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Viscosity Measurement of Substituted Chalcone Dibromide In 70% Water-Dioxane Mixture at Different Temperature and Determination of Thermodynamic Parameters

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ABSTRACT

Viscosities of Substituted Chalcone Dibromide have been determined at different temperature in 70% Water-Dioxane mixture. Thermodynamic parameters like Free Energy change (ΔG), Enthalpy Change (ΔH) & Entropy Change (ΔS) have been determined. The measurement of viscosity of electrolyte in solutions provides & excellent method of obtaining data on solute-solute & solvent-solvent interaction.

Keywords : Substituted Chalcone, Density, viscosity, interaction, Gibb's free energy, Change in entalpy, Change in entropy

I. INTRODUCTION

Viscosity value is dependent on intermolecular forces in the liquid and the molecular complexity of the compound. When large intermolecular forces are present or liquids that have complex molecular structure, a liquid will tend to be thick or highly viscous. Viscosity is one of the important physical properties of liquid and gases and it implies resistance to flow as fluids (liquid and gases) exhibit a characteristic property of flowing under applied force of their own weight. In common parlance, a liquid is said to be viscous if its viscosity is substantially greater than that of water; and may be described as mobile if the viscosity is noticeably less than water.

The basic principle of viscosity measurement is to study the interaction between solute and solvent. Polar solute when dissolved in water shows strong interaction while non-polar solute increases the structured-ness of water. The addition of organic co-solvent or mixture of solvents to water also has remarkable effects on the viscosities of the compounds.The measurement of viscosity of electrolyte in the solution provides a data on solute-solute, solute-solvent and solvent-solvent interactions. These molecular interaction of electrolyte in binary mixtures of two liquids are measured in terms of 'viscosity coefficient.Researchers have studied the solute-solvent interactions at different concentrations by calculating β-coefficients and thus many related reports. have been published. Density, viscosity, and ultrasonic speed of halogenated symmetric double Schiff bases in DMF solutions were studied at 308.15K by Gangani B.J. and Parsania P.H. Agrawal have calculated the β-coefficient as a measure of solute-solvent interaction. Viscosity and Density of Two 1-Alkyl-3-methyl-imidazolium Triflate Ionic Liquids at High Pressures and its effect of Alkyl Chain Length was studied by Maria C. M. and co-workers.

The properties of Chalcone Dibromide have been used to obtain information about intermolecular interaction. They depend upon the nature of aldehyde/ketone and amines from which these are derived. This provokes to investigate the densities and viscosities of synthesized Chalcone Dibromide (L_3 & L_4) in 70% of 1,4-dioxane-water mixture, at varying temperatures. All ligands were synthesized by standard methods. In the present study, attempt has been made to calculate β-coefficient and viscosity for two ligands at different temperatures of 303, 308, 313, 318 and 323 K in binary mixture of 70% dioxane-water. The study of measurement of viscosities & molecular ineractions in terms of β-coefficient of Dibromo Chalcone as a antibiotic drugs in 70% dioxane-water mixture.
Following antibiotic drugs used in present investigation –
1.2'-Hydroxy,5-chloro-chalcone dibromide (HCCDB) - L_3
2 2'-Hydroxy, 5-Chloro4-Methoxy Chalcone Dibromide (HCMCDB) - L_4

II. EXPERIMENTAL AND INSTRUMENTATION

EXPERIMENTAL

The drugs Chalcone dibromide are synthesized by standard method.The solvents used were of AR grade & doubly distilled water was used. The density and the viscosity measurements of the ligand solutions were done at 303, 308, 313, 318 and 323 K following the standard protocol. The ligands (L_3 & L_4) were recrystallized before use. The solvent 1,4- dioxane was purified using standard procedure. All the working solutions were freshly prepared from the deionized water to avoid any ionic contamination.The 0.01M solution of each ligand was prepared in 70 % of 1,4-dioxane-water mixture.

INSTRUMENTATION

All Weighing was done on electronic balance, made by Adair Dutt & Co. (T) Pvt. Ltd.(Readability ± 0.001 g).Densities of solutions were determined by a bicapillary Pyknometer (± 0.2%) having a bulb volume of about 10 cm^3 & capillary having an internal diameter of 1mm & calibrated with deionised doubly distilled water (0.9960 gm cm^{-3} at 303.15 K). The viscosities were measured by means of Ostwald's Viscometer (± 0.11% kg m^{-1} s^{-1}) which was kept in equilibrium with Elite Thermostatic water bath (± 0.1^0C). Both ligands were prepared in 70% dioxane-water mixture.

