude in the 0.1 Hz - 10 kHz frequency range. The capacitance and electric resistance of the lipid membranes generated from a solution containing egg phosphatidylcholine crown ether in a hexadecane solvent were determined. The dependences on forming electrolyte composition and on electrolyte concentration were obtained. KCl was used as the electrolyte.

The resulting analysis of impedance spectra based on the Randles model demonstrated that the ion transport to and from the lipid bilayer surface was diffusion-controlled. The stability constant of the dibenzo[18]crown-6-K⁺ complex was calculated. Further studies should enable us to determine the surface concentration of crown ether and of the crown ether-K⁺ complex.