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Acoustic and Thermodynamic Properties of Pyridoxine Hydrochloride in Water at Temperature 298.15K.

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ABSTRACT

For the study of acoustic and thermodynamic properties of pyridoxine hydrochloride in water at temperature 298.15K, Initially we measure three impartment parameters such as ultrasonic velocity (U), density (ρ) and viscosity (η). The ultrasonic velocity was measured by using the ultrasonic pulse eco overlap (PEO) technique at frequency 5 MHz. The measurement of density has been carried out by using hydrostatic plunger method and viscosity by Oswald's viscometer. The temperature 298.15K have been kept constant using thermostat by circulating water. This experimental data have been used to calculate the thermo-acoustical parameters such as adiabatic compressibility (β), acoustic impedance (Z), free length (L_f), free volume (V_f) , wada's constant (β_m) and Rao's constant (R). All these parameters have been used to give the interpretations of solute- solvent interaction between Pyridoxine hydrochloride and water molecules. This study provides important information regarding molecular properties of a mixture of solute and solvent.

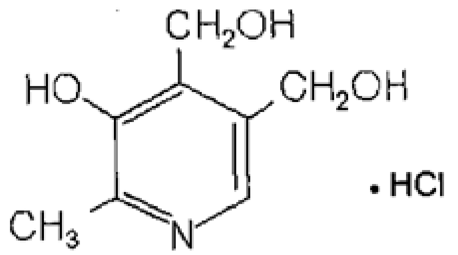
Keywords: Ultrasonic velocity, adiabatic compressibility, frees volume, Wada's constant, Rao's constant and pyridoxine hydrochloride.

INTRODUCTION

Ultrasonic velocity, density, viscosity and other thermo acoustical parameters such as adiabatic compressibility (β), acoustic impedance (Z), free length (L_f), free volume (V_f) , wada's constant (β_m) and Rao's constant (R). These parameters have been play very important role for studying weak and strong molecular interactions in binary mixture [1-4]. These parameters are also very helpful to study the nature of intermolecular forces in liquid mixtures and also give idea about association, dissociation and complex formation in a given mixture.

In 1938 Pyridoxine was first isolated from yeast and liver. This vitamin widely distributed in plant and animal tissues. They are especially rich in cereals (wheat, rice), peas, carrots, potatoes, sweet potatoes, bananas, avocados, watermelons and yeasts. Vitamins B_6 are also found in eggs yolk, salmon, chicken, fish, pork and liver. Pyridoxine is adequately available in human and cow's milk. Pyridoxine hydrochloride is a white crystalline substance; it is soluble in water and alcohol and slightly in fat solvent. Pyridoxine hydrochloride is useful in biomedical and clinical applications

The chemical formula of Pyridoxine Hydrochloride is $C_8H_{11}NO_3$ HCL. Its molecular weight is 205.64 gm. It is derivatives of pyridine C_5H_5N.



Structure of Pyridoxine Hydrochloride

METHODOLOGY

The stock solution of Pyridoxine Hydrochloride was prepared in double distilled water. Solution of different concentration ware prepared using water as solvent. The ultrasonic velocity of pure solvent and their solutions measurement were carried out with a highly versatile and accurate 'pulse echo overlap technique (PEO) method by using automatic ultrasonic recorder (AUAR-102) and frequency counter. The frequency of the pulses was kept at 5MHz. The density and viscosity were measured using hydrostatic plunger method and Oswald's viscometer respective. Temperature is maintained using thermostatically controlled water circulation system with accuracy of 0.5^0c. The other thermo-acoustical parameters such as adiabatic compressibility, relaxation time, classical absorption, free volume, internal pressure, at temperature 298.15K were calculated using ultrasonic velocity, density and viscosity [5-8]. The experimental and calculated data for different concentration of Pyridoxine Hydrochloride are given in the table 1 and 2.

THEORY:

Ultrasonic velocity was measured by using pulse Echo overlap method at 5MHz.The interferometer was filled with test liquid and temperature was maintained by circulating water around the measuring cell from thermostat. From the experimental data of ultrasonic velocity, density and viscosity of given solution, the various thermo-acoustical parameters were calculated using following standard equation [9].

