IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Studies of Ultrasonic Velocities, Densities, Viscosities & Refractive Indies of Naratriptan Hydrochloride at Different Temperatures

S. R. Gaur[1*] *R, P. Phase*[2] *S.B.Hiwale*[1]
Dept. of Chemistry
*Principal author
Sant Ramdas Arts, Commerce & Science College Ghansawangi[1] & *L. B. S. College Partur*[2]

Abstract: Densities, viscosities, refractive indices and ultrasonic velocities of Naratriptan hydrochloride were measured over the entire mole fractions at different temperatures (K). From these experimental results, excess molar volumes VE, viscosity deviation Δη, refractive index deviation Δn D, deviations are calculated. It was found that in all cases, the data obtained fitted with the values correlated by the corresponding models very well. The results are interpreted in terms of molecular interactions occurring in the solution.

Keywords: *Viscosity; Density; Refractive Index; Ultrasonic Velocity; Molecular interactions*.

Introduction: In the recent years, mixed solvents rather than pure solvents find practical application in most chemical processes as their properties are less known Gracia, et al., (1997); Pitzer,(1995). Ultrasonic technique has become a powerful tool for studying the molecular behavior of liquid mixtures Ali et al., (1996). This is because of its ability of characterizing physico - chemical behavior of liquid medium Manisha and Shukla, (1996); Velmurugan et al., (1987). Binary liquid mixtures due to their unusual behaviour have attracted considerable attention Ewing et al., (1970). Data on some of the properties associated with the liquids and liquid mixtures like density, viscosity and ultrasonic velocity find extensive applications in chemical engineering process simulation, textile industries solution theory and molecular dynamics Mchaweh et al., (2004). These measurements are used to study the molecular interactions. In pure liquids, liquid mixtures and ionic interactions in solution comprising either single or mixed solute.

Ultrasonic study is the important research topic and as its usefulness in the fields of biology, biochemistry, engineering, geography, geology, medicine and polymer industry is found very interesting Nain et al., (2012); Jahagirdar et al., (1998). Ultrasonic velocity (U) together with density (ρ) and viscosity (η) data furnishes a wealth of information about bulk properties and intermolecular forces Nozdrev, (1963); Pierce, D. C. (1981), which find applications in several industries and technological processes. A literature survey reveals that ultrasonic velocities of various organic, inorganic and biological compounds in various solvents have been studied Laux et al., (2009); Akhtar, (2004). The drug-solvent molecular interaction and their temperature dependence play an important role in the understanding of drug action Thakur and Chauhan. (2011); Dhondge et al., (2012).

Density (ρ) is elementary physical property of matter. Many researchers have been used bicapillary pycnometers for measurements of densities of pure liquids, liquid mixtures Kharat and Nikam, (2007); Shukla, et al., (2008) and also aqueous solutions Kharat, (2013) ; Nikam, et al., (2000).

In the present studies focused on the various aspects like ultrasonic velocities, densities, viscosities & refractive Indies of organic compounds. Unfortunately there is very little literature is available to correlate our obtained results.For this we select drugs like Naratriptan hydrochloride, are the organic compounds which are widely and commonly used in the treatment of symptoms of migraine headaches (severe, throbbing headaches that sometimes are accompanied by nausea and sensitivity to sound or light). Naratriptan hydrochloride is in a class of medications called selective serotonin receptor agonists. It works by narrowing blood vessels around the brain, stopping pain signals from being sent to the brain, and stopping the release of certain natural substances that cause pain, nausea, and other symptoms of migraine. Naratriptan hydrochloride does not prevent migraine attacks or reduce the number of headaches you have.

Experimental Section:

Materials and Methods:

All the chemicals used in this study were of analytical grade and obtained from Lobo Chemicals, India. The claimed mass fraction purity for the chemicals was ≥0.998. These chemicals were dried over molecular sieves and partially degassed prior to use. The purity of these experimental chemicals was checked by comparing the observed densities, viscosities, refractive indices and velocities with those reported in the literature. The measured values are included in Table 1 along with the available literature values.

