ABSTRACT

Measurements of density, ultrasonic velocity and viscosity of acidic amino acids in the presence of salt solutions (1M, 2M CH₃COONa and 1M CH₃COOK) were made for investigating the intermolecular interactions. Aspartic and Glutamic acids have been chosen to observe the effect of CH₂ group on the volumetric and thermodynamic properties. The activity of egg-white Lysozyme was measured in the presence of carbohydrate additives (Glucose and Maltose) and urea in the reaction medium by accurate quantitative measurements of such properties as partial molal volume, adiabatic compressibility, B-coefficient, free energy of activation etc. The interaction of protein-water molecules in aqueous sugar and urea solutions and the temperature dependence of these interactions play very important role in understanding the thermodynamic processes in living cells.

Ultrasonic velocity data and the derived parameters such as adiabatic compressibility (βₐ), change in adiabatic compressibility (Δβₐ), and apparent molal adiabatic compressibility provide a basis for understanding the type and the extent of intermolecular interactions, such as weak or strong or no interaction at all. The decrease in compressibility with increase in the thermal breaking of solvent components, which in turn results in greater attractive forces among the molecules of a solution. Decrease in the βₐ values with increase in composition is due to greater attractive forces among the molecules of a liquid.
Partial and transfer molal volume of acidic amino acids in the temperature range: 298.15-323.15K has been studied in different salt solutions. CH$_2$ group exerts an independent influence on the characteristics of adjacent water molecules, thus causing an increase in the partial molal volume. In Maltose, two glucose units are joined by $\alpha$-1, 4 glycosidic linkage so the values of apparent molal volume of Maltose + Lysozyme + water systems are nearly twice in comparison to Glucose +Lysozyme +water system. Hydrophilic- hydrophilic interactions between the $-\text{OH}$ groups of monosaccharide and the hydrophilic R group present on the exterior of Lysozyme structure are responsible for the positive values of transfer volume while nonpolar-hydrophillic interactions between the nonpolar Urea and hydrophilic R group of Lysozyme present on the exterior are responsible for negative values of transfer volumes.

Viscosity ($\eta$) measurement provides valuable information about the size and shape of the molecules. The values of $\eta$ have been calculated for all the systems under investigation and that they are found to increase with concentration and decrease with increase in temperature except in the case of Urea in Lysozyme solution. In the case of Urea in Lysozyme solution, viscosity first decreases from 0.02 mol/kg to 0.06 mol/kg and then it gradually increases. B-coefficient of Jones-Dole equation has also been evaluated by using the viscosity data. (Change in enthalpy ($\Delta H^*$), entropy ($\Delta S^*$) and free energy of activation ($\Delta G^*$) have been evaluated from viscosity data. $\Delta G^*$ has been found to increase linearly with temperature.)