1] Ultrasonic velocity: $u = 2d / t$

Where, d = Separation between transducer & reflector

t = Traveling time period of ultrasonic wave

2] Density $\rho = \left(\frac{W_a - W_1}{W_a - W_w}\right) \times \rho_w$

Where,

W_a = Weight of the plunger in air

W_1 = Weight of the plunger in the experimental liquid

W_w = Weight of the plunger in water

ρ_w = Density of water

3] Viscosity $\eta = \frac{\rho \times t_1}{\rho_w \times t_w} \times \eta_w$

Where,

t_1 = Flow Time of experimental liquid

t_w = Flow Time of water

η_w = Viscosity of water

4] Adiabatic Compressibility: $\beta = [1 / u^2\rho]$

5] Acoustic impedance : $Z = u.\ \rho$

6] Intermolecular free length: $(L_f) = \frac{k}{u\ \rho^{1/2}}$

Where,

k = Jacobson's constant = (93.875+0.345T) x10^{-8} (T is temperature)

7] Free volume : $(V_f) = Mw\ u / k\ \eta$

Where,

k = Time independent constant = 4.28 x 10^9

M_w = molecular weight of solution

8] Wada's Constant : $(\beta_m) = (M_w/\ \rho) \times \beta^{-1/7}$

9] Rao's Constant $(R) = (M_w/\ \rho) \times u^{1/3}$

RESULTS AND DISCUSSION

The experimental data of ultrasonic velocity, density, viscosity, adiabatic compressibility and acoustic impedance of pyridoxine hydrochloride with water at 298.15K, are recorded in table 1, and Intermolecular free length, free volume, Wada's constant and Rao's constant are given in table 2.

The variation of ultrasonic velocity and acoustic impedance with molar concentration are shown in figure (1) and figure (5). It is observed that ultrasonic velocity and acoustic impedance have linear variations with increase in molar concentration. The variation of adiabatic compressibility with increase in molar concentrations have reverse trend as shown in figure (4). This shows that there is a strong intermolecular force between pyridoxine hydrochloride and water molecules[10].

Variation of density with molar concentration is shown in figure (2), which are increases with increase in molar concentration. Increase in density due to the fact that numbers of vitamin molecules are added to the solution [11-13].

Figure (3) gives the variation of viscosity of aqueous ascorbic acid solution with the molar concentration. Viscosity is increases with increase in molar concentration shows that there is molecular interaction between solute and solvent molecules [14].

The variation of free length and free volume with concentration as showed in figure (6) and figure (7). Free length and free volume decreases with increase in molar concentration. This shows that there is strong interaction between solute and solvent molecules and association take place between vitamin B6 and water molecules. [15– 17].

The variation of Wada's constant and Rao's constant with concentration is shown in figure (8) and (9). It is observed that Wada's constant and Rao's constant increase with increasing molar concentration. This indicates that there is strong molecular interaction between solute and solvent molecules due to hydrogen bonding.

Table No.1

Concentration	**Ultrasonic Velocity (u) cm s^{-1}**	**Density (ρ) g cm^{-3}**	**Viscosity (η) Centi poise**	**Adiabatic compressibility ($\beta \times 10^{-11}$) cm^2 $dyne^{-1}$**	**Acoustic impedance ($Z \times 10^5$) g cm^{-2} s^{-1}**
0	149599	0.9970	0.8900	4.4816	1.4915
0.02	149722	0.9988	0.8918	4.4663	1.4954
0.04	149931	0.9998	0.9022	4.4494	1.4990
0.06	150156	1.0011	0.9043	4.4303	1.5032
0.08	150386	1.0035	0.9123	4.4062	1.5091
0.10	150566	1.0047	0.9163	4.3905	1.5127

Table no. 2

Concentration	Free length (L_f x 10^{-11}) cm	Free Volume (V_f X 10^{-8}) cm³/Mole	Wada's constant (βm) cm$^{19/7}$/dyne$^{1/7}$	Rao's constant(R) cm$^{10/3}$/s$^{1/3}$
0	1.3167	1.7869	543.6418	959.2291
0.02	1.3144	1.7818	544.9399	961.3133
0.04	1.3120	1.7777	546.7139	964.3688
0.06	1.3091	1.7719	548.3729	967.1843
0.08	1.3056	1.7611	549.5242	968.9542
0.10	1.3032	1.7571	551.1925	971.7878