Preparation of aqueous solutions for present study: for present study were prepared in triply distilled deionized water by weight-by weight method in airtight stoppered glass bottle. Dhona balance to an accuracy of ±1 ×10−5 g was used to record the masses. Density and viscosity measurements at different temperatures were undertaken by using glass-walled water bath. The Bi-capillary Pycnometer, Ubbelohde Viscometer, and Ultrasonic Interferometer were calibrated with triply distilled deionized water (conductivity 0.054 μS) before the measurements of density, viscosity, ultrasonic velocity, and refractive indices. Uncertainties in the density, viscosity, ultrasonic velocity, and temperature measurements were 5.8 ×10−2 kg m−3, 4.71 ×10−7m−1 kg s−1, 0.23 m s−1 , and 0.006 K, respectively.

Density:

Densities were determined by using a 25 cm3 bicapillary pycnometer and calibrated with deionized double distilled water with a density of 996.0 kg ·m-3 at a temperature of 303.15 K. The pycnometer was thermostatted in a transparent walled water bath (maintained constant to ± 0.01 K) for 15 min to attain thermal equilibrium, and the liquid level in the two arms was obtained with a traveling microscope which could read to 0.01 mm. The precision of the density measurements was estimated to be ± 0.0003 g ·cm-3.

Viscosity

The kinematic viscosities were measured with Mansingh survemeter using water. The time was measured with a precision of 0.01s, and the uncertainty in the viscosity was estimated to be less than 0.0003 mPa·s. The kinematic viscosity was obtained from the working equation

$$v = at - b/t$$

Ultrasonic Velocity: Ultrasonic Velocity measurements the three experimental techniques used for the measurements of ultrasonic velocity are interferometer method, For present study, a single crystal variable path interferometer has been employed for the measurements of ultrasonic velocity of aqueous solutions. The test solution in the cell is allowed to thermally equilibrate. The micrometer was rotated very slowly so as to obtain a maximum or minimum of anode current. A number of maximum readings (n) of anode current were counted. The total distance (d) travelled by the micrometer for n =10 were read. The wave length (λ) was determined by the equation

$$\lambda = {}^{2d}/_{n}$$

Refractive Indices: Refractive Index Measurements For pure solvent, the refractive index, n, is a constant. It can be defined as the ratio of the speed of a wave either light or sound in a reference medium to a second medium.

$$n = \frac{Speed\ of\ light\ in\ medium\ 2}{Speed\ of\ light\ in\ medium\ 1}$$

The incident light is in material 1 and the refracted light is in material 2. Abbes refractometer was used for the measurements of refractive indices of aqueous solutions. Refractive index range of refractometer was 1.3000 – 1.7000. Accuracy in the refractive index measurements was ± 0.0002. Refractometer operates on the critical angle principal. For measurements of refractive of the liquid/solution, the liquid/solution sample was added on the surface of the refracting prism with a clean dropper. The refracting prism was covered by light entering prism and both prisms were locked with hand wheel Kharat and Nikam, (2003). For the measurements of refractive indices at different temperatures water at different temperatures was circulated through the refractometer by pump. Before the measurements refractive indices of aqueous solutions, the refractometer was calibrated with piece of glass of known refractive index provided with the instruments. To check the calibration, the refractive indices of distilled water were measured at different temperatures.

Results and Discussion:

Measured values of densities, viscosities, refractive indices and ultrasonic velocities of Nicardipine at temperatures of (88.210, 74.561, 72.157& 68.108) K are listed in Table.1.

The values of Naratriptan hydrochloride, density (ρ), ultrasonic velocity (U), and viscosity (η), various concentrations at different temperatures are shown in Table & graph 1

Density (ρ): The density of the drug is measured throughout the experimental period and concentration at various temperatures. The density was highly increased in 0.06m at 69.324(k), followed by 0.1m at 68.108 (k) 0.07 at 68.351 (k) & 0.09m at 66.106 (k) &0.04m at 8.0342k. The highest density was decreased in the0.01m at 88.210 (k) followed by 0.02 m 74.561 (k)was observed.

