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Effect of Temperature on molecular interaction in Rabeprazole Sodium in different solvent

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ABSTRACT

A drug can be defined as a chemical substance of known structure, other than a nutrient of an essential dietary ingredient, which, when administered to a living organism, produces a biological effect. By measuring ultrasonic velocities, densities of rabeprazole sodium at different concentrations and at 298K,303K,308K in aqueous solution and alcoholic solution acoustic and thermodynamic parametes will be calculated. From these data molecular interaction will be predicted. Also reactivity of the drug can be predicted.
Key words: drug, rabeprazole, thermodynamic, interaction, reacitivity

1. INTRODUCTION

Ultrasonic measurements are very useful in chemical and food processing, pharmaceuticals, material testing, and underwater ranging and cleaning and are also commonly employed in mechanical machinery of material 1. Ultrasound is regarded as being of low intensity when there no permanent change takes place in the material during propagation of ultrasonic waves[2]. This is the uniqueness of the ultrasonic method over other diffraction method Ultrasonic technique has been employed to investigate the properties of any substance to understand the nature of molecular interactions in pure liquid3 Arun Kumar Misra et.al.,[3]have attempted the interactions of paracetamol with fatty acids through viscometric technique. Conformity ofmacromolecular interactions was reported by many workers using ultrasonic technique.[4] In recent years, the study of intermolecular interactions through ultrasonic investigations plays an imperative role in the growth of molecular sciences [5-7]. A systematic knowledge of solution behavior of drugs is of great importance in order to understand their physiological action [8]

In pharmacology, a drug is a chemical substance, typically of known structure, which, when administered to a living organism, produces a biological effect [9]. A drug can be defined as a chemical substance of known structure, other than a nutrient of an essential dietary ingredient, which, when administered to a living organism, produces a biological effect. Traditionally drugs were obtained through extraction from medicinal plants, but more recently also by organic synthesis. [10] now a days ultrasonic technique is used to study molecular interaction in drug solution.[11-13]

In the present study we measured ultrasonic velocity, density of aqueous and alcoholic solution of rabeprazole sodium at different concentrations and temperatures. From this data acoustic parameters will be calculated which helps to predict effect of solvent as well as concentrations and temperatures can be predicted.

2. MATERIALS AND METHODS

velocity (U) in aqueous solution and alcoholic solution of Rabeprazole sodium, which was prepared by taking purified AR grade samples, have been measured using an ultrasonic interferometer (Mittal type, Model F-81) working at 2MHz frequency and at temperature different temperatures and at different concentrations. The accuracy of sound velocity was ±0.1 ms-1. A digital constant temperature water bath has been used to circulate water through the double walled measuring cell made up of steel containing the experimental solution at the desire temperature. The density of pure solvent and soltion was determined using density bottle by relative measurement method with an accuracy of ±0.1Kgm-3. An Ostwald's viscometer was used for the viscosity measurement of pure liquids and liquid mixtures with an accuracy of ±0.0001NSm-2. The temperature around the viscometer and pycknometer was maintained within ±0.1K in an constant temperature water bath. All the precautions were taken to minimize the possible experimental error**.**

3. RESULT AND DISCUSSION

Using the experimental data of ultrasonic ultrasonic velocity (U), density (ρ), various acoustical parameters such as adiabatic compressibility (βa), intermolecular free length (Lf), Acoustic impedance (Z) were calculated by the following equations (1-3).

$$\beta a = (U^2\rho)^{-1} \quad \text{..... (1)}$$

$$L_f = K_T\beta a^{1/2} \quad \text{..... (2)}$$

$$Z = U\rho \quad \text{..... (3)}$$

From table 1,2,3 and fig 1 it shows that ultrasonic velocity in aqueous solution of rabeprazole sodium is higher than that in alcoholic solution. Also with increase in temperature and concentration ultrasonic velocity in aqueous solution of rabeprazole sodium is higher than that of alcoholic solution. The increase in density and ultrasonic velocity may be due to cohesive forces and molecular association of solute in aqueous medium. This shows a stronger interaction between solute and solvent molecules in aqueous medium. Due to transfer of sound energy from one molecule to other ultrasonic velocity increases which indicates strong solute-solvent interactions.

