THE EFFECT OF PHOSPHATE ESTER DERIVATIVES OF POLYPRENOL ON MODEL MEMBRANE STABILITY

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The occurrence of polyprenols and their phosphate ester derivatives in membrane fractions from prokaryotic and eukaryotic cells has frequently been reported. Polyprenyl phosphates mainly function as carriers of glycosyl units across membranes in prokaryotic peptidoglycan and lipopolysaccharide biosynthesis. The terpenoid theory of the origin of primitive membranes proposed that dipolyprenyl phosphates might form spontaneously on the mineral surface and self-organize into vesicles.
In our study we used voltammetric and electron microscopy (TEM) techniques to investigate the mechanical properties of hemispherical bilayer membranes and lipid vesicles made from dioleoylphosphatidylocholine (DOPC), hexadecaprenyl monophosphate (C_{80}-P), hexadecaprenyl diphosphate (C_{80}-PP) and their mixtures. The membrane hydrophobic thickness and the membrane Young's moduls were determined. By comparison with the DOPC bilayers hexadecaprenyl mono- and diphosphate decreased the membrane hydrophobic thickness and increased the membrane electromechanical stability for various prenyl phosphate/DOPC mole ratio values. The quantitative changes in values of membrane thickness and stability were more significant for the phospholipid membranes modified by C_{80}-PP. TEM micrographs of DOPC, C_{80}-P, C_{80}-PP, C_{80}-P/DOPC and C_{80}-PP/DOPC lipid vesicles showed several structures which were described. The obtained data from voltammetric investigations and TEM analyses show that the mechanical properties of lipid membranes change under the influence of hexadecaprenyl phosphate ester derivatives. The properties of modified membranes can result from the presence of microdomains in liquid-crystalline phospholipid membranes. On the basis of TEM micrographs, we infer that hexadecaprenyl phosphates change the fluidity and elasticity of modified vesicular lipid membranes. The formation of lipid vesicles by C_{80}-P, C_{80}-PP, C_{80}-P/DOPC and C_{80}-PP/DOPC and the variety of their structures can confirm and supplement the terpenoid theory of the origin of primitive membranes.