

system attributed to structural changes⁵⁵. This research work proved that some of the novel molecules can stabilize the biochemical part of living beings⁵⁶⁻⁵⁹. The measured and calculated thermodynamic parameters are useful to know the interactions like solute-solute or solute-solvent or solvent-solvent type.

6. Conclusion

The parameters are correlated with aqueous amino acid and glycol ether. The system containing aqueous amino acid and glycol ether has weak intermolecular H-bonding. The decrease in density, viscosity and ultrasonic velocity indicates the decrease in solute-solvent and solvent-solvent interactions which results structure-breaking of the solvent. The acoustical parameters proved that H-bonding interactions are weak at higher concentration. The increase in adiabatic compressibility with present work suggests that the medium become more and least compressible. The L_f is again a predominant factor in determining the existing interactions among the components of the mixture.

References

- [1] Varada Rajulu, A. and Mabu Sab, P. (1995) Acoustical parameters of polyethylene glycol/water mixtures, *Bull. Mater. Sci.*, 18(3), 247-253.
- [2] Paladhi, R. and R.P. Singh, (1990) Effects of Solvent Power and Polymer Molecular Weight on Rao Formalism of Polymer Solutions, *Acustica*, 72, 90-95.
- [3] Singh, R.P., Reddy, G.V., Majumdar, S. and Singh, Y.P. (1983) Ultrasonic velocities and Rao and Wada formalism in polymer solutions, *J. Pure Appl. Ultrason*, 5, 52-54.
- [4] Saxena, S. K., Pendharkar, J.K. and Ghalsasi, Y. (2013) Acoustic Parameters of Potassium Halides With Variable Normality, *International Interdisciplinary Research Journal*, 3(5), 178-182.
- [5] Ramasami, P. (2002) Solubilities of amino acids in water and aqueous sodium sulfate and related apparent transfer properties, *J. Chem. Eng. Data*, 47, 1164-1166.
- [6] Yan, Z. and Wang, J. Lu. J. (2002) Viscosity behavior of some R-amino acids and their groups in water_sodium acetate mixtures, *Biophys. Chem.*, 99, 199-207.
- [7] Lapanje, S. (1978) *Physicochemical aspects of protein denaturation*, Wiley:New York.
- [8] Zhao, H. (2006) Viscosity B-coefficients and standard partial molar volumes of amino acids and their role in interpreting the protein (enzyme) stabilization, *Biophys. Chem.*, 122, 157-183.
- [9] Rodriguez, H., Soto, A., Arce, A. and Khoshkbarchi, M. K. (2003) Apparent molar volume, isentropic compressibility, refractive index, and viscosity of dl-alanine in aqueous NaCl solutions, *J. Solution Chem.*, 32, 53-63.
- [10] Banipal, T. S., Kaur, D., Banipal, P. K. and Singh, G. (2008) Interactions of some peptides with sodium acetate and magnesium acetate in aqueous solutions at 298.15 K: A volumetric approach, *J. Mol. Liq.*, 140, 54-60.
- [11] Sadeghi, R., Goodarzi, B. and Karami, K. (2009) Effect of potassium citrate salts on the transport behavior of L-alanine in aqueous solutions at T=(293.15 to 308.15) K, *J. Chem. Eng. Data*, 54, 791-794.
