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Evaluation of Viscometric Parameters of Gibberellic Acid by Using Ostwald Viscometer

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Abstract: The viscometric evaluation of Gibberellic acid have been carried out at 0.05M, 0.04M, 0.03M and 0.02M concentrations and also at various composition viz. 50%, 45%, 40% and 35% of gibberellic acid in ethanol and water mixture. The A and β-coefficient values were determined. Data obtained were used to determine various solute-solute and solute-solvent interactions.
Keywords: Viscosity, Gibberellic Acid, A and B coefficient, Solute-Solute, Solute Solvent Interaction.

I. INTRODUCTION

Gibberellic acid (also called gibberellin A3 or GA3) is a growth hormone found in plants and fungi. It is a pale yellow solid having chemical formula $C_{19}H_{22}O_6$. It is possible to produce the hormone industrially using microorganisms.[1] Gibberellic acid is a simple gibberellin, a pentacyclic diterpene acid promoting growth and elongation of cells. "It affects decomposition of plants and helps plants growth if used in small amounts, but eventually plants develop tolerance to it. GA stimulates the cells of germinating seeds to produce mRNA molecules that code for hydrolytic enzymes. Gibberellic acid is a very potent hormone whose natural occurrence in plants controls their development. Since GA regulates growth, applications of very low concentrations can have a profound effect while too much will have the opposite effect".[2]

Viscosity measurement data provides useful information in aqueous and nonaqueous solvents about solute-solute and solute-solvent interactions[3-5]. Correlation between drug's activity and viscosity is helpful in studying drug-receptor interactions. Hence, the measurement of viscosity of an electrolyte in a solution provides an excellent method of obtaining data on solute-solute and solute-solvent interactions. Viscosity measurements provide the information regarding the transport properties of the drugs and ion-solvent interactions. "These interactions of electrolyte in binary mixtures of two liquid have been studied in terms of β-coefficient of viscosity"[6-8]. Rate of transport of drug is also evaluated by viscometric technique.[9-11] The interactions is like, hydrophobic interactions.[12] The useful information regarding the transport property of drugs and the molecular interactions can be obtained from the viscosity measurements, obtained data are useful and helpful for a possible correlation between hormone activities and viscosities. Hence, viscometric study of gibberellic acid is important.

II. MATERIALS AND METHODS

The substance used for viscosity parameters measurement is gibberellic acid purchased from reputed company and purified by known method. All the chemicals used are of analytical grade. The density measurements are made by using density bottle. All the weighing is made on digital weighing balance with an accuracy of + 0.0001 gm. The viscosity measurement is carried out by using Ostwald viscometer. Measurement is carried out at constant temperature by using thermostat.

III. RESULT AND DISCUSSION

From formula, the viscosity of each solution is determined

$$\eta 2 = \eta 1 \times \frac{\rho 2 \times t2}{\rho 1\ t1}$$

Where,
η2 is viscosity of drugs solution,
η1 is viscosity of solvent,
d1 and d2 are densities of solvent and drugs respectively,
t1 and t2 are time of flow for and solvent drugs respectively.

$$\eta r = \eta\ 1 \times \frac{\rho 2 \times t2}{\rho 1 \times t1} \qquad \text{---------------- } 1$$

Where, ηr is relative viscosity.
The density and relative viscosity data for different drugs at different concentration and temperature at various percentages are presented in Table No. 1 to2.
By using Jones-Dole equation19, the relative viscosities are analyzed from the given equation as,

$$\eta\ r\text{-}1/\sqrt{c} = A + \beta\ \sqrt{c} \text{ ---------------- } 2$$

Where,
C is Molar concentration of ligand,
A is Falkenhagen coefficient,

β is Jones-Dole coefficient
A is the measure of solute-solute i.e. ion-ion interactions and β is the measure of solute-solvent interactions. " η r-1/ √ c" is also known as "Specific Viscosity" denoted by "ηsp."

