

Carbohydrates Protect Mitochondrial F_0F_1 -ATPase Complex against Thermal Inactivation

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Z. Naturforsch. **55c**, 594–599 (2000); received February 10/March 31, 2000

Carbohydrates, Thermal Stabilization, Mitochondrial F_0F_1 -ATPase

Organisms and cellular systems are required to adapt to stress conditions like high temperature, often responding by accumulating organic solutes, such as sugars. This accumulation is associated with the effectiveness of these osmolytes in minimizing protein denaturation and membrane damage under stress conditions. In this work, we have studied the effect of sugars on the protection against thermal inactivation of mitochondrial F_0F_1 -ATPase complex, in preparations of submitochondrial particles containing or depleted of inhibitor protein. We observed that after 15 min of pre-incubation at 70 °C of latent MgATP-submitochondrial particles (with inhibitor protein) in the presence of 1.5 M of sucrose or trehalose, or 3.0 M of glucose or fructose, about 80% of enzyme activity remained active. In the same conditions, but in the absence of sugars, the activity of the particles was completely abolished. Submitochondrial particles depleted of the inhibitor protein (AS-particles) were almost completely inactivated after 3 min of pre-incubation at 70 °C in the absence of sugars and more than 60% of the enzyme activity remained active when these particles were pre-incubated in the presence of sugars. In such condition, the enzyme acquires a more compact and heat-stable conformation. Sugars, as well as the inhibitor protein, inhibit reversibly F_0F_1 -ATPase complex activity and protect this enzyme against inactivation by high temperature. Interestingly, the protection, promoted by sugars, of particles containing inhibitor protein is higher than of particles depleted of inhibitor protein, suggesting a synergism between sugar and inhibitor protein.