Temperature effect on the regularity of bilayer stacking in multilamellar lipid vesicles

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Multilamellar lipid vesicles (MLV) of phosphocholines are widely used in research and applications and generally considered well behaved in which concerns bilayer stacking and homogeneity in lipid and aqueous phase distribution. Researchers that work in the field, especially those that use X-ray scattering in their work, know that this simple scenario is only partially corroborated by experiment. The piling up of the MLV bilayers is not always regular showing multimodal peaks in SAXS that can only originate from bilayer populations that have different stacking distances.

It is known that when the hydration step leading to the formation of the multilamellar assemblies is done with an aqueous media having a non-negligible concentration of univalent ions, an uneven interlayer salt concentration may result and affect the interbilayer distance [1]. However, a non-zero ionic strength is by no means necessary to observe irregularity of sacking. MLV in water that are uniform at room temperature develop multiple reflections in SAXS above ca. 40 ºC denouncing irregularity of lamellae staking. We attribute the deviations from the equilibrium interbilayer distance to the geometric constrains created by the thermal expansion of the lipid and of water, as exemplified in Figure 1. Our interpretation is supported by dynamic light scattering measurements.

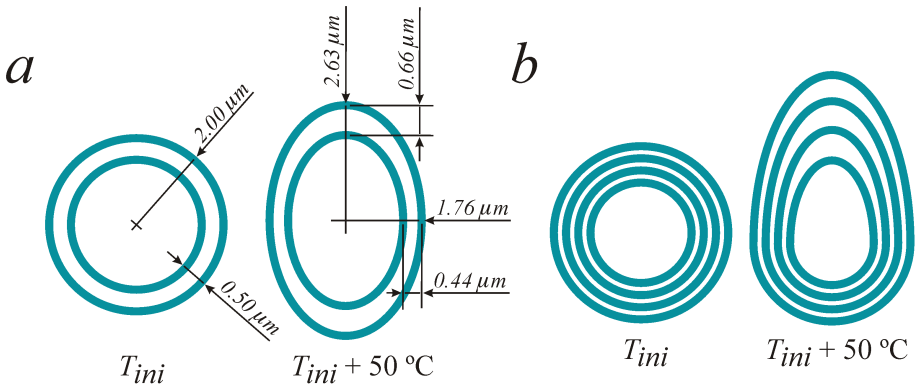

Figure 1: The consequence of an increase of 50 ºC on the geometry of DOPC vesicles taking into account the thermal expansion coefficients of the water and the lipid, panel *a*. In *b* we propose a schematic model for the change of the membrane stacking of a MLV with the increase of temperature.

References

[1] G. Pabst, A. Hodzic, J. Strancar, S. Danner, M. Rappolt and P. Laggner, Biophys. J. **93**, 2688 (2007).

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