- [12] Banipal, T. S., Kaur, J., Banipal, P. K. and Singh, K. (2008) Study of interactions between amino acids and zinc chloride in aqueous solutions through volumetric measurements at T = (288.15 to 318.15) K, *J. Chem. Eng. Data*, 53, 1803-1816.
- [13] Shen, J., Li, Z. F., Wang, B.H. and Zhang, Y.M. (2000) Partialmolar volumes of Some amino acids and a peptide in water, DMSO, NaCl, and DMSO/NaCl aqueous solutions, *J. Chem. Thermodyn.*, 32, 805-819.
- [14] Sadeghi, R. and Goodarzi, B. (2008) Volumetric Properties of potassium dihydrogen citrate and tripotassium citrate in water and in aqueous solutions of alanine at T = (283.15 to 308.15) K, *J. Chem. Eng. Data*, 53, 26-35.
- [15] Sadeghi, R. and Gholamireza, A. (2011) Thermodynamics of the ternary systems:(water + glycine, L-alanine and L-serine + diammoniumhydrogen citrate) from volumetric compressibility and (vapour + liquid) equilibria measurements, *J. Chem. Thermodyn.*, 43, 200-215.
- [16] Rajagopal, K. and Gladson, S. E. (2011) Partial molar volume and partial molar compressibility of four homologous α -amino acids in aqueous sodium fluoride solutions at different temperatures, *J. Chem. Thermodyn.*, 43, 852-867.
- [17] Riyazuddeen and Altamash, T. (2010) Study of interactions of l-histidine/l-glutamic acid/l-tryptophan/glycylglycine with KCl/KNO₃ at different temperatures: 298.15, 303.15, 308.15, 313.15, 318.15, 323.15 K, *Thermochim. Acta*, 501, 72-77.
- [18] Riyazuddeen and Khan, I. (2009) Effect of KCl and KNO₃ on partial molal volumes and partial molal compressibility of some amino acids at different temp., *Int. J. Thermophys.*, 30, 475-489.
- [19] Riyazuddeen and Bansal, G. K. (2006) Intermolecular/Interionic interactions in l-leucine, l-asparagine and Glycylglycine-aqueous electrolyte systems, *Thermochim. Acta*, 445, 40-48.
- [20] Riyazuddeen and Basharat, R. (2006) Intermolecular/Interionic interactions in l-isoleucine, l-proline, l-glutamine-aqueous electrolyte systems, *J. Chem. Thermodyn.*, 38, 1684-1695.
- [21] Riyazuddeen and Khan, I. (2008) Viscosity studies of l-alanine, l-proline, l-valine, l-leucine + aqueous KCl/KNO₃ solutions at different temperatures, *J. Chem. Thermodyn.*, 40, 1549-1551.
- [22] Hedwig, G. R. and Reading, J. F. (1991) Partial molar heat capacities and partial molar volumes of some N-acetyl amino acid amides, some N-acetyl peptide amides and two peptides at 25C, *J. Chem. Soc., Faraday Trans.*, 87, 1751-1758.
- [23] Lou, Y. and Lin, R. (1998) Enthalpy of transfer of amino acids from water to aqueous glucose solutions at 298.15 K, *Thermochim. Acta*, 316, 145-148.
- [24] Li, S., Sang, B. W., Lin, R. (2002) Partial molar volumes of glycine, l-alanine and l-serine in aqueous glucose solutions at T = 298.15 K, *J. Chem. Thermodyn.*, 34, 1761-1768.
- [25] Banipal, T. S. and Sehgal, G. (1995) Partial molal adiabatic compressibilities of transfer of some amino acids and peptides from water to aqueous sodium

