Journal of Advanced Scientific Research

Available online through http://www.sciensage.info

ISSN
0976-9595
Research Article

ULTRASONIC INVESTIGATION OF MOLECULAR INTERACTIONS IN THE SOLUTION OF ROOT EXTRACT OF *RICINUS COMMUNIS* AT 4 MH_Z

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ABSTRACT

Ultrasonic Velocity, density, viscosity have been measured experimentally for the solution of leaf extract of *Ricinus communis* in 50% ethyl alcohol with various concentrations at 298.15 K, 303.15 K, 308.15 K keeping constant frequency of 4 mh_z. As the acoustical parameters like adiabatic compressibility, intermolecular free length, relative association, relaxation time, specific acoustic impedence would prove to be more useful to predict and confirm the molecular interactions, these have been determined by measuring the Ultrasonic Velocity, density, viscosity of the prepared solution. A variation in these parameters will provide strong information regarding the molecular interactions taking place in the solution. The propagation of ultrasonic waves affects the physical properties of the medium and hence gives useful information about the molecular interactions such as ion-ion, ion-dipole, dipole-dipole interaction, hydrogen bonding in the solution. Here the study shows that the ultrasonic velocity increases here with increase in concentration this is due to the solvation process of solute by two different solvent molecules like water and ethanol, from this we can say that there is strong solute-solvent interaction in the root extract solution of *Ricinus communis*.

Keywords: Ultrasonic velocity, Adiabatic compressibility, Relative association, Intermolecular free length.

1. INTRODUCTION

Ultrasonic velocity measurements and other acoustical parameters of liquid mixtures are the powerful technique in understanding the chemical nature and the molecular interactions [1-4]. Many researchers used ultrasonic velocity measurement for studying solute-solvent interaction in number of systems including organic liquid, dilute solutions in organic acid and complexes [5-7].Ultrasonic velocity in liquids and liquid mixtures provide valuable information about their physico-chemical properties and the nature of molecular interactions in them [8-10]. Our country is very well known for Ayurveda, in the Ayurveda medicines are largely made up from plants, herbs. One of such plants is which is also known as *Ricinus communis*. *Ricinus communis* is known for its antifungal nature. The solution of leaf extract of *Ricinus communis* in 50% ethyl alcohol is studied at 4 MHz for the concentration of 1%, 0.5%, 0.25%, 0.125% at 298.15K, 303.15K, 308.15K. Here the effect of concentration at different temperature on molecular interaction will be predicted which may be helpful for predicting the reactivity of the extract.

2. MATERIAL AND METHODS

The leaf extract used in this study was of analytical range. 50% ethyl alcohol was used for the preparation of solution. A special thermostatic water bath arrangement was made to maintain constant temperature. 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of *Ricinus communis* was Prepared by taking accurate weights on electronic digital balance (Model CB/CA/CT-Series, Contech having accuracy ± 0.0001 g.) The ultrasonic velocity of the 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of *Ricinus communis* was measured with the Multifrequency ultrasonic interferometer (Model M-83, Mittal Enterprizes) at 4 MHz frequency with an accuracy of ± 2 m/s. All the readings were taken at 298.15 K, 303.15K, 308.15K. The viscosity was measured by using Ostwald's viscometer and the density of the solution was measured by using Digital densitometer (DMA-35, Anton paar).

2.1. Computation

By using ultrasonic velocity following ultrasonic parameters are calculated.

2.1.1. Adiabatic compressibility

$$\beta = 1/v_s^2 d$$

Where, v - velocity of solution,d - density of liquid

2.1.2. Intermolecular free length

$$L_f = K\sqrt{\beta_s}$$

Where, K-temperature dependent known as Jacobson's constant

2.1.3. Specific acoustic impedance

$$Z = v \times d_s$$

2.1.4. Relative association

$$R_A = d_s / d_0 [v_0 / v_s]^{1/3}$$

Where, v_0 - ultrasonic velocity of solvent, v_s - ultrasonic velocity of solution

2.1.5. Relaxation time

$$\tau = 4/3\ \beta_s \times \eta$$

3. RESULT AND DISCUSSION

The experimentally determined values are listed in the following table.