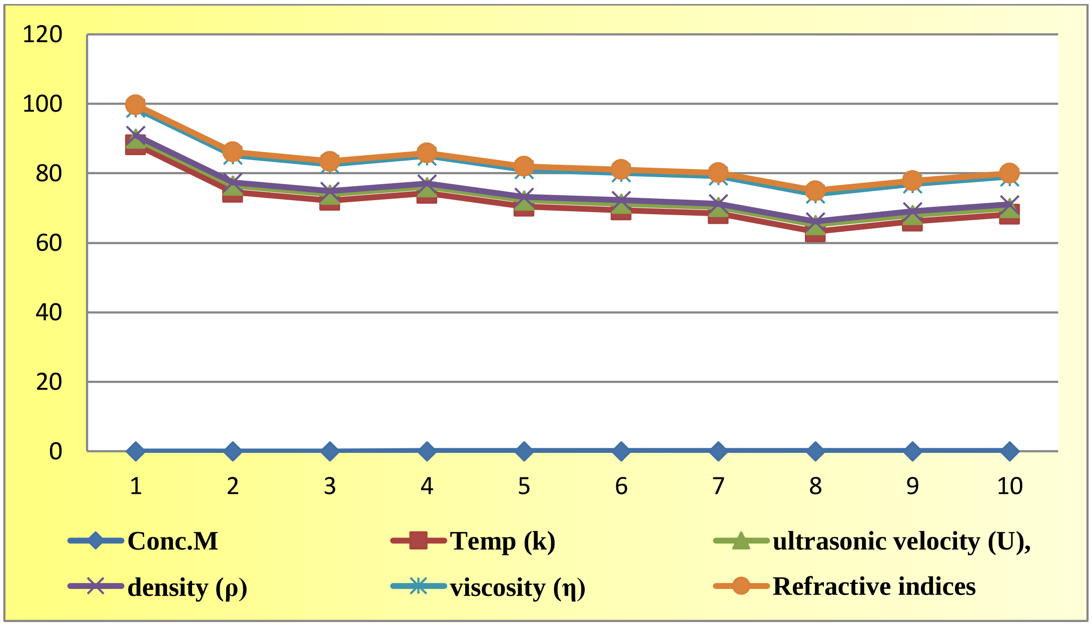
Ultrasonic velocity (U): The ultrasonic velocity is highly increased in the 0.08m at 63.102 (k) followed by 0.02m at 74.561 (k) 0.07m at 68.351 (k) the ultrasonic velocity is highly decreased in 0.01m at 88.210 (k) was observed.

Viscosity (η): The viscosity is highly increased in the 0.07m at 68.351 (k) followed by 0.1m at 68.108 (k) 0.06m at 69.324 (k).The viscosity is highly decreased in 0.03m at 72.157 (k) was observed.

Refractive indices: The refractive indices is highly increased in 0.1m at 68.108 (k) while it was highly decreased in 0.02 m at 74.561 (k)

Sr.no.	Conc. M	Temp (k)	ultrasonic velocity (U),	density (ρ)	viscosity (η)	Refractive indices
1	0.01	88.210	1.7856	0.8793	7.8956	0.8957
2	0.02	74.561	1.8967	0.8968	7.8964	0.8791
3	0.03	72.157	1.7964	0.9156	7.6874	0.8946
4	0.04	74.241	1.8361	0.9357	7.9356	0.8957
5	0.05	70.405	1.7863	0.9168	7.9487	0.9189
6	0.06	69.324	1.8567	0.9986	7.9469	0.9278
7	0.07	68.351	1.8863	0.9879	7.9785	0.8789
8	0.08	63.102	1.9765	0.9467	7.9386	0.9687
9	0.09	66.106	1.8657	0.9367	7.9348	0.9168
10	0.1	68.108	1.8561	0.9871	7.9687	0.9768

Table no.1
Showing the Fluctuation of ultrasonic velocity, density, viscosity & refractive indices of Naratriptan hydrochloride drug against concentration



Graph no.1

Showing the Fluctuation of ultrasonic velocity, density, viscosity & refractive indices of Nicardipine hydrochloride against concentration.

The drug solvent molecular interaction plays an important role in the understanding the of drug action. Viscometric properties provide valuable clues for solute–solvent interactions in the solution phase. Such results can be helpful in predicting the absorption of drugs and transport of drugs across the biological membranes. Therefore, it may be interesting to investigate variation of their properties with concentration for understanding the mechanism of drug action. S.S. Dhondge, et al., (2011); Iqbal and Verrall, (1989); Banipal, et al., (2011).

