

RELEVANCE OF WATER DOMAINS ON THE KINETICS OF PEPTIDE INTERACTION WITH LIPID MEMBRANES

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Water distribution is expected to be very dependent on lipid head composition at constant pressure and temperature but its relevance in cell response has not been clearly stated. In this paper, the microscopic behavior of the water molecules in the complex water/lipid head groups is analyzed by following the kinetic response of lipid monolayers to perturbations induced by aminoacid residues and soluble proteins.

Expansion of the monolayer can give place to water domains between the lipids which surface tension modulates the interaction of free aminoacids of different polarities, peptides and aqueous soluble proteins. The creation of water domains are related to the energy of lateral interactions and the hydration energy of lipid head groups of the different lipid molecules. Those domains appear to be responsible of the modulation of membrane-protein interaction by a mechanism in which higher hydration promotes obstacles in the diffusion pattern of peptide residues.

Increase in hydration results from the reorientation of tilted head group dipole with respect to the membrane plane leading to additional water binding sites and water accessible surface defects as inferred from the measure of capacitance at different area per lipid curves in monolayers. The relaxation of water organization increases with the motional freedoms of phospholipids which can be changed by lipid components such as cholesterol and charged lipids. Thus, the kinetics of peptide and proteins interaction process can be modulated by hydration through lipid lateral compression caused by changes in lipid composition.

Molecular Dynamics simulations illustrate how the properties of the water molecules in the interfacial region of phospholipid bilayers depend on features like area per lipid, preferred conformations of their polar head and order of the acyl chains. Properties like the water-water HB-average-number and -lifetime are sensitive to the water-lipid interactions through direct HBs and the effect of the induced interfacial dipolar potential that extends 10Å from the lipids. The magnitude of the relaxation contribution and the relevance of these results in crowded systems, the regulation of enzyme activity and biological function are discussed.

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