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Influence of various perfluorocarbons on the structural changes of lipid monolayers and on protein adsorption

Perfluorocarbons (PFCs) have high medical potential, serving as therapies in ophthalmology, cancer therapy, and respiratory diseases by replacing liquid PFC ventilation and unsafe lung surfactant (LS) substitutes in the future [1,2].

The influence of different perfluorocarbon atmospheres on changes in the vertical and lateral structure of model membranes and on the adsorption of surface-active proteins was analyzed. PFCs with different properties were used to investigate the significance of molecular shape and hydrophobicity in altering the structure of the lipid layers. F-Decalin, F-Octyl bromide, F- Hexane, and Decafluorobutane were used in this study.

The model membranes consist of monolayers on an aqueous surface, with a neutral pH value, composed of the zwitterionic lipid dipalmitoylphosphatidylcholine (DPPC). DPPC is present in 50% of the LS [3]. To modulate the conditions during inhalation and exhalation for the LS, we studied the Langmuir films at surface pressures of 5 mN/m and 25 mN/m. Human serum albumin and lysozyme were chosen as surface-active proteins.

The adsorption of proteins was studied at the ID10 beamline of the Europen Synchrotron Facility (Grenoble, France) by combined grazing incidence X-ray diffraction (GIXD) and X-ray reflectivity (XRR). The samples were measured *in situ* at ambient temperature and pressure to mimic natural conditions.

In summary, surface-active proteins adsorb to the lipid membrane at neutral pH with and without the PFC atmosphere. This process can take several hours and can be accelerated by the addition of salts.
Our findings reveal that PFCs adsorb to the hydrophobic regions of the lipids and proteins, leading to a compression of the lipid and protein layer. Notably, F-Decalin reduces the size of the crystalline domains, the surface tension of the monolayers, and induces a fluidization of the lipid monolayer. This intriguing effect is observed for monolayers with initially high surface tensions, opening new areas for further exploration.

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