INFLUENCE OF ENVIRONMENT ON PROTEIN-PROTEIN INTERACTIONS OF FIBRINOGEN ACCORDING TO TRANSLATIONAL DIFFUSION DATA

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It is known about the cascade of blood clotting at physiological pH 7.4 which starts from the thrombin-induced fibrinogen-fibrin transition followed by spontaneous association of fibrin(ogen) into fibrin oligomers with their subsequent polymerization into protofibrils and fibers. Fibrinogen self-assembly is known as an essentially sensitive to physicochemical properties of environment like pH and ionic strength, which control non-covalent driving forces. The spatial distribution and the value of the total protein charge depend on the external environment. The charge characteristics of protein molecules were varied by changing the pH and ionic strength of the solvent. Using the data on the hydrodynamic behavior of proteins, it was shown how the parameters of the environment solution affect the intermolecular interactions of fibrinogen.

To obtain information about the fibrinogen intermolecular interactions at different pH and ionic strength of surrounding water medium we applied the approach based on the experimental study of protein translational diffusion coefficient and its analysis using the Vink theory. The subsequent data analysis, used the DLVO theory and "porous" colloid particle model, allowed us to estimate the attractive and repulsive forces in the protein-protein intermolecular interactions as a function of protein external conditions. Potentials of electrostatic interaction and van der Waals forces were estimated using the second virial coefficient and the Hamaker constant. We have shown that the high Hamaker constant and the smallest value of second virial coefficient characterize the significant van der Waals attraction of fibrinogen molecules at physiological conditions (pH 7.4 and I = 0.1). The increase of pH up to 9.5 causes the zero values of second virial coefficient and Hamaker constant corresponding to the full compensation of attraction and repulsion forces. In acidic medium (pH 3.5) strong electrostatic repulsion substantially predominates over the van der Waals attraction of fibrinogen. The strong charge screening effect at high ionic strength is characterized by a significant decrease of all intermolecular interactions which is expressed in almost zero virial coefficients and the Hamaker constant values. Thus, it is experimentally shown that the physiological values for the pH and salinity of water medium provide the optimal conditions for the maximum physical attraction of fibrinogen molecules, being used in nature to facilitate the blood clotting.

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