The values of density, ultrasonic velocity, Refractive indices and relative association at different temperatures (K) are presented in table 1. It showed that as the concentration of solutes increase, the density, ultrasonic velocity, relative association increases because of strong molecular interactions. It suggests powerful dipole-dipole interaction between the component molecules Kumar et al., (2012).

The ρ, η and U values increased linearly with concentration (C). The densities of the solutions increase with C. Thus, the rule of additivity of density is observed. The ρ, η and U data were correlated with the concentration C and found to have a fairly good-to-excellent correlation between a given parameter. The variation of η and U with C is considerably more than that of ρ due to specific molecular interactions. Molecular interactions depend on the strength of the repulsive forces acting amongst solvent and solute molecules and hence intermolecular motion is affected accordingly. Attractive forces resulting molecular association (solvation), i.e. modification of the solute molecules.

The refractive indices was varies as the temperature increased in the present investigation obtained for the two drug. Similar trends was obtained in the another studies and reported that the results of refractive indices versus *x1* at different (K) for the systems of acetophenone are acetophenone + methyl acetate exhibit a positive deviation at all the studied temperatures. The values of Δ□*s* are negative at all the temperatures and the values of Δ□*s* become less negative as temperature increased. This may be attributed to the weakening of structure making interactions at elevated temperatures due to enhanced thermal motion Maham et al., (1997). The excess free length is negative over the whole mole fraction range for all binary mixtures at different.

The values of density, ultrasonic velocity, refractive indices are presented in table 1. It shows that as the concentration of solutes increase, the density, ultrasonic velocity, increases. The linear increase of ϱ and u with concentration of solute confirmed an increase of cohesive forces because of strong molecular interactions. It suggests powerful dipole-dipole interaction between the component molecules Kumar et al., (2012). According to an earlier model proposed by Kincaid & Eyring. (1938), ultrasonic velocity decreases with increase in free length and vice versa. This is also in accordance with the expected molecular interaction between the solute-solvent, increases in compressibility.The calculated values of ultrasonic velocity and adiabatic compressibility are in good concordance with reported work Patil & Naik (2015); Santosh et al., (2010).

When the temperature increased the values of (U), (ρ) and (η) were decreases, this trend reveals that at increasing temperature the molecular interaction between the molecules decreased and it shown low in higher temperatures (Kolhe and Bhosale, 2017). It can be observed that density (ρ) of solutions increases with the concentration of solute (m) in the solution for all the system studied. The similar kind of behavior is found by the researcher at various temperatures (Gardas and Coutinho, 2008). Further the density of ternary mixture decreases slightly with respect to temperature for all the systems (Pal and Kumar, 2004; Dhondge et al., 2012).

Acknowledgement:

The authors kindly acknowledged the UGC (WRO, Pune) for sanctioning the project under which the work was carried out to carry out.

REFERENCES:

