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Influence of Palmitoyl-Oxovaleroyl-Phosphocholine on the Membrane Organization

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Abstract. Two types of biophysical experimental methods, fluorescence microscopy of giant unilamellar vesicles (GUVs) and electron paramagnetic resonance (EPR) spectroscopy were used to reveal the membrane architecture in the complementary scales: micron- and nano-scales. The influence of the oxidized phospholipid, palmitoyl-oxovaleroyl-phosphocholine (POVPC), on the membrane lateral organization was studied. Two hetero-acid glycerophosphocholines, monounsaturated palmitoyl-oleoyl phosphatidylcholine (POPC) and polyunsaturated palmitoyl-docosahexaenoyl phosphatidylcholine (PDPC), were used to examine the effect of the degree of unsaturation and chain length in the phosphatidylcholine molecule (PC). Quaternary POVPC-containing mixtures (POPC or PDPC/POVPC/eggSM/Chol) were investigated in order to estimate the capacity of this oxidized lipid to form liquid-ordered phase (L_o). Fluorescence microscopy showed significantly different domain pattern in both types of GUVs. While in PDPC-containing mixtures POVPC increased the temperature of micron-scale L_o/L_d (liquid-disordered) phase separation, POPC-containing vesicles exhibited a homogenous appearance even at very low POVPC concentrations. The order parameter and fraction of the two co-existing L_o and L_d phases for both PC mixtures as a function of POVPC concentration were ascertained by EPR. In this method an opposite trend was observed, in POPC mixture L_d nanoscale domains in a continuous L_o phase were established. These results suggest a different mechanism of action of the oxidized lipid in the monounsaturated and the polyunsaturated ternary mixtures. It could be assumed that POVPC influences in a greater extent POPC/eggSM/Chol mixtures than PDPC-containing ones. The interaction of oxidized lipids with other lipids and how these molecules change 2D and 3D membrane architecture shed light on the understanding of the inflammation processes in human health.

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