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Retardation of Bulk Water Dynamics by Disaccharide Osmolytes
NIMESH SHUKLA, LEE CHEN, Wesleyan University, ENRICO POMARICO, MAJED CHERGUI, cole Polytechnique Fdrale de Lausanne, CHRISTINA OTHON, Wesleyan University — Bioprotective nature of disaccharides is hypothesized to derive from the modification of the hydrogen bonding network of water which protects biomolecules through lowered water activity at the protein interface. Using ultrafast fluorescence spectroscopy, we measured the relaxation of bulk water dynamics around the induced dipole moment of two fluorescent probes (Lucifer Yellow Ethylenediamine and Tryptophan). Our results indicate a reduction in bulk water reorganization rate of approximately 30%. We observe this retardation in the low concentration regime measured at 0.1 and 0.25 M, far below the onset of glassy dynamics. This water structuring should be significant in crowded biological systems, contributing to a global change in protein energy landscape, resulting in a significant enhancement of protein stability under environmental stress. We observed similar dynamic reduction for two disaccharide osmolytes, sucrose and trehalose, with trehalose being the more effective in reducing solvation dynamics.

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