- chloride and aqueous glucose solutions, *Thermochim. Acta*, 262, 175–183.
- [26] Curtis, R. A., Prausnitz, J. M. and Blanch, H. W. (1998) Protein-Protein and Protein-Salt interactions in aqueous Protein solutions containing concentrated Electrolytes, *Biotech. Bioeng.*, 57, 11–21.
- [27] Zhang, Y. and Cremer, P. S. (2006) Interactions between macromolecules and ions: the Hofmeister Series, *Curr. Opin. Chem. Biol.*, 10, 658–663.
- [28] Moreira, L. A., Bostrom, M., Ninham, B. W., Biscaia, E. C. and Tavares, F. W. (2006) Hofmeister effects: Why protein charge pH titration and protein precipitation depends on the choice of background salt solution, *Colloids Surf. A*, 282–283, 457–463.
- [29] Schneider, C. P., Shukla, D. and Trout, B. L. (2011) Arginine and the Hofmeister series: The role of ion-ion interactions in protein aggregation suppression, *J. Phys. Chem. B*, 115, 7447–7458.
- [30] Kuehner, D. E., Engmann, J., Fergg, F., Wernick, M., Blanch, H. W. and Prausnitz, J. M. (1999) Lysozyme Net charge and ion binding in concentrated aqueous electrolyte solutions, *J. Phys. Chem. B*, 103, 1368–1374.
- [31] Hokfelt, T. (1991) Neuropeptides in perspective: the last ten years, *Neuron* 7, 867–79.
- [32] Shen, H., Witowski, S. R., Boyd, B. W. and Kennedy, R. T. (1999) Detection of peptides by precolum derivatization with biuret reagent and preconcentration on capillary liquid chromatography columns with electrochemical detection, *Anal. Chem.*, 71, 987–994.
- [33] Wang, J., Yan, Z., Zhuo, K., Lu, J. (1999) Partial molar volumes of some α -amino acids in aqueous sodium acetate solutions at 308.15 K, *Biophys. Chem.*, 80, 179–188.
- [34] Rodriguez, H., Soto, A., Arce, A. and Khoshkbarchi, M. K. (2003) Apparent molar volume, isentropic compressibility, refractive index, and viscosity of dl-alanine in aqueous NaCl solutions, *J. Solution Chem.*, 32, 53–63.
- [35] Soto, A., Arce, A. and Khoshkbarchi, M. K. (1998) Experimental data and modeling of apparent molar volumes, isentropic compressibilities and refractive indices in aqueous solutions of glycine + NaCl, *Biophys. Chem.*, 74, 165–173.
- [36] Singh, S. K., Kundu, A. and Kishore, N. (2004) Interactions of some amino acids and glycine peptides with aqueous sodium dodecyl sulfate and cetyltrimethylammonium bromide at T = 298.15 K: a volumetric approach, *J. Chem. Thermodyn.*, 36, 7–16.
- [37] Yan, Z., Wang, X., Xing, R., Wang, J. (2009) Interactions of some glycylic dipeptides with in sodium butyrate aqueous solutions at 298.15 K: A volumetric and conductometric study, *J. Chem. Eng. Data*, 54, 1787–1792.
- [38] Banipal, T. S., Kaur, D., Banipal, P. K. and Singh, G. (2008) Interactions of some peptides with sodium acetate and magnesium acetate in aqueous solutions at 298.15 K: A volumetric approach, *J. Mol. Liq.*, 140, 54–60.
- [39] Ali, A., Khan, S., Hyder, S. and Tariq, M. (2007) Interactions of some α -amino acids with tetra-n-alkylammonium bromides in aqueous medium at different temperatures, *J. Chem. Thermodyn.*, 39, 613–620.
- [40] Sadeghi, R., Goodarzi, B. and Karami, K. (2009) Effect of potassium citrate salts on the transport behavior of l-alanine in aqueous solutions at T = (293.15 to 308.15) K, *J. Chem. Eng. Data*, 54, 791–794.
- [41] Lark, B. S., Patyar, P. and Banipal, T. S. (2007) Temperature effect on the viscosity and heat capacity behaviour of some amino acids in water and aqueous magnesium chloride solutions, *J. Chem. Thermodyn.*, 39, 344–360.