RESULT AND DISCUSSION

The relative viscosity,Ƞr is given by the ratio of the viscosity of a solution (η_2) to the viscosity of the solvent used (η_1) and have been analyzed by Jones-Dole equation (11)

$$\eta^{r-1}/\sqrt{C} = A + \beta\sqrt{C}$$

Where, C = molar concentration of ligands
A = Falkenhagen coefficient

β = Jones-Dole coefficient

Falkenhagen coefficient (A) is the measure of ion-ion interactions and Jones-Dole coefficient (β) is the measure of solute-solvent interactions.

'$\eta_{r-1}/\sqrt{C}$' is also known as 'specific viscosity' denoted by 'η_{sp}'.

In the present study, the parameters like relative viscosity (**η_r**), density (**ρ**) of 0.01 M solution of ligands L_3 & L_4, prepared in 70% of 1,4-dioxane-water mixture were calculated at temperature 303, 308, 313, 318 and 323 K.The experimental data obtained was tabulated (table no. 1 to 2) as under

Table 1 : Measurement of Viscosity At Different Temperatures

System : Ligand L_3

Temp. T(^{0}K)	1/T(K^{-1}) x 10^{-3}	Density (ρ) gm.cm^{-3}	Time Flow Sec	Viscocity η_l	Relative Visccosity $\eta_r = \eta_l / \eta_w$	Log η
303	3.30	0.9779	24.22	6.963 x 10^{-3}	0.8705	-2.15
308	3.24	0.9683	23.07	5.961 x 10^{-3}	0.8222	-2.22
313	3.19	0.9563	22.22	5.093 x 10^{-3}	0.7835	-2.29
318	3.14	0.9370	21.82	4.607 x 10^{-3}	0.7552	-2.33
323	3.09	0.9317	20.60	4.040 x 10^{-3}	0.7089	-2.39

System : Ligand L_4

Temp. T(^{0}K)	1/T(K^{-1}) x 10^{-3}	Density (ρ) gm.cm^{-3}	Time Flow Sec	Viscocity η_l	Relative Visccosity $\eta_r = \eta_l / \eta_w$	Log η
303	3.30	1.0510	22.93	7.085 x 10^{-3}	0.8857	-2.15
308	3.24	1.0367	22.16	6.131 x 10^{-3}	0.8457	-2.21
313	3.19	1.0337	21.76	5.391 x 10^{-3}	0.8294	-2.26
318	3.14	1.0311	21.26	4.940 x 10^{-3}	0.8098	-2.30
323	3.09	1.0236	20.80	4.570 x 10^{-3}	0.8018	-2.34

From the above table 1, it is seen that as temperature increases the relative viscosity decreases. This shows decrease in solute-solvent interactions. This can be explained in terms of hole theory of liquid where there are vacancies or holes in liquid. The liquid molecules keep on moving continuously into these vacancies. Consequently, the vacancies also keep on moving around, as otherwise the liquid will not be able to flow. This process, however, requires energy. The liquid molecules therefore, need some energy to move into hole. At increasing temperature, the energy becomes increasingly available and so liquid can flow more easily. Thus, the viscosity falls appreciably with rise in temperature.

Addition of macromolecules raises the viscosity of pure solvent to higher value. This occurs because the large molecules which extend across the streaming lines greatly enhance the resistance to flow. As a result, viscosity of macromolecular solution is always greater than that of pure solvent. However, in practice, the viscosity of a solution can be below that of a pure solvent. In fact, negative viscosity was discovered long time ago in variety of binary simple liquid mixtures. It may be regarded as arising from specific interactions between solute and solvent molecules such that a liquid structure of some kind in the solvent is destroyed in the vicinity of solute molecules. The values of viscosity ‘A’ & ‘β’ coefficients responsible for solute-solute & solvent-solvent interactions are presented in table below. It shows that the interactions between solute-solvent decreases with increasing temperature. β-coefficient values obtained, employing the various equations do not agree well with each other, but they are of the same order. Negative values of β-coefficient are associated with a structure breaking effect of the solutions. It has been suggested, that the viscosity β-coefficient measures of ion-dipole interaction between ions & solvent molecules.

Table 2 : A & β Coefficient Values

System	A	β (lit/mole)
L_3	19.80	-1.25
L_4	22.15	-1.00

From table 2, it is clear that, all ligands possess negative values of β-coefficient. This shows weaker interaction between solute and solvent. The solute with negative β-coefficient is characterized as ‘structure breakers'.

Values of **β** -coefficient at in the order – $L_4 > L_3$

This shows that the solute-solute interaction is highest among the molecules of ligand L_3 and L_4 so they tend to interact with solvent molecule to lesser extent leading to decrease in solute-solvent interaction which is shown by lowest **β** -coefficient value.