Table 1: Density, Viscosity and Velocity (at frequency 4 MHz) of *Ricinus communis* leaf extract solution

SR. No.	Conc. (%)	Temp. (K)	Density (d_s) (Kg m^{-3})	Velocity(v_s) (m/s)	Viscosity (η) (Kg $m^{-1}s^{-2}$)
1	1%	298.15	934.1	1616.8	19.78 E^{-4}
		303.15	931	1504.7	20.651 E^{-4}
		308.15	924.3	1501.2	16.26 E^{-4}
2	0.5%	298.15	933	1540.3	20.42 E^{-4}
		303.15	929.3	1583	19.79 E^{-4}
		308.15	925.2	1681.2	17.07 E^{-4}
3	0.25%	298.15	929.3	1502.1	16.73 E^{-4}
		303.15	926	1531.2	17.66 E^{-4}
		308.15	923	1608.1	15.207 E^{-4}
4	0.125%	298.15	928.2	1500.7	16.41 E^{-4}
		303.15	925.6	1515.2	17.28 E^{-4}
		308.15	922.2	1601.1	15.00 E^{-4}

Table 2: Acoustic parameters of Ricinus Communis leaf extract solution in 50% Ethyl Alcohol at 4 MHz

Sr. No.	Conc. (%)	Temp. (K)	Adiabatic Compressibility	Specific Acoustic Impedence Kg M^{-2} S^{-1}	Intermolecular free length	Relative Association	Relaxation time
1.	1%	298.15	4.095 E^{-10}	1510252.8	4.162 E^{-11}	3.600 E^{-1}	10.799 E^{-13}
		303.15	4.744 E^{-10}	1400875.7	4.520 E^{-11}	4.256 E^{-1}	13.029 E^{-13}
		308.15	4.8007 E^{-10}	1387559.1	4.5887 E^{-11}	5.265 E^{-1}	10.214 E^{-13}
2.	0.5%	298.15	4.517 E^{-10}	1437099	4.371 E^{-11}	3.775 E^{-1}	12.26 E^{-13}
		303.15	4.294 E^{-10}	1471081	4.301 E^{-11}	4.041 E^{-1}	11.30 E^{-13}
		308.15	3.884 E^{-10}	1543326	4.127 E^{-11}	4.742 E^{-1}	8.81 E^{-13}
3.	0.25%	298.15	4.769 E^{-10}	1395901.5	4.491 E^{-11}	3.856 E^{-1}	10.61 E^{-13}
		303.15	4.606 E^{-10}	1417706	4.454 E^{-11}	4.162 E^{-1}	10.58 E^{-13}
		308.15	4.189 E^{-10}	1484276	4.286 E^{-11}	4.907 E^{-1}	8.35 E^{-13}
4.	0.125%	298.15	4.795 E^{-10}	1389648.2	4.503 E^{-11}	3.846 E^{-1}	10.46 E^{-13}
		303.15	4.713 E^{-10}	1400044.8	4.500 E^{-11}	4.194 E^{-1}	10.83 E^{-13}
		308.15	4.24 E^{-10}	1472920	4.312 E^{-11}	4.913 E^{-1}	8.45 E^{-13}

The ultrasonic velocity of 1%, 0.5%, 0.25%, 0.125% Ricinus Communis (Erandi) root extract was measured at 298.15K, 303.15K, 308.15K at 4 MHz frequency. From Table no.1& fig.no.1, shows that ultrasonic velocity increases with increase in concentration this is because of the solvation process of solute by two different solvent molecules that is water and ethyl alcohol, it is observed that the ultrasonic velocity increases with the increase in temperature this is because of structure in liquid mixture with many cavities. These cavities can accommodate solute molecules. The ultrasonic velocity increases here with

increase in concentration this is due to the salvation process of solute by two different solvent molecules like water and ethanol. From table no. 2 and fig.2 it is observed that the adiabatic compressibility decreases with increase in concentration this may be attributed to increase in compressible molecules. A decreased value of adiabatic compressibility indicates strong interaction between components of the mixture. From Fig.3 it is seen that the specific acoustic impedence also increases with increase in concentration, this increase in acoustic impedence shows increase in molecular packing in the medium which gives the possibility of molecular interaction due to hydrogen bonding between solute and solvent. Fig.4. shows that intermolecular free length increases with decrease in concentration this is due to closed packed structure formed by one solute and two solvent molecules.

