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Short Communication

ULTRASONIC INVESTIGATION OF ION-SOLVENT INTERACTIONS OF DRUG IN NON-AQUEOUS MEDIUM

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ABSTRACT

The study of molecular interactions in the solutions and liquids are of considerable importance and has been undertaken by many researches now-a-days. Many physical methods are employed to study the physical properties of liquids/solutions. They are ultrasonic, thermodynamic, thermochemical and spectroscopic methods. Ultrasonic velocity measurements are highly sensitive to molecular interactions and used to provide qualitative information about the nature and strength of the intermolecular / inter- ionic interactions. Diseases in human beings and animals may be caused by a variety of microorganisms. Antibiotics, antiseptic and disinfectants are prescribed as drugs. The drug-solvent interactions play an important role in the understanding of drug action. The term "Sulfanilamides" (Sulphanilamide) is also used to describe a family of molecules containing these functional groups. Sulphanilamide reduces vaginal burning, itching and discharge that may occur with this condition. Sulfamerazine is also a sulfonamide antibacterial agent. It is bacteriostatic in nature. Inhibition of dihydrofolic acid synthesis decreases the synthesis of bacterial nucleotides and DNA. In the present investigation, the solutions of different molalities were prepared with the samples in non-aqueous medium and the experiments were carried out from low concentration to higher concentration, at different temperatures. The measured values of density, viscosity and ultrasonic velocity were used to compute adiabatic compressibility and specific acoustic impedance. An attempt is made to identify the entry solvate into the samples and the entry of biological molecules into the solvate which supports to identify the molecular structure. From the experimental data of ultrasonic velocity, density and viscosity, calculated the acoustical parameters.

Keywords: Ion-Solvent Interactions, Ion-Ion Interactions , Sulfa Drug, Adiabatic Compressibility, Specific Acoustic Impedance

1. INTRODUCTION

Many approaches and spectroscopic techniques such as X-ray crystallography, chromatography, NMR, ESR, vibration and Raman spectroscopy, neutron & light scattering, circular dichroism (CD), IR and ultrasonic velocity measurements are used to determine the structure - function relationship of biomolecules.

Among these techniques, ultrasonic velocity measurements have been found to be most powerful tool in the investigation of structure, the thermodynamic properties and predict the intermolecular interactions in pure liquid [1], liquid mixtures [2-5] and ionic interactions in electrolytic solutions [6, 7]. Though the molecular interactions studies can be best carried out through spectroscopic methods [8, 9] the other non spectroscopic techniques such as dielectric and magnetic [10-11] are also used.

Ultrasonic velocity and viscosity [12-18] measurements have been widely used in field of interactions and structural aspect evaluations studies. In the present work, the solutions of various molalities were prepared by adding the samples of sulfa drugs with definite weight to the measured quantities of the solvent (Formamide). The weight of the samples were measured by using a digital balance with an accuracy of ±0.0001gm, the experiment has been carried out at various temperatures ranging from 278.15K to 328.15K.

2. MATERIALS AND METHODS

The solutions of different molalities of sulphanilamide and sulfamerazine were prepared with AR grade formamide. Density of the solution was measured with 25ml of specific gravity bottle by a Digital balance of accuracy of 0.0001gm/cc.

Cannon fenske viscometer was used for the viscosity measurements, and the time was noted by stop watch with an accuracy of ± 0.1sec. Mittal's interferometer of frequency to 2MHz, with an accuracy of ± 2 m/s was used.

Acoustical parameters were evaluated by the following formulae.

(I) Adiabatic compressibility $(\beta) = [1/u2\rho]$ (TPa^{-1})

(II) Specific acoustic impedance $(Z) = \rho u$ $(Kgm^{-2}S^{-1})$

3. RESULTS AND DISCUSSIONS

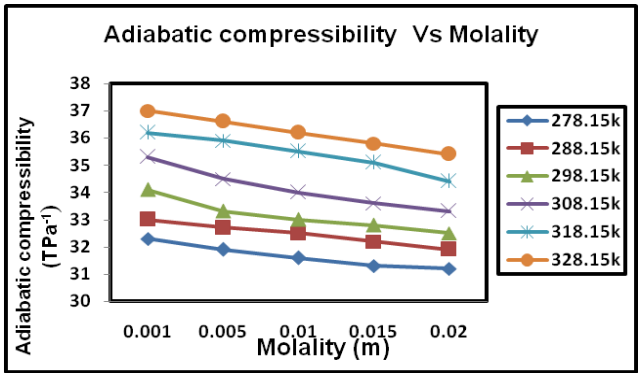
The adiabatic compressibility value of sulphanilamide decreases with the increase of molality. It increases with rise of temperatures [19] as shown in the table 1 and fig. 1.

When the salt is added to the solvent, the compressibility is lowered. This lowering is attributed to the influence of the electrostatic field of the ions on the surrounding molecules. Such a decrease may be due to (i) an increase in the number of incompressible molecule [20-22].

(ii) structural changes occurring in the solution. This may be due to the association taking place between the molecules. When the temperature increases, the associated groups of molecules breakdown increases and the forces of attraction between the molecules decrease. This leads to an increase in the adiabatic compressibility of the system [23].