1. **Akhtar Y. (2004)** . "Interaction studies of L-proline and L-glutamine with some electrolytes in aqueous media." J. Ind. Council Chem., 2143-47
2. **Ali A, Nain A K and Kamil M, (1996).**Thermochim.Acta., 274,209.
3. **Dhondge, S.S., Paliwal, R.L., Bhane, N.S., Pandhurnekar, C.P., (2012).** Study of thermodynamic properties of aqueous binary mixtures of glycine, l-alanine and β-alanine at low temperatures (T ¼ 275.15, 279.15, and 283.15) K. J. Chem. Thermodynamics 43, 114–121
4. **Ewing, M.B., Levian, B.J., and Marsh, K.N (1970).** Journal of chemical thermodynamics., 2:689-691
5. **Gardas, R.L., Coutinho, J.A.P., (2008).** Estimation of speed of sound of ionic liquids using surface tensions and densities: a volume based approach. Fluid Phase Equilib. 267, 88–192
6. **Gracia, R Alcaide, J M Leal and J S Matos., (1997). J**. Chem. Soc. Faraday Trans 93 1115
7. **Jahagirdar, D. V.; Arbad, B. R.; Mirgane, S. R.; Lande, M. K. and Shankarwar A. G.; (1998).“**Density, ultrasonic velocity and viscosity measurements of four pharmacologically significant drugs in methanol at 25 °C." J. Mol. Liq., 75 33-43.
8. **K S Pitzer, (1995).** Thermodynamics New york: Mc. Graw Hill book Co
9. **Kharat, S. J. (2013).**Partial molar volume, Jones–Dole coefficient, and limiting molar isentropic compressibility of sodium ibuprofen in water and its hydration number and hydration free energy, Thermochimica Acta, , 566, 124.
10. **Kharat, S. J., and Nikam, P. S., (2003).** Excess molar volumes and deviations in viscosity of binary mixtures of N,N-Dimethylformamide with aniline and benzonitrile at (298.15, 303.15, 308.15, and 313.15) K, *J. Chem. Eng. Data*, , *48(4)*, 972
11. **Kharat, S. J., and Nikam, P. S., (2007).**Density and viscosity studies of binary mixtures of aniline + benzene and ternary mixtures of (aniline + benzene + N,Ndimethylformamide) at 298.15, 303.15, 308.15, and 313.15 K, J. Mol. Liq., 131, 81
12. **Kincaid J F, Eyring H. (1938)**.A partition function for liquid mercury. J Chem Phys; 6: 587-597
13. **Kolhe, R.K., Bhosale, B.B., (2017).** Study of excess acoustical parameters of dimethyl sulphoxide in 2-Propanol as binary liquid mixture at various temperatures. Int. J. Sci. Res. Publ. 7 (8), 494–511
14. **Kumar R, Mahesh R, Shanmugapriyan B, Kannappan V (2012).** Volumetric, viscometeric, acoustic and refractometric studies of molecular interactions in certain binary systems of *o*-chlorophenol at 303.15K. Ind J Pure Appl Phys 50: 633-640.
15. **Laux, D.; Leveque, G. and Cereser C. V. (2009)** "Ultrasonic properties of water/sorbitol solutions." Ultrason., 49 159-161.
16. **Maham Y, Hepler L G, Mather A E, (1997).** Hakin A W and Marriot R M, *J Chem Soc Faraday Trans.*, , **93**, 1747.
17. **Manisha Gupta and Shukla J P. (1996).** Indian J Pure Applied Physics., 34,772.
18. **Mchaweh A, Alsaygh A and Mosh-Feghian M A, (2004).** Fluid Phase Equilib., ,**224**,157.
19. **Nain, A.; Pal, R. and Sharma, R.; (2012).** "Physicaochemical study of solute-solute and solutesolvent interactions of l-histidine in water+sucrose solutions at different temperatures." J. Mol. Liq., 165 154-160.
20. **Nikam, P. S., Ansari, H. R. and Mehdi, H., (2000)**.Acoustical properties of fructose and maltose solutions in water and in aqueous 0.5 M NH4 Cl, J. Mol. Liq., 84(2), 169.
21. **Nozdrev, V. F.; (1963).** "Application of Ultrasonic in Molecular Physics." Gordon and Breach, New York
22. **Pal, A., Kumar, S., (2004).** Viscometric and volumetric studies of some amino acids in binary aqueous solutions of urea at various temperatures. J. Mol. Liq. 109, 23–31.
23. **Patil S U, Naik A B (2015)..** Effect of concentration of substituted pyrazolines on acoustical parameters. Int J Sci Res; 486-488
24. **Pierce, D. C. (1981).** "Acoustics.", Mc Graw Hill, New York

25. **Santosh M S, Bhat D K, Bhat A S. (2010).**Volumetric and ultrasonic investigation of Glycylglycine in aqueous FeCl3 solutions. J Sol Chem; 39: 1763-1773.
26. **Shukla, R.K., Kumar, A., Shukla, A., and Srivastava, K., (2008).**Density, ultrasonic velocity, surface tension, excess volume and viscosity of quaternary fluid solutions, J. Mol. Liq., 140, 117.
27. **Thakur S. K. and Chauhan S. (2011) .**"Ultrasonic velocity and allied parameters of drug colimax in aq. 1-propanol at 298.15K." J. Chem. Pharm. Res., 3 657-664.
28. **Velmurugan S, Nambinarayanan T K, Srinivasa Rao A and Krishnan B., (1987).** Indian J Physics., 618,105.