Fig.5. shows decrease in relative association with increase in concentration this is mainly due to breaking of associated solvent-solvent molecules on addition of solute in it. Fig 6.shows that as concentration increases relaxation time increases it is because of the relaxation process showing the presence of strong molecular interactions.

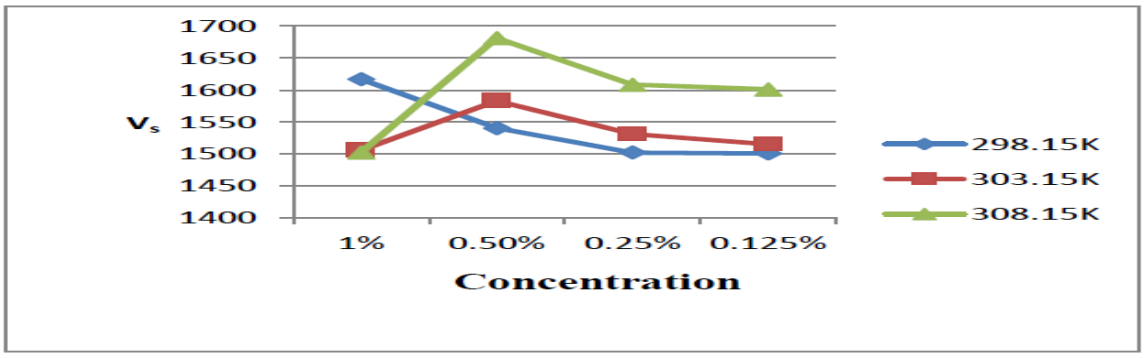

Fig. 1: Variation of Ultrasonic velocity with temp. at different concentrations

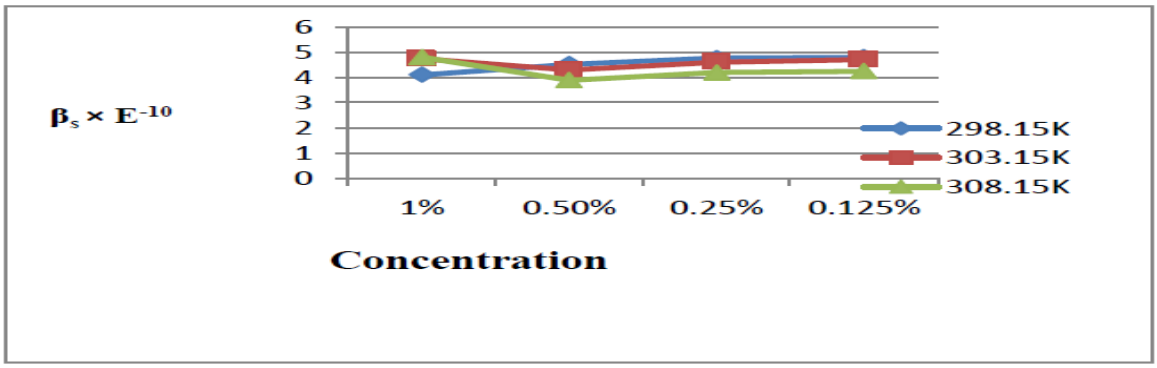

Fig. 2: Variation of Adiabatic compressibility with temperature at different concentrations