From table 1,2,3 and fig 2 it shows that adiabatic compressibility decreases with increasing concentration and temperatures in aqueous solution indicates strong solute solvent interaction exist in aqueous solution to that of alcoholic solution. It may be due more formation of hydrogen bonding between solute and solvent as temperature increases. The temperature will enhance the structural changes by disturbing the bonding between the components of solute.

From table 1,2,3 and fig 2 it shows that intermolecular free length is least in aqueous solution as compare to alcoholic solution with increasing temperature shows strong solute solvent interaction exist in aqueous solution.

Due to hydrogen bonding formation in the aqueous solution of Raboprazole sodium acoustic impedance increases with increasing concentration and temperature shows that strong molecular interaction between solute and solvent molecules in aqueous solution .

3. CONCLUSION

From ultrasonic velocity, density and acoustic parameters it shows that in aqueous solution more voids are present so that solute can goes to solvent cavity more easily and hence more cohesion exist which increases ultrasonic velocity, density, and decreases adiabatic compressibility, free length indicating strong solute solvent interaction present in aqueous solution to that of alcoholic solution. Due to this reactivity of the drug is more in aqueous solution.

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Table1: The experimentally measured values of Velocity (U), Density (ρ), and the calculated values of Adiabatic compressibility (βa), Intermolecular free length (Lf), Acoustic impedance (Z) of aqueous solution of Rabeprazole sodium, concentrations and at 298K.

Concentration	Ultrasonic velocity U (m/s)	Density ρ (kg/m3)	Viscisity $\eta*10^{-3}$ (CP)	Adiabatic Compressibility β_a*10^{-10} (Pa^{-1})	Intermolecular free length L_f*10^{-10} (m)	Acoustic Impedance $Z*10^4$ (kg/m^2s)
T=298Kwater						
0.00025	1501.21	1302.05	0.9201	3.40	0.0117	195.465
0.0005	1515.28	1305.68	0.9215	3.33	0.0116	197.840
0.001	1564.15	1310.15	0.9255	3.12	0.0115	204.90
T=298K ethyl alcohol						
0.00025	1468.25	1301.25	0.9116	3.56	0.0120	191.08
0.0005	1487.36	1299.45	0.9136	3.47	0.0118	193.274
0.001	1531.23	1301.20	0.9163	3.32	0.0115	197.942

Table 2: The experimentally measured values of Velocity (U), Density (ρ), and the calculated values of Adiabatic compressibility (βa), Intermolecular free length (Lf), Acoustic impedance (Z) of aqueous solution of Rabeprazole sodium at concentrations and at 303K

Concentration	Ultrasonic velocity U (m/s)	Density ρ (kg/m3)	Viscisity $\eta*10^{-3}$ (CP)	Adiabatic Compressibility β_a*10^{-10} (Pa^{-1})	Intermolecular free length L_f*10^{-10} (m)	Acoustic Impedance $Z*10^4$ (kg/m^2s)
			T=303Kwater			
0.00025	1536.21	1304.11	0.9212	3.24	0.0113	200.33
0.0005	1565.28	1308.15	0.9226	3.12	0.0110	204.76
0001	1594.15	1312.19	0.9268	2.99	0.0108	209.18
T=303K ethyl alcohol						
0.00025	1498.25	1303.05	0.9124	3.41	0.0115	195.40
0.0005	1520.36	1305.27	0.9139	3.31	0.0114	198.448
0.001	1545.23	1307.18	0.9173	2.98	0.0112	201.989

Table 3: The experimentally measured values of Velocity (U), Density (ρ), and the calculated values of Adiabatic compressibility (βa), Intermolecular free length (Lf), Acoustic impedance (Z) of aqueous solution of Rabeprazole sodium at concentrations and at 308K

Concentration	Ultrasonic velocity U (m/s)	Density ρ (kg/m3)	Viscosity $\eta*10^{-3}$ (CP)	Adiabatic Compressibility β_a*10^{-10} (Pa^{-1})	Intermolecular free length L_f*10^{-10} (m)	Acoustic Impedance $Z*10^4$ (kg/m^2s)
T=308Kwater						
0.00025	1546.21	1306.15	0.9220	3.20	0.0112	201.958
0.0005	158328	1310.28	0.9232	3.04	0.0109	207.457
0001	1598.15	1313.24	0.9278	3.12	0.0108	209.857
		T=308K ethyl alcohol				
0.00025	1509.25	1305.25	0.9131	3.36	0.0124	196.699
0.0005	1527.23	1306.32	0.9142	3.28	0.0113	199.505
0.001	1563.21	1308.22	0.9185	3.12	0.0110	204.502

