The role of lipid oxidation on membrane biophysical properties: implications on lipid lateral organization and cell damage

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Lipid oxidation promotes important changes in the physical properties of biological membranes which may lead to cell physiology malfunction. Some oxidized lipids have hydrophilic groups pendant on the hydrocarbon chains, as hydroperoxized groups for instance, some on the shortened acyl oxidized lipid chains. In this presentation, we will firstly demonstrate how lipid chemical transformations induced by oxidative stress alter plasma membrane structural features as observed by optical microscopy. SAXS results from liposomes, representing model lipid vesicles, composed of different amounts of unsaturated, oxidized and saturated lipids will be presented and discussed. Interestingly, the analysis of SAXS data points out to an increase in membrane surface area of hydroperoxized lipid bilayers, in good agreement with micropipette measurements on giant unilamellar vesicles (GUVs) under photo-oxidation and molecular dynamic simulation results. Further, SAXS also allows us localizing the oxidized species inside the vesicle lipid bilayer. In addition, we will also discuss lipid phase separation, as liquid order (Lo) – liquid disorder (Ld) phase coexistence, induced by the generation of oxidized lipids inside the membrane. However, the phase separation depends on the new chemical structure of the oxidized molecule formed. Finally, we extend our study to mimetic membranes of lysosomes with the aim to explore how lipid oxidation may affect cell death associated to autophagy.

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