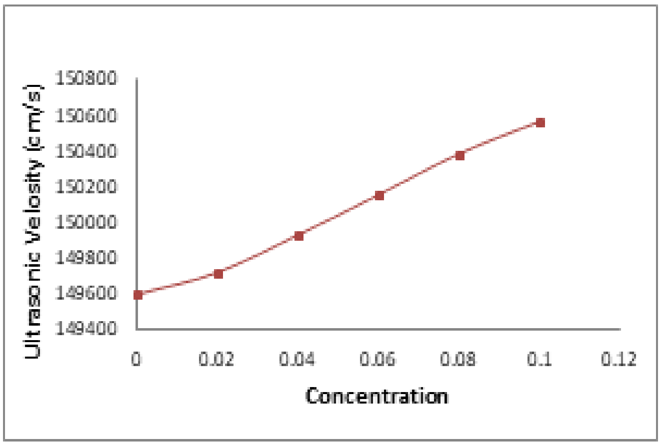


Fig. 1: Variation of Ultra. Velocity with conc.

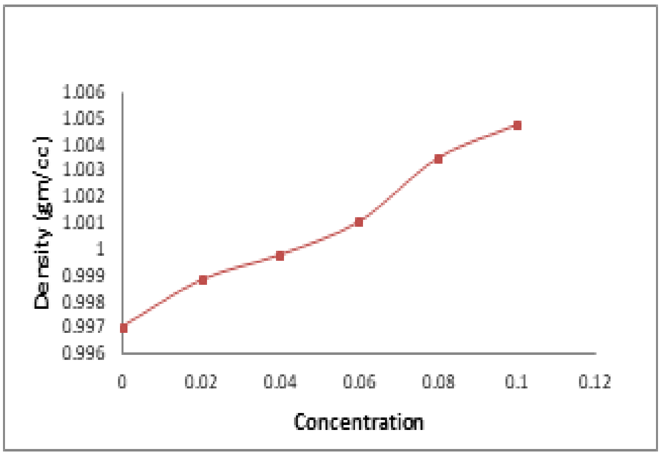


Fig. 2. Variation of Density with conc.

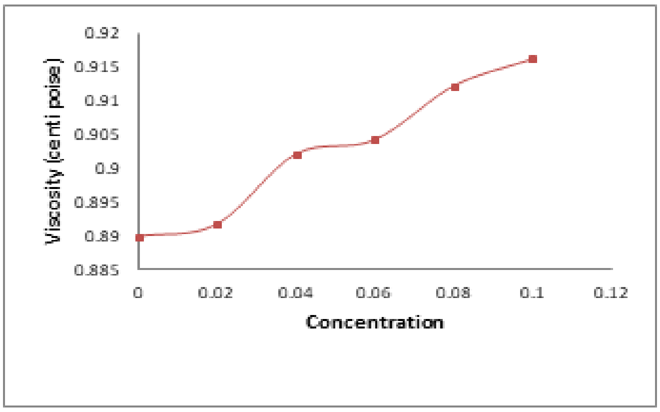


Fig.3: Variation of Viscosity with conc.