Fig 1 Ultrasonic velocity at different concentration & temperature

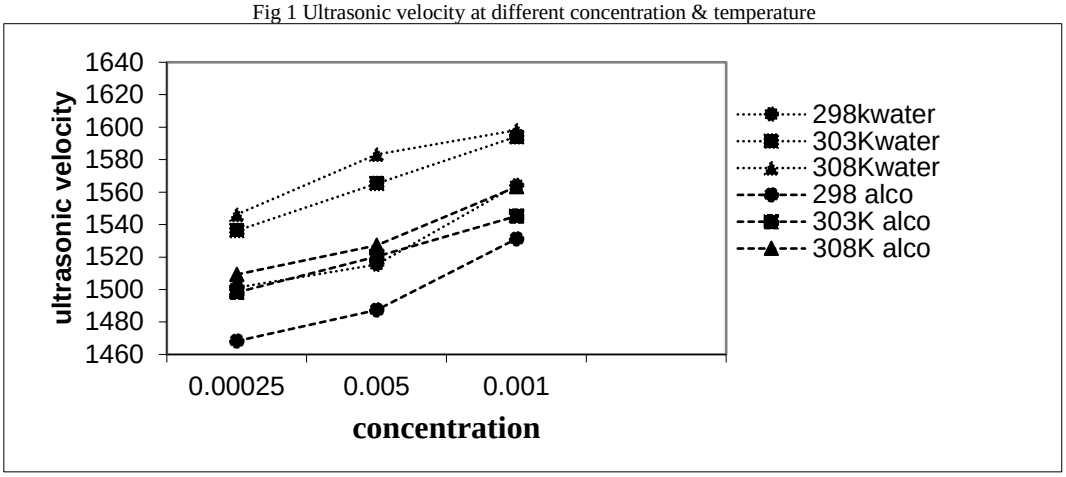

Fig2 Adiabatic compressibility at different concentration & temperature

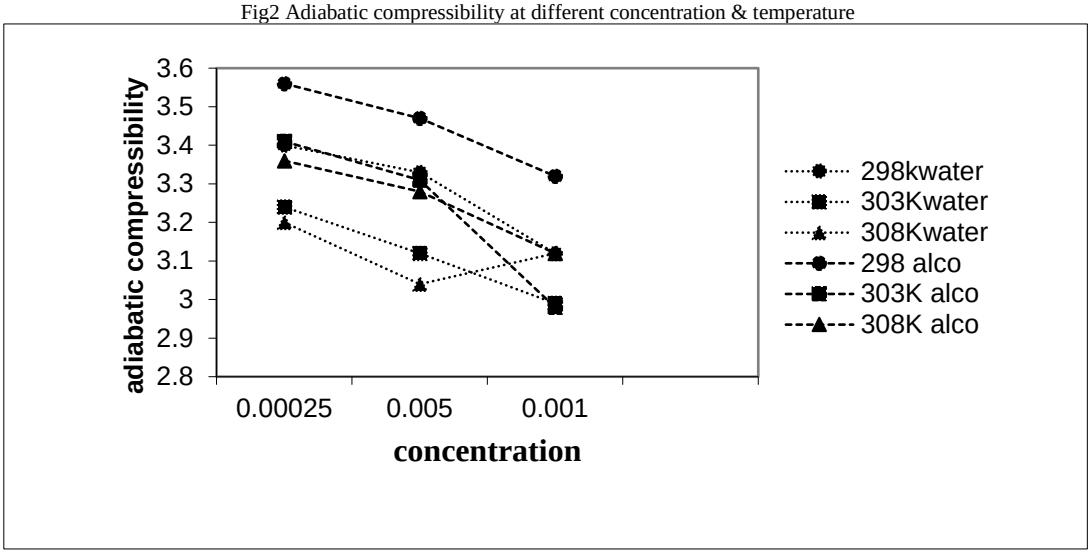

Fig3 Intermolecular free length at different concentration & temperature