Table 1: Adiabatic Compressibility (Tpa^{-1}) of Sulphanilamide

Molality(m)	278.15K	288.15K	298.15K	308.15K	318.15K	328.15K
0.001	32.3	33.0	34.1	35.3	36.2	37.0
0.005	31.9	32.7	33.3	34.5	35.9	36.6
0.01	31.6	32.5	33.0	34.0	35.5	36.2
0.015	31.3	32.2	32.8	33.6	35.1	35.8
0.02	31.2	31.9	32.5	33.3	34.4	35.4



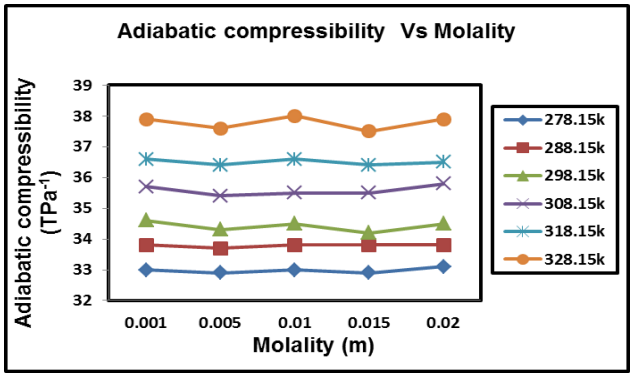


Fig. 1 & 2: Adiabatic Compressibility of Sulphanilamide and Sulfamerazine

Table 2: Adiabatic Compressibility (Tpa^{-1}) of Sulfamerazine

Molality(m)	278.15K	288.15K	298.15K	308.15K	318.15K	328.15K
0.001	33.0	33.8	34.6	35.7	36.6	37.9
0.005	32.9	33.7	34.3	35.4	36.4	37.6
0.01	33.0	33.8	34.5	35.5	36.6	38.0
0.015	32.9	33.8	34.2	35.5	36.4	37.5
0.02	33.1	33.8	34.5	35.8	36.5	37.9

The rise and fall is observed in adiabatic compressibility of Sulfamerazine, accounted for some abrupt changes at 0.01 molality as shown in the table 2 and fig. 2. This may be due to pre-dominance of dissociation of molecules occurring in the solution.

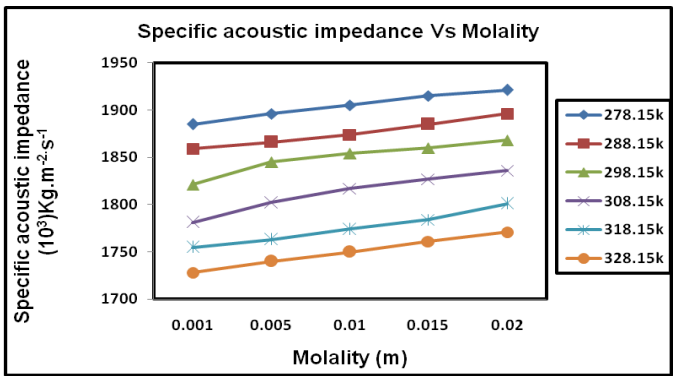
The decreasing trend of compressibility may be due to the rupture of hydrogen bond strength formed between the drug-amide molecules [24]. In the present work, the specific acoustic impedance 'Z' decreases with increasing temperature and increases with increasing solute

concentration for these samples sulphanilamide are shown in the table 3 and fig. 3. These variations of 'Z' with a change in temperature and concentration are consistant with that shown by ultrasonic velocity. This increasing value of specific acoustic impedance supports the possibility of molecular interactions between unlike molecules [25].

But in the case of sulfamerazine there is an abrupt change occurred at 0.01 molality as shown in the table 4 and fig. 4. This may be due to the weak drug-amide interactions prevailing in the solution. 'Z' shows similar behaviour to that of ultrasonic velocity and opposite to that of adiabatic compressibility [26].

Table 3: Specific Acoustic Impedance (10^3) KG.M^{-2}.S^{-1} Sulphanilamide

Molality (m)	278.15K	288.15K	298.15K	308.15K	318.15K	328.15kK
0.001	1885	1859	1821	1781	1755	1728
0.005	1896	1866	1845	1802	1763	1740
0.01	1905	1874	1854	1817	1774	1750
0.015	1915	1885	1860	1827	1784	1761
0.02	1921	1896	1868	1836	1801	1771



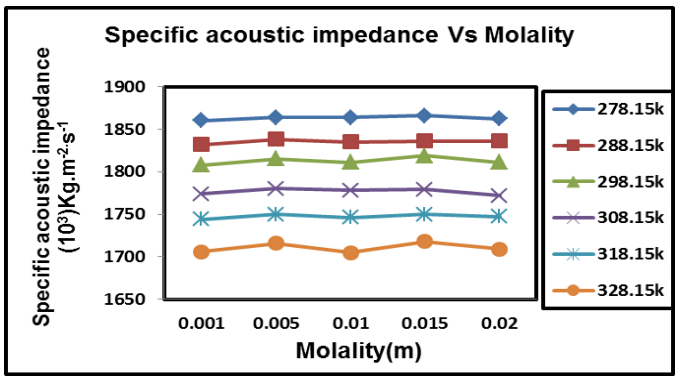


Fig. 3 & 4: Specific Acoustic Impedance of Sulphanilamide and Sulfamerazine

Table 4: Specific Acoustic Impedance (10^3) KG.M^{-2}.S^{-1} Sulfamerazine

Molality (m)	278.15K	288.15K	298.15K	308.15K	318.15K	328.15K
0.001	1860	1832	1808	1774	1744	1706
0.005	1864	1838	1815	1780	1750	1716
0.01	1864	1835	1811	1778	1746	1705
0.015	1866	1836	1819	1779	1750	1718
0.02	1862	1836	1811	1772	1747	1709

4. CONCLUSION

Sulphanilamide compounds identified as chemotherapetic agents possess broad spectrum of biological properties [27].The detailed study of acoustical parameters suggests that there is a molecular association existing in the solution.The addition of solute into the solvent brings about a strong solute-solvent occur in the case of sulfanilamide solution. But in the case of abrupt changes in the sulfamerazine solution,there is a weak drug amide action occurs in the solution.

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