The Effect of the Lipid Bilayer State on Fluorescence Intensity of Fluorescein-PE in a Saturated Lipid Bilayer

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Fluorescein-PE is a fluorescence probe that is used as a membrane label or a sensor of surface associated processes. Fluorescein-PE fluorescence intensity depends not only on bulk pH, but also on the local electrostatic potential, which affects the local membrane interface proton concentration. The pH sensitivity and hydrophilic character of the fluorescein moiety was used to detect conformational changes at the lipid bilayer surface. When located in the dipalmitoylphosphatidylcholine (DPPC) bilayer, probe fluorescence depends on conformational changes that occur during phase transitions. Relative fluorescence intensity changes more at pretransition than at the main phase transition temperature, indicating that interface conformation affects the condition in the vicinity of the membrane. Local electrostatic potential depends on surface charge density, the local dielectric constant, salt concentration and water organisation. Initial increase in fluorescence intensity at temperatures preceding that of pretransition can be explained by the decreased value of the dielectric constant in the lipid polar headgroups region related in turn to decreased water organisation within the membrane interface. The abrupt decrease in fluorescence intensity at temperatures between 25 °C and 35 °C (DPPC pretransition) is likely to be caused by an increased value of the electrostatic potential, induced by an elevated value of the dielectric constant within the phosphate group region. Further increase in the fluorescence intensity at temperatures above that of the gel-liquid phase transition correlates with the calculated decreased surface electrostatic potential. Above the main phase transition temperature, fluorescence intensity increase at a salt concentration of 140 mM is larger than with 14 mM. This results from a sharp decline of the electrostatic potential induced by the phosphocholine dipole as a function of distance from the membrane surface.