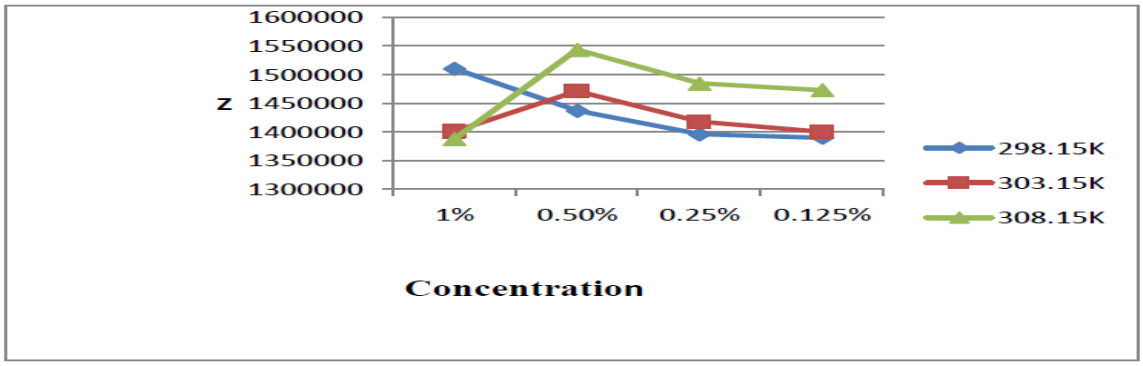

Fig. 3: Variation of specific Adiabatic impedance with temperature at different concentrations

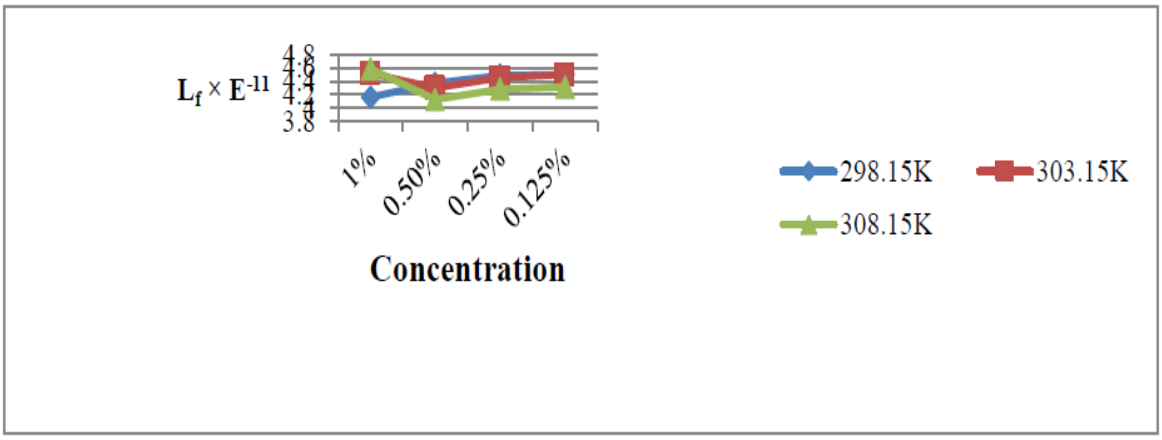

Fig. 4: Variation of intermolecular free length with temperature at different concentrations

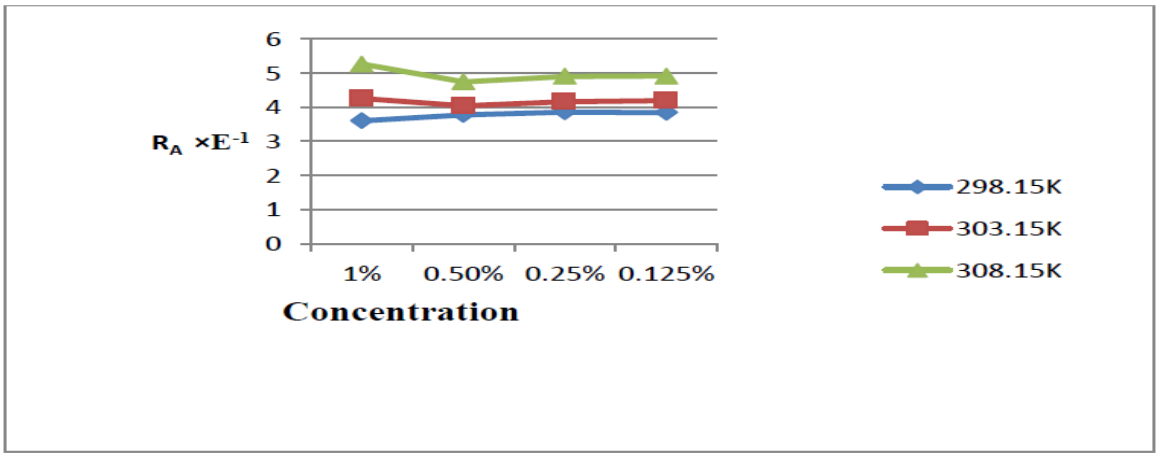

Fig. 5: Variation of relative association with temperature at different concentrations

