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Elucidating the mechanisms of small molecule cryoprotection using Neutron Membrane Diffraction

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The interaction between membranes and small molecules is a key factor in determining survival of organisms or cells during dehydration and/or freezing. Cryoprotective molecules fall into two categories: those important in desiccation and freezing tolerance in nature (such as sugars), which cannot pass through membranes; and penetrating molecules, such as DMSO, which are used in laboratory cryopreservation. Both types of molecules affect membrane structure, but the interactions, and therefore cryoprotective mechanisms, are different.

To understand these mechanisms we have previously studied the structure of synthetic membranes in the presence of small sugars using SAXS and SANS [eg 1-2]. More recently we have used membrane diffraction, which yields higher order diffraction peaks, allowing Fourier reconstruction of the bilayer structure [3-4]. These experiments are conducted on stacked multilamellar membranes (with and without the relevant molecules) under partially dehydrated conditions (relevant to desiccation and freezing). By deuterating one or more components, and adjusting the neutron contrast of the water by changing the D2O/H2O ratio, it is possible to isolate the locations of the molecules in the bilayer region with high precision.

Using the cold triple axis spectrometer MIRA [5] (MLZ, Garching, Germany) we have optimised these measurements for the number of higher order diffraction peaks under conditions of contrast variation. Each subsequent peak, and Fourier term, provides improved spatial resolution and diminishes the effects of truncation artefacts in Fourier series.

We have recently extended these measurements to systems containing DMSO. In this talk we will present these results, and use them to contrast the different modes of action of the two classes of cryoprotective molecules. The implications for our understanding of cryopreservation will be discussed.

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Speakers Gender

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Do yo wish to take part in the poster slam

No

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