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Mechanical and Electrical Properties of Cell-Mimetic Membranes Studied by Flicker Spectroscopy, Electrodeformation and Electroporation of Lipid Vesicles

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Abstract. We report on the bending elasticity, the edge tension and the electrical capacitance of model lipid membranes [1] in sugar-containing aqueous environments. Flicker spectroscopy [2] of nearly spherical giant unilamellar vesicles (GUVs) showed softening of palmitoyl-oleoyl phosphatidylcholine (POPC) membranes in the presence of sucrose. The edge tension of POPC bilayers was obtained from membrane electroporation induced by applying strong electrical pulses with short duration (60-80 V/mm for 5 ms) [3]. Pore resealing was studied for vesicles in medium containing sucrose and glucose at concentrations from 0 to 0.4 mol/L. The edge tension of lipid bilayers was found to depend on the sugar content in the surrounding aqueous solution. Measurements of the membrane capacitance were performed using vesicle electrodeformation [4] under AC fields at frequencies in the range of 0.5-10 kHz in aqueous solutions with up to 0.2 mol/L of sucrose at various conductivities of the solutions inside and outside the vesicles adjusted by addition of sodium chloride. The membrane capacitance is reported to increase with increasing the sucrose concentration in the aqueous medium, thus suggesting an effect of sugar molecules on the electrical properties of lipid membranes.

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