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The trehalose coating effect on the internal protein dynamics

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Abstract

^{15}N and ^{13}C NMR experiments were applied to conduct a comparative study of a cold shock protein (Csp) in two states - lyophilized powder and a protein embedded in a glassy trehalose matrix. Both samples were studied at various levels of rehydration. The experiments used (measuring relaxation rates R_1 and $R_{1\rho}$, motionally averaged dipolar couplings and solid state exchange method detecting reorientation of the chemical shift anisotropy tensor) allow obtaining abundant information on the protein structural features and internal motions in a range of correlation times from nanoseconds to seconds. The main results are: (a) the trehalose coating makes the protein structure more native in comparison with the dehydrated lyophilized powder, however, trehalose still cannot remove all non-native hydrogen bonds which are present in a dehydrated protein; (b) trehalose has an appreciable effect on the internal dynamics: the motion of the backbone N-H groups in the nanosecond and microsecond time scales becomes slower while the motional amplitude remains constant; (c) upon adding water to the Csp-trehalose mixture, water molecules accumulate around proteins forming a layer between the protein surface and the trehalose matrix. The protein dynamics become faster, however, not as fast as in the fully hydrated state; (d) the hydration response of dynamics of the NH and CH(CH₂) groups in a protein is qualitatively different: upon increasing protein hydration, the correlation times of the N-H motions become shorter and the amplitude remains stable, and for CH(CH₂) groups the motional amplitude increases and the correlation times do not change. This can be explained by a different ability of the NH and CH(CH₂) groups to form hydrogen bonds. © the Owner Societies 2012.

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