Vestnik Moskovskogo Universiteta Seriya 2 Khimiya 2000 vol.41 N6, pages 37-42

Calorimetric and FTIR-spectroscopic study of solvent effect on the state of dry solid bovine pancreatic α-chymotrypsin immersed in anhydrous organic solvents

Sirotkin V., Zinatullin A., Solomonov B., Faizullin D., Fedotov V.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Calorimetric heat effects and structural rearrangements accompanying the immersion of dry solid bovine pancreatic α-chymotrypsin in anhydrous organic solvents and water were measured at 298 K. It was found that the enthalpy and IR-absorbance changes being put together obey good linear correlation. According to the extent of their influence on the protein structure and thermodynamic state the solvents could be divided into two groups. The first group exhibiting nearly zero effects consists of carbon tetrachloride, benzene, nitromethane, acetonitrile, 1, 4-dioxane, n-butanol, n-propanol and pyridine. Dry solid protein is suggested to be stable in such media due to kinetic reasons. Immersion of the protein into a second group solvents, namely, dimethyl sulfoxide, methanol, ethanol, and in pure water as well, is followed by swelling of the protein and accompanied with significant exothermic enthalpy change and structural rearrangements. It was shown that attribution of the solvent to the first or the second group is determined by its thermody-namic hydrophilicity (partial excess molar Gibbs free energy of water in a given solvent at infinite dilution). The first group consists of liquids with thermodynamic hydrophilicities all above 2.7 kJ/mol. The thermodynamic hydrophilicities of the second group solvents are lower than 2.3 kJ/mol. At close hydrophilicities the presence of mobile protons in the solvent molecule sufficiently accelerates the solid protein swelling. It is deduced that thermodynamic hydrophilicity and proton donating ability could be principal factors controlling the stability of dry solid proteins and kinetics of swelling in liquids examined at room temperature.