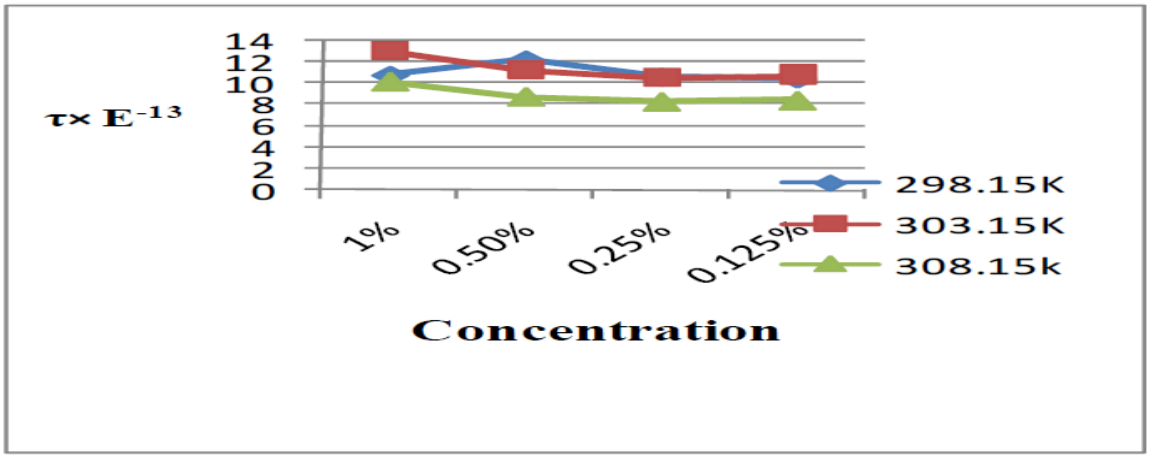

Fig. 6: Variation of relaxation time with temperature at different concentrations

4. CONCLUSION

The ultrasonic velocity increases here with increase in concentration this is due to the solvation process of solute by two different solvent molecules like water and ethanol. Evaluation of adiabatic compressibility, specific acoustic impedence, relative association, relaxation time, intermolecular free length clearly shows strong solute-solvent interaction.

5. ACKNOWLEDGEMENT

The authors are thankful to Lokmanya Tilak Mahavidyalya, Wani for their kind support to carry out this research work successfully.

Conflict of interest

The authors stated that no conflicts of interest.

6. REFERENCES

1. Praveen S, Shukla D, Singh S, Singh KP, Shukla JP. *Appl. Acoust.*, 2009; **70 Suppl 3**:507-509.
2. Umadevi M, Keshavswamy R, Rathina K, Mahalaxmi R. *J. Mol. Liq.*, 2016; **219**:820-822.
3. Nayak N, Aralaguppi MI, Aminabhavi TM. *J.Chem. Eng.Data.,* 2003; **48:**1489-1494.
4. Steele WV, Chirico RD, Cowell AB, Knipmeyer SE, Nguyen A. *J.Chem. Eng.Data.*, 2002; **47 Suppl 4:**667- 688.
5. Reis JCR, Santos AFS, Disas FA, Lampreia IMS. *Chem.Phys.Chem.*, 2008; **9:**1178-1188.
6. Khansanshin TS, Shchemelev AP, Srivastava TN, Singh RP, Swaroop B. *Ind.J.Pure Phys.*, 1983; **21**: 67-72.
7. Kumar A, Srivastava U, Singh AK, Srivastava U, Singh AK, Shukla RK. *Can.Chem.Trans.,* 2016; **4 Suppl 2**:157-167.
8. Bhatt SC, Semwak H, Lingwal V, Singh K, Semwak BS. *J.Acous.Soc.Ind.*, 2000; **28:**293-296.
9. Dhanlashmi A, Sekar S. *J.Pure. Appl. Ultrason.*, 1999; **21:**97-99.
10. Sastry GLN. *J.Acous.Soc.Ind.*, 1986; **14:**1-9.