$$\eta_2 = \eta_1 \times \frac{\rho_2 \times t_2}{\rho_1 \, t_1}$$

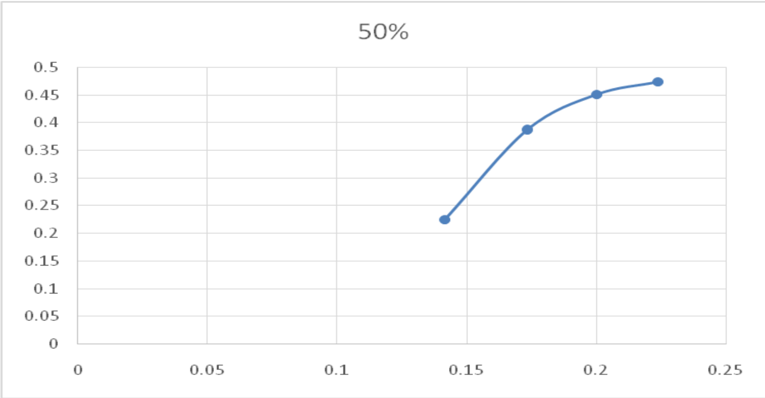
$$\eta_r = \eta_1 \times \frac{\rho_2 \times t_2}{\rho_1 \times t_1}$$

Table – 1 - Viscosity measurements at System: gibberellic acid different concentration of ligand

DETERMINATION OF RELATIVE AND SPECIFIC VISCOSITIES AT DIFFERENT CONCENTRATIONS AND COMPOSITION									
Composition	**Conc. C (M)**	**√C**	**Time t (sec.)**	**Density ρx10^3 (kg.cm^{-3})**	**ήr**	**$ή_{sp}$=$ή_r$-1**	**($ή_r$-1)/√C (pa^{-}s)**	**A**	B
50%	0.05	0.2236	41.0333	0.931619	1.105904	0.105904	0.473632	0.18	0.33
	0.04	0.2	40.4633	0.931313	1.090184	0.090184	0.450918		
	0.03	0.1732	39.6266	0.930791	1.067042	0.067042	0.38708		
	0.02	0.1414	38.3166	0.930771	1.031745	0.031745	0.224506		
45%	0.05	0.2236	40.2333	0.935306	1.083477	0.083477	0.373334	0.035	1.2
	0.04	0.2	40.2266	0.932063	1.079541	0.079541	0.397704		
	0.03	0.1732	38.5166	0.928652	1.029868	0.029868	0.172446		
	0.02	0.1414	37.52	0.926306	1.000686	0.000686	0.004851		
40%	0.05	0.2236	39.16	0.949412	1.246416	0.246416	1.102038	0.47	0.66
	0.04	0.2	35.9533	0.946701	1.141083	0.141083	0.705413		
	0.03	0.1732	34.4	0.944769	1.089556	0.089556	0.517068		
	0.02	0.1414	33.7	0.943487	1.065937	0.065937	0.466312		
35%	0.05	0.2236	34.7666	0.955927	1.131869	0.131869	0.589755	1.44	0.47
	0.04	0.2	33.5033	0.954251	1.088829	0.088829	0.444143		
	0.03	0.1732	32.6433	0.953837	1.060419	0.060419	0.34884		
	0.02	0.1414	32.55	0.952793	1.056231	0.056231	0.397673		

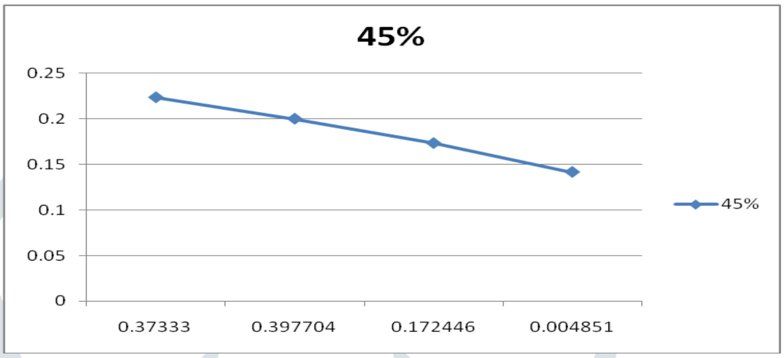
50%

$(\eta_r-1)/\sqrt{c}$	$\sqrt{c}$
0.473632	0.2236
0.450918	0.2
0.38708	0.1732
0.224506	0.1414



