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Development of a fluorescence based viscosity sensor for medical applications

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The purpose of this project is to determine the binding properties of molecular rotors with macromolecules, specifically plasma proteins. This is to aid in the development of a viscometer based on molecular rotors that could be used on blood plasma by determining to what effect the presence of these proteins will affect the measurements of the viscometer so that it may be put into use in the medical field. Molecular rotors are a class of florescent molecules that form a twisted internal charge transfer complex upon excitation, they have a preferred de-excitation pathway of rotation about a C=C double bond. When molecular free volume is limited, rotation about this bond is hindered and fluorescence probability increases. The intensity of the fluorescence of these molecules can be used as a measure of the viscosity of the solvent. Intensity and viscosity are related by the following equation: log F = C + x log h where F is the fluorescent yield, h is the viscosity, and x and C are constants. The rotors in this study are CCVJ (9-[(2-Cyano-2-hydroxy carbonal) vinyl] julolidine) and CCVJ-TEG (9-[(2-Cyano-2-hydroxy carbonal) vinyl] julolidine triethyleneglycol). The affinity of these molecular rotors to various plasma proteins is determined by comparing the solubility of the molecular rotors in proteinaceous and nonproteinaceous solutions. The molecular rotors are allowed to diffuse through a dialysis membrane until the equilibrium between the two solutions is reached. The concentration of the rotors in the solutions was determined by measuring the absorbance of these solutions according to the Beer-Lambert law: A= e * c where A is absorbance, e is the extinction coefficient of the specific substance at the specific wavelength, and c is the concentration of that substance. The proteins tested in this manner were albumin, fibrinogen, and IgG. Bovine proteins were used because all mammalian proteins are very similar and bovine proteins are easier to obtain than human proteins. The results show that CCVJ and CCVJ-TEG are very strongly attracted to Albumin, and weakly attracted to fibrinogen. This attraction may affect the fluorescence of the rotor molecules, meaning that in developing these molecular rotors as viscosity sensors for blood plasma, further studies must be performed to determine the effect of the proteins on the fluorescent behavior of the rotors so that the protein composition of the plasma can be accounted for.