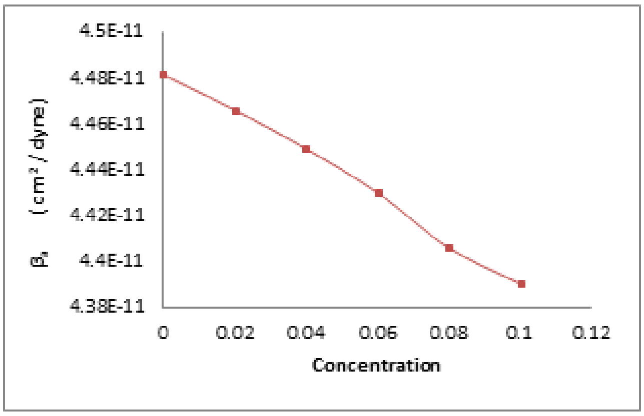


Fig. 4 Variation of Adiabatic comp. with conc

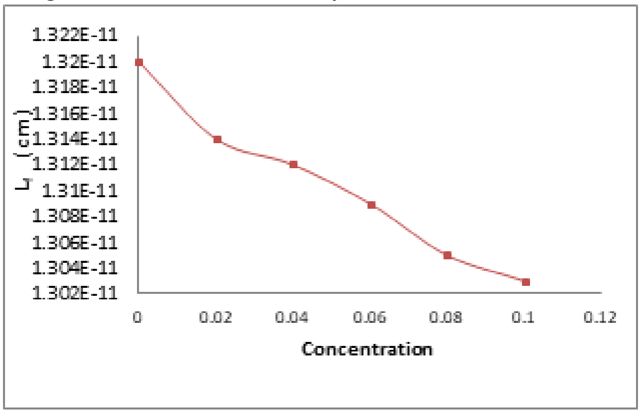


Fig. 5: Variation of Acoustic impedance with conc.

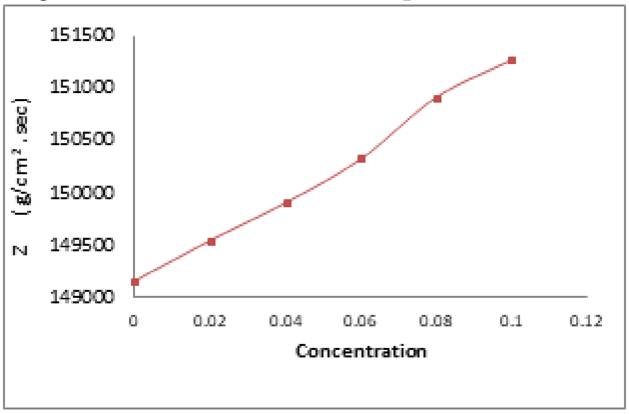


Fig. 6: Variation of free length with conc

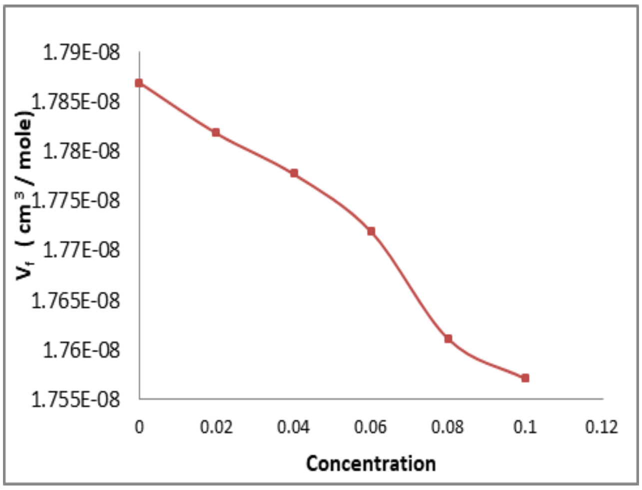


Fig. 7: Variation of Free volume with conc.

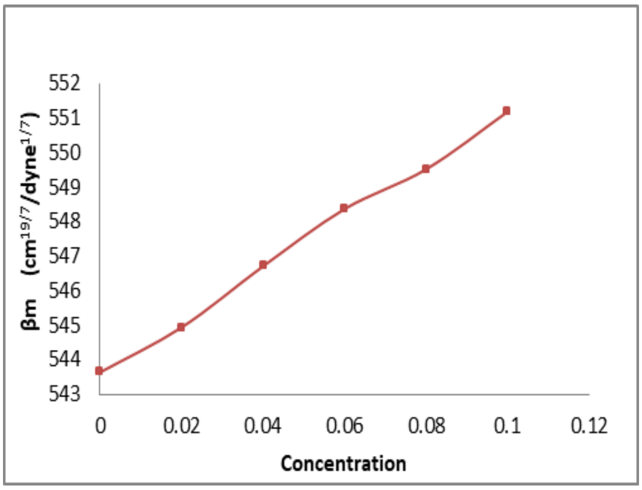


Fig. 8: Variation of Wada constant with conc.

