Acoustic Studies of Paracetamol and Dichlofenac Sodiumat 2MHz and at 303.15K

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***Abstract*:- The study of molecular interactionfrom various acoustic parameters gives an insight into the molecular process. Internal pressure is important to study the thermodynamic properties of liquids. The internal pressure is the cohesive force, which is a resultant of force of attraction and force of repulsion between the molecules. Paracetamol is used as antipyretic while dichlofenac sodium is analgesic. At different concentrations ultrasonic velocities, densities and viscosities of paracetamol and dichlofenac sodium was measuredat 2MHzand at 303.15K. From experimental values various thermo acoustical parameters like adiabatic compressibility, intermolecular free length, free volume, internal pressure, were calculated. By comparing the values of acoustic parameters of paracetamol and dichlofenac sodium solution molecular interaction was predicted.**

Key words: Acoustic, paracetamol, internal pressure, dichlofenac sodium,free volume

INTRODUCTION:

Characterization of liquid isdone by parameters free volume, internal pressure.The study of liquids and liquid mixtures and internal pressure has been exhaustive since the pioneering work of Vander Waal`s around 1887, who suggested that the shape of the liquid molecules determine the intermolecular interactions[1].The associate natureof water with solute is learnt by its hydration Number[2]. While its structure making or breakingproperty is got from its free volume and internal pressure. To determine these parameters theultrasonic velocity is a simple probe used by physicist along with basic quantities like density and viscosity[3]. The molecular interaction in pure liquid components and their mixtures is studied on the basis of acoustic and thermodynamic properties[4] .Literature survey shows that ultrasonic study of liquid mixture is highly useful in understanding the nature of molecular interaction[5-8].The internal pressure is the cohesive force, which is a resultant of force of attraction and force of repulsion between the molecules. Paracetamol is used as antipyretic while dichlofenac sodium is analgesic. In our work [9-13]in the present investigation the ultrasonic velocity, densityand viscosity of 0.001 M, 0.01M and 0.1M paracetamol solutionand dichlofenac sodium solution at temperature 303.15K ismeasured and acoustic and thermodynamic parameters have been calculated. From theseparameters the effect of concentration and temperature on molecular interactionis interpreted.

EXPERIMENTAL.

The chemicals used were of analytical grade. Double distilled water was used for preparation ofsolutions. A special thermostatic water bath arrangement was made for density, ultrasonicvelocity and viscosity measurements, in which continuous stirring of water was carried out withthe help of electric stirrer and temperature variation was maintained within ± 0.010C Singlecrystal interferometer (Mittal Enterprises, Model F-81) with accuracy of ± 0.03% and frequency2 MHz was used in the present work for measurement of ultrasonic velocities of solutions.Densities of solutions were measured using specific gravity bottle of 10 ml volume. These valueswere accurate up to ± 0.1 kg/m3. All the weighing was made on Roy CCB-4 digital electronicbalance having an accuracy of ± 0.001g. Viscosities of the solution were measured by Ostwald's viscometer.

RESULTS AND DISCUSSION:

From the observed values the adiabatic compressibility,intermolecular free length ,free volumeand internal pressure were calculated.
Adiabatic compressibility was calculated by using the equation

$$\beta = 1/v2.d \quad .....(1)$$

Where, v = velocity & d = density

Intermolecular free length (Lf) is one of the important acoustic properties to study the
intermolecular interactions. It has been evaluated from adiabatic compressibility (β) by
Jacobson's formula,

$$Lf = K. \beta s.....(2)$$

Free volume is calculated by following equation

$$Vf= ([Meffv^{/}/ K\eta)^{3/2} .....(3)$$

Internal pressure is calculated by following equation

$$\pi = bRT (k \eta / u)^{1/2}\rho^{2/3}/M^{7/6}.....(4)$$

Ultrasonic velocity increases in paracetamol and dichlofenac sodium with increasing concentration. But dichlofenac sodium shows high value of ultrasonic velocity shows strong interaction in the solution. The low value of

adiabatic compressibility and free length for dichlofenac sodium indicates formation of hydrogen bonding and hence more interaction in the solution ofdichlofenac sodium.

Internal pressure plays an important role in explaining molecular interaction, as this represents the resultant of the forces of attraction and repulsion between the molecules. As observed, internal pressure (Pi) decreases with concentration. It is noted that the internal pressure may give information regarding the nature and strength of forces existing between the molecules.Nonlinear variation of internal pressure shows existence of molecular interaction in both the solution. The decrease of Vf indicates the formation of hard or tight solvation layer around the ion and increase of Vf may be due formation of thin or loose solvation layer[14]. In dichlofenac sodium free volume is slightly increases compare to paracetamol at 0.001M concentration shows loose solvation layer is formed in dichlofenac sodium solution showingsomedipoleinduceddipoleinteractionbetween solute and solvent molecules.More interaction is observed inthe dichlofenac sodium.

Table 1.Acoustic parameters of aqueous solution of Paracetamol at 2MHz

Concentration (M)	**Ultrasonic velocity (m/s)**	**Density (Kg/m^3)**	**Viscosity $\eta x10^{-3}$ (NSm^{-2})**
0.001	1490.05	1020.52	0.8391
0.01	1526.26	1024.59	0.8511
0.1	1556.39	1029.31	0.8904

Table 2 Acoustic parameters of aqueous solution of Paracetamol at 2MHz

Concentration **(M)**	Adiabatic compressibility **$\beta x10^{-10}$**	Intermolecular free length **L_f (A^0)**	Free volume $V_f x\ 10^{-8}$	Internal Pressure $\pi x10^5$
0.001	4.41	0.0131	1.206	318.488
0.01	4.19	0.0128	1.279	317.327
0.1	4.00	0.0125	1.435	329.134

Table 3.Acoustic parameters of aqueous solution of Dichlofenac sodium at 2MHz

Concentration (M)	**Ultrasonic Velocity (m/s)**	**Density (Kg/m^3)**	**Viscosity $\eta x10^{-3}$ (NSm^{-2})**
0.001	1524.48	1009.61	0.8215
0.01	1563.58	1020.58	0.8567
0.1	1601.30	1038.83	0.9642

Table 4 .Acoustic parameters of aqueous solution of Dichlofenac sodium at 2MHz

Concentration **(M)**	Adiabatic compressibility **$\beta x10^{-10}$**	Intermolecular free length **L_f (A^0)**	Free volume $V_f x\ 10^{-8}$	Internal Pressure $\pi x10^5$
0.001	4.26	0.0129	1.20	314.87
0.01	4.00	0.0125	1.34	313.518
0.1	3.75	0.0121	1.43	324.483

CONCLUSION:

High value of ultrasonic velocity, low values of adiabatic compressibility, intermolecular free length,internal pressure in dichlofenac sodium shows moremolecular interaction more than paracetamolat 303.15K.

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