- [42] Shilpa A. Mirikar, Pravina P. Pawar and Govind K. Bichile (2011) Studies in thermodynamic properties of glycine in aqueous solutions of mono and divalent electrolytes at different temperatures, *Scholars Res. Lib. Archives Appl. Sci. Res.*, 3(5), 233–241.
- [43] Kanhekar, S.R., Pawar, P. and Bichile, G.K. (2010) Thermodynamic properties of electrolytes in aqueous solution of glycine at different temperatures, *Ind. J. Pure and Appl. Phys.*, 48, 95–99.
- [44] Banipal, T. S. and Sehgal, G. (1995) Partial molar adiabatic compressibility of transfer of some amino acids from water to aqueous sodium chloride and aqueous glucose solutions, *Thermochim. Acta*, 262, 175–183.
- [45] Kachare A V, Patil D D, Patil S R and Sonar A N, (2013) Intermolecular Interaction Studies In Aqueous Amino Acid And Glycol Ether System At 298.15K And At Various Concentrations, *J. Appl. Chem.*, 2 (5), 1207–1215.
- [46] Nithiyantham, S. and Palaniappan, L. (2009) Ultrasonic Investigation On Aqueous A-Amylase, *Rasayan J. Chem.*, 2(3), 709–711.
- [47] Palani, R., Geetha, A., Saravanan, S. and Shanbhag, V. (2008) Intermolecular Interactions of Some Amino Acids In Aqueous 1,4-Dioxane Solutions At 298.15 K, *Rasayan J. Chem.*, 1(3), 495–502.
- [48] Baluji, S., Inamdar, P. and Soni, M. (2004) Acoustical studies of Schiff bases in 1,4-dioxane and dimethylformamide at 308.15K, *Acta. Phys. Chim. Sin.*, 20(9), 1104–1107.
- [49] Venis, R. and Rajkumar, R. (2011) Densities, viscosities and ultrasonic velocities in ternary liquid mixture of anisole with cyclohexanone and 1-hexanol at 308.15 K and 318.15K, *J. Chem. Pharm. Res.*, 3(2), 878–885.
- [50] Thirumaran, S. and Sabu Job, K. (2009) Ultrasonic investigation of amino acids in aqueous sodium acetate medium, *Ind. J. of Pure & Appl. Physics*, 47, 87–96.
- [51] Tabhane, V. A., Chimankar, O. P., Manja, S. and Nambinarayanan, T. K. (1999) Thermoacoustical studies on aqueous solutions of some biomaterial with NaOH, *J. Pure Appl. Ultrason.*, 21, 67–70.
- [52] Thirumaran, S. and Kannapan, A.N. (2009) Volumetric And Ultrasonic Studies of Some Amino Acids In Aqueous Sodium Buterate Solution, *Global J. Mole. Sci.*, 4(2), 160.
- [53] Kanhekar, S. R. and Bichile, G. K. (2012) Studies in thermodynamic properties of electrolytes in aqueous solution of amino acid at different temperatures, *J. Chem. Pharm. Res.*, 4(1), 78–86.
- [54] B. Eyring, and J.F. Kincadid, (1938) Free Volumes and Free Angle Ratios of Molecules in Liquids, *J. Chem. Phys.*, 6, 620.

- [55] Agrawal, P.B., Siddique, M.I.M. and Narwade, M.L. (2003) Acoustic properties of substituted thiadiazoles and methyl-5-carboxylates in dioxan-water, ethanol-water and acetone-water mixtures at 298.5'0.1 K, *Ind. J. Chem.*, 42A(5),1050.
- [56] Chimankar, O. P., Shriwas, R and Tabhane, V. A. (2011) Intermolecular interaction studies in some amino acids with aqueous NaOH, *J. Chem. Pharm.Res*, 3(3), 587-596
- [57] Kumar, A. (1995) Alternate view on thermal stability of the DNA duplex, *Biochemistry*, 34, 12921-12925.
- [58] Sharp, K. A. and Honig, B. (1995) Salt effects on nucleic acids, *Curr.Opin.Struct.Biol*,5,323-328.
- [59] Nain, A. K. and Chand, D. (2009) Volumetric, ultrasonic, and viscometric behaviour of glycine, dl-alanine and l-valine in aqueous 1,4-butanediol solutions at different temperatures, *J. Chem. Thermodyn*, 41, 243-249.