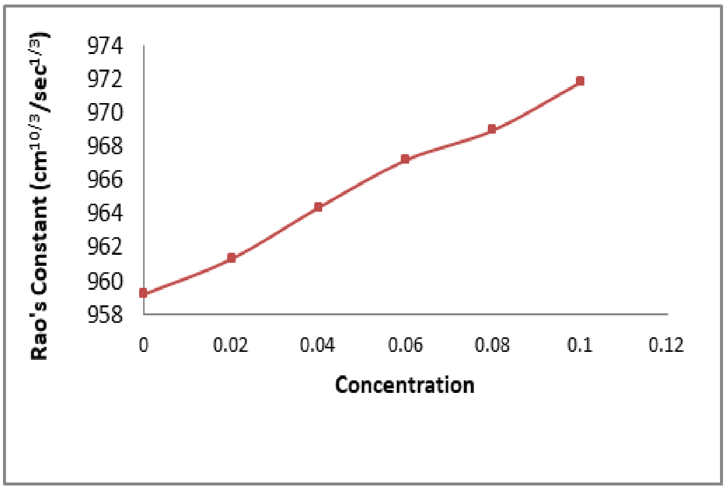


Fig. 9: Variation of Rao' constant with conc.

CONCLUSION

Ultrasonic velocity, density and viscosity of different concentration of Pyridoxine hydrochloride with water at 298.15K and thermo-acoustical parameters are calculated. The linear variation in ultrasonic velocity and other acoustical parameters indicates that there is a strong molecular interaction between Pyridoxine hydrochloride and water molecules and association take place between solute and solvent molecules with increase in concentration.

Conflicts of interest: The authors stated that no conflicts of interest.

REFERENCES

1. Anyranci. G, et al, J. Chem. Themodyn (2007), doi:10,1016/j 2007.04.009.
2. Tabhane.P.V, Chimankar.O.P., Dudhe.C.M, Tabhane.V.A, (2012), Lop Conf. series material sci & Engg. 42 012033, doi : 10.1088/1757-899A/42/012033.
3. Ali A.,Nain A. K ,(1996), Acoustic let. 19-53
4. Tabhane.P.V, Chimankar.O.P., Dudhe.C.M, Tabhane.V.A, (2012) Der Chemic Sinica, 3(4) 944-947.
5. Voet D. J., Voet J. G., Pratt C. W., Principle of biochemistry, (2008), 137.
6. Taylar T. V., Ascorbic acid supplementation in the treatment of pressure sores, 1974, 544-546.

7. Khalid Iqbal, Alam Khan and M. Muzaffar Ali Khan, Pakistan J. of nutrition, **3(1)**, (2004), 5-13.
8. Gaby S. K. and Singh V. N., Vitamin C, Vitamin intake and health, A scientific review, 1991.
9. Dudhe C.M. , Patil K.C.,(2012), Int.J. of Natural Product research, 2(4) 76-78.
10. Rao K., Rajulu A. V. and Naidu S. V. Journal Polym. Mater., 1989, 8,149.
11. Tabhane V. A., Agrawal S. and Rewatkar K.G., (2000) , J.Acous.soc. India vol. 28 no.. 1-4, 369-372.
12. Chimankar.O.P, Shrivas Ranjeeta, Tabhane.V.A,(2010), Archives of Applied science research. 2(6):285-289
13. Chimankar.O.P, Shrivas Ranjeeta, Chopade P S., Tabhane.V.A., (2011), J.Chem. Pharm Res, 3(3):579-586.
14. Arul G., Palaniappan L., (Oct. 2005), Indian Journal of pure & applied physics vol. 43, PP 755-758.
15. Sonar A.N. , Pawar N.S. , (2010) Rasayan, J. Chem Vol 3 (1) ,38-43.
16. Bhandakar.V.D., Chimankar.O.P, Pawar N.R., (2010), J.chem. pharm. Res., 2(4), 873.
17. Sonar A.N. , Pawar N.S., (2010), Rasayan J. Chem. Vol 3 no. 1 ,38-43.