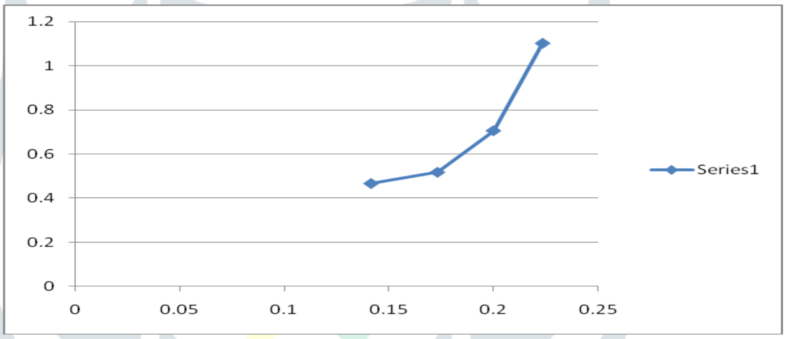
45 %

$(\eta_r-1)/\sqrt{c}$	$\sqrt{c}$
0.373334	0.2236
0.397704	0.2
0.172446	0.1732
0.004851	0.1414



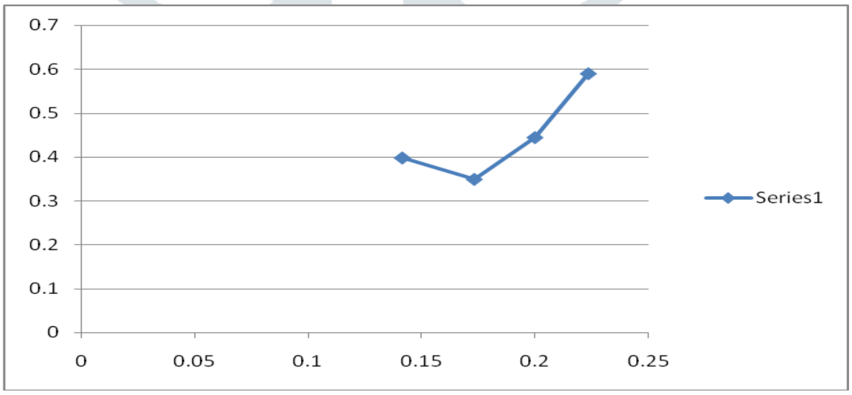
40 %

$(\eta_r-1)/\sqrt{c}$	$\sqrt{c}$
1.102038	0.2236
0.705413	0.2
0.517068	0.1732
0.466312	0.1414



35%

$(\eta_r-1)/\sqrt{c}$	$\sqrt{c}$
0.589755	0.2236
0.444143	0.2
0.34884	0.1732
0.397673	0.1414



CONCLUSION:

The results given in Table-1 shows that when the concentration of gibberellic acid decreases, the relative viscosity decreases. This may be due to the fact that along with the decrease in concentration i.e. number of moles per liter, solute solvent interactions also decrease. The graphs are plotted between $(\eta_r-1)/\sqrt{c}$ against $\sqrt{c}$. The graphs for each system give a linear straight line showing validity of Jones-Dole equation. The slope of the straight line gives the value of β-coefficient and form the intercept of that line, A can be found out. The plots of $(\eta_r-1)/\sqrt{c}$ against $\sqrt{c}$ for each system is in figure from the graphs of $(\eta_r-1)/\sqrt{c}$ against $\sqrt{c}$, 'A' which is the measure of ion-ion i.e., solute-solute interactions and 'β' which is the measure of solute-solvent interactions has been calculated and given Table-1 The values of A increases as the percentage of water increases shows solute –solvent interaction because water is polar solvent and have high dielectric constant. The values of A are smaller as compare β shows strong solute solvent interaction.

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