The positive ‘A’ values of ligands at all temperatures may indicate the presence of very strong ionic interactions. Thus the **β**-coefficient values for all the ligands are negative indicating weak solute-solvent interaction. Whereas the positive values of ‘A’ for all the ligands in 1,4-dioxane at temperature 303, 308, 313, 318 and 323 K may indicate strong ionic interaction.

The data of A and **β**-coefficient of viscosity leads in determining the solute-solute and solute-solvent interactions.

Thus, from the present study and observations, it can be concluded that in 1,4-dioxane-water mixture, ligands show weak solute-solvent interaction and very strong ionic interactions at all temperatures.

The thermodynamic parameters like free energy change (ΔG), Enthalpy Change (ΔH) & Entropy Change (ΔS) have been determined to study in various interaction taking place in solution of ligand.

Table 3 : Values of Thermodynamic Parameters

System	ΔG(J $Mole^{-1}$ deg^{-1})	ΔH (J $Mole^{-1}$ deg^{-1})	ΔS (J $Mole^{-1}$ deg^{-1})
L_3	-46134.94	5323.69	-169.830
L_4	- 17574.76	862.71	-60.849

The values of thermodynamic parameters (ΔG, ΔH, ΔS) are presented in table 3. It is seen from table 3 that negative values of ΔG shows evolution of energy.

III. CONCLUSION

It is conclude that as the temperature increases the relative viscosity decreases. This shows decrease in solute-solvent interactions. The ligand L_3 & L_4 possesses negative values of β-coefficient. This shows weaker interaction between solute and solvent. The solute with negative β-coefficient is characterized as ‘structure breakers'. Negative values of ΔG shows evolution of energy. A resulting data may be helpful for a possible correlation between drugs activities & viscosities.

REFERENCES

[1]. Aminabhai, T.M., Joshi S.S. & Shukla, S. S., Can. J. Chem., 68.319 (1990).

[2]. Aralguppi M.I., Aminabhai T.M., Balundgi, R.H. & Joshi S.S., J. Phy., Chem., 95,5299 (1991).

[3]. Patil, K. J., Manwatkar, S.M. & Dondge, S.S.,Ind. J. Chem.33,4 (1994).

[4]. Karia, F., Baluja, S.Asian J. Chem., 12(2), 593(2000).

[5]. Wadi, R. K., Vinita Kakkar., Ind. J. Chem.,39 (6), 598 (2000).

[6]. Jauhar S.P., Sandhu S., *Ind. J. Chem.*, 39 (4), 392, (2000).

[7]. Gangani B.J., Parsania P.H., *Arch. of App. Sci. Res.*, 7 (1), 10-14, (2015).

[8]. Agrawal P.B., *Ph.D. Thesis* S.G.B.A.U., Amravati (2001).

[9]. Maria C. M. Sequeira, Helena M. N. T. Avelino, Fernando J. P. Caetano, and João M. N. A. Fareleira, J. Chem. Eng. Data, 66, 4, 1763–1772, (2021)

[10]. Mahajan M. M. and Raghuwanshi P. B., Int. Res. J. of Natural and App. Sci., 3 (7), 127-137, (2016).

[11]. Wagh S.P., *Int. J. of Chem. and Phy. Sci.*, 4, 69-72, (2015).

[12]. Parthasarathi S., Saravanakumar K., Buskaran R.., Kubendran T. R.., *Int. J. of Sci. and Tech.*, 1(2), 96-101 (2011).

[13]. Pan HP, Bai TC and Wang XD. J Chem Eng Data. 2009, 9.

[14]. Levine RD. Cambridge University Press, 2005.

[15]. Archana Pandey, Anil Kumar Shukla, Saksena AR et al., World Appl Sci J. 2011, 13(4): p. 725.

[16]. Carnero Ruiz C and Molina-Bolivar JA. J Aguiar Langmuir. 2001, 17: p. 6831.

[17]. Ali Azhar S and Atya Hassan. J Phys Chem Biophys. 2012, 2(3): p. 1.

[18]. Patil KC and Dudhe CM. Der Pharma Chemica. 2015, 7(9): p. 239.

[19]. Chandami AS, Hedaoo DS and Wadekar MP. Der Pharma Chemica. 2016, 8(4): p. 322. [8]

[20]. Giratkar VA, Lanjewar RB, Gadegone SM et al., Der Pharma Chemica. 2017, 9(13): p. 46. [9]

[21]. Venkatesan J, Sekar M, Thanikachalam V et al., Der Pharma Chemica. 2017, 9(14): p. 164.

[22]. Davoud Balarak, Hossein Azapira and Ferdos Kord Mostafapour. Der Pharma Chemica. 2016, 8(10): p. 243.

[23]. Furniss BS, Hannafoid AJ, Smith PWG et al., Vogel's Text Book of Practical Organic Chemistry, Fifth Edition, 2007, p. 407.