Water-Mediated HB Networks Couple the Embedded Protein with Surroundings in Trehalose-Water but not in Sucrose-Water Matrixes

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Trehalose is a non-reducing disaccharide of glucose found in organisms, which can survive adverse conditions such as extreme drought and high temperatures. Furthermore, isolated structures, as enzymes or liposomes, embedded in trehalose are preserved against stressing conditions[1]. Analogous protective effect is also accomplished by other saccharides, but with a lower efficiency. Among other hypotheses, the protective effect of trehalose has been suggested to stem from the formation of a water-mediated, hydrogen bond network, which anchors the biomolecule surface to the water-sugar matrix[2]. Here it will be reported:

i) on the recombination kinetics of the primary, light-induced charge separated state ($P^+Q_A^-$), and the thermal stability of the photosynthetic reaction centre (RC) of *Rhodobacter sphaeroides*, in trehalose-water and in sucrose-water matrixes of decreasing water content, and

ii) on the structural an dynamic effects that *carboxy-myoglobin* embedded in saccharide-water matrixes of very low water content, causes on the water-sugar matrix.

Data show that, in sucrose, at variance from trehalose, the system undergoes a "*nano phase-separation*" at very low water/sugar ratios. We rationalise this result assuming that the hydrogen bond network, which anchors the protein surface to its surroundings is formed in trehalose but not in sucrose. Furthermore, we suggest that both the coupling, in the case of trehalose, and the "*nano phase-separation*", in the case of sucrose, start at very low water content when the components of the system enter in competition for the residual water.

1. Crowe LM (2002) *Comp Biochem Physiol A* 131:505-513
2. Giuffrida S, *et al.* (2003) *J Phys Chem B* 107:13211-13217