Study of specific ion effects in membrane-mimetic systems of zwitterionic surfactants

Christoforou Maria* Leontidis Epameinondas

University of Cyprus, Department of Chemistry, Kallipoleos 75, 1678, Nicosia, Cyprus
*email:christoforou_maria@yahoo.gr

The term “specific ion effect” refers to phenomena, in which ions of the same charge have considerably different effects in physicochemical, environmental and biological systems, and play a significant role in these phenomena. The specific effects of electrolytes are ubiquitous in chemistry and biology and are often correlated with the Hofmeister series of ions. Despite more than a century of research the origin of ionic specificity in most systems has not been clarified and generally accepted explanations at the molecular level are still to be developed.[1,2,3] Understanding specific salt effects in particular model systems will allow answering crucial questions related to electrolyte effects in chemistry and biology.

The main objective of the present work is to provide improved understanding of anionic specificity in biological membranes. This was done by examining the interactions of sodium salts (NaX) of anions belonging to the lyotropic series with a lipid model system. The purpose of this research was to investigate the specific adsorption of ions at the surface of dodecylphosphocholine (DPC) micelles, which function as a membranomimetic model system. DPC is a single-tailed analogue of the zwitterionic double-tailed phospholipid DPPC, a major and important component of cellular membranes. Because of the zwitterionic character of DPC molecules, they do not have strong Coulomb interactions with ions. As a result, weaker interactions (for example Van der Waals, Hydration Forces) can be studied more conveniently.

The effect of several sodium salts on the DPC micelles was investigated using many analytical techniques: Small angle neutron scattering (SANS), nuclear magnetic resonance, dynamic light scattering, fluorescence of the dye RH421 and determination of the zeta potential. The combination of all these techniques provides important qualitative but also quantitative information about the structure modification of the micelles (size, shape) and ion-lipid interactions as a function of the type and concentration of the electrolyte used. In all cases the interaction order is PF$_6^-$ > SCN$^-$ > ClO$_4^-$ > I$^-$ > ClO$_3^-$ > NO$_3^-$ > Br$^-$ > Cl$^-$ in agreement with the Hofmeister series.

References