

Lateral diffusion of lipids and diffusion of water through lipid bilayers in the presence of (1,1-dimethyl-3-oxobutyl)phosphonates

Rudakova M., Troshina A., Filippov A.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The influence of some amphiphilic (diethyl, dipropyl, and dibutyl) esters of (1,1-dimethyl-3-oxobutyl) phosphonic acid with the regularly changing number of CH₂ groups in the hydrocarbon (hydrophobic) moiety on the lateral diffusion of dioleoyl phosphatidylcholine lipid and transmembrane diffusion of water in the oriented multibilayer system was studied by ¹H pulsed field gradient NMR at phosphonate concentrations up to 30 mol %. The shape of the ³¹P NMR spectra and the dependence of the shape of the ¹H NMR spectra on the bilayer orientation suggest that the presence of phosphonates does not affect the phase state of the system. The lamellar liquid crystalline phase remains unchanged, and phosphonate molecules become incorporated into the bilayer and have the same orientation as phospholipid molecules. The presence of phosphonates in the lipid bilayer increases the coefficients of lipid lateral diffusion and water diffusion through bilayers. This effect depends monotonically on the number of CH₂ groups in the phosphonate molecule. The most probable place for the incorporation of amphiphilic phosphonate molecules is the hydrophilic/hydrophobic interphase region of the bilayer. The molecules incorporated into the interphase disorder the bilayer and increase lateral diffusion of lipids and bilayer permeability compared with the ester-free bilayer. When the number of CH₂ groups in the ester molecule increases from diethyl to dibutyl phosphonate, the arrangement of lipid hydrocarbon tails becomes more ordered. This decreases the lipid lateral diffusion coefficient and bilayer permeability to water molecules. © 2008 MAIK Nauka.

<http://dx.doi.org/10.1007/s11504-008-3027-1>
