A COMPARATIVE STUDY OF ACOUSTICAL PARAMETERS OF SULFA DRUGS IN NON-AQUEOUS MEDIUM

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ABSTRACT

Measurement of ultrasonic velocity in non-aqueous electrolytic solution gives information about the behaviour of solution such as molecular association and disassociation. The attraction and repulsion between the molecules of the components involved show considerable effect upon the physical and chemical properties of a solution such as density, viscosity and ultrasonic velocity. The study of solute-solvent interaction in the present investigation is of great importance in biological chemistry, physical chemistry, environmental chemistry and geo chemistry. In the case of Liquid state study, viscometric properties provide valuable ideas 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 (intra and extracellular) membranes. Therefore, it may be interesting to investigate the variation of their properties with concentration for understanding the mechanism of drug action. The measured values of density and ultrasonic velocity, viscosity were used to compute the acoustical parameters such as adiabatic compressibility and specific acoustic impedance. An attempt is made to identify the entry of solvate into the samples and entry of biological molecules into the solvate which supports to identify the molecular structure.

Key words: Amides, ion-solvent interactions, solute-solvent interactions, adiabatic compressibility, specific acoustic impedance.

INTRODUCTION:

Ultrasound is a novel and challenging method that is being developed for bio molecules where non-invasive technique is of great interest. Diseases in human beings and animals may be caused by a variety of microorganisms. Antibiotics, antiseptic and disinfectants are prescribed as drugs. Amides are also drugs such as sulfa drugs. The drug-solvent interactions plays an important role in the understanding of drug action. In the recent years, ultrasonic technique provides information regarding the behaviour of liquids and solids owing to its ability of characterizing physico-chemical behaviour of the medium [1-3]. Many researchers have studied the behaviour of aqueous solutions [4-6]. But only a few attempts appear to have been made in non-aqueous medium [7,8].

The accurate measurement of density, viscosity, ultrasonic velocity and the acoustical parameters such as adiabatic compressibility and specific acoustic impedance will give significant information regarding the state of affairs in a solution [9].The ultrasonic study is also useful to understand the behaviour of biomolecules [10]. The non -aqueous solutions of Benzene sulphonamide and Sulfamerazine are prepared with different molalities and the experiment were carried out from 278.15K, 288.15K, 298.15K.308.15K, 318.15K and 328.15K.

Benzene sulphonamide is one of the sulfa drug used in the treatment of gastrointestinal, duodenyl ulcer and neurological disorder. It is an inhibitor of human carbonic anhydrase [11,12]. Sulfamerazine is also a sulfonamide antibacterial agent. The present work dealts with the ultrasonic investigation and acoustical study of amides in formamide.

MATERIALS AND METHODS: .

The solutions of different molalities of Benzene sulphonamide and Sulfamerazine are prepared with AR grade formamide. Density of the solution is measured with 25ml of specific gravity bottle by a Digital balance of accuracy of .0001gm/cc. Cannonfenske viscometer is used for the viscosity measurements, and the time is noted by stop watch with an accuracy of ± 0.1sec. Ultrasonic velocity of the solution is calculated by using Mittal's interferometer of frequency to 2MHz, with an accuracy of ± 2 m/s is used.

The following acoustical Parameters are Computed by using the formulae.

(i) Adiabatic compressibility (β) = [1/u2ρ] (TPa^{-1})

(ii) Specific acoustic impedance (Z) = ρu $(Kgm^{-2}S^{-1})$

Where 'u'is the ultrasonic velocity of the solution and 'ρ' is the density of the solution.

RESULTS AND DISCUSSIONS:

The orientation of solvent molecules around the solute is determined by adiabatic compressibility [13].The adiabatic compressibility is a measure of intermolecular association or dissociation or repulsion [14].

The adiabatic compressibility increases with the molality changes and rise in temperature [15]That means 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 solvent molecules, such a decrease may be due to (i) an increase in the number of incompressible molecule[16,17,18].

(ii) The structural changes occurring in the solution. This may due to the association taking place between the molecules. When the temperature increases, the associated groups of molecules breakdown increasingly and the forces of attraction between the molecules decrease. This leads to an increase in the adiabatic compressibility of the system [19].

TABLES AND FIGURES

Adiabatic compressibility (Tpa^{-1})

Table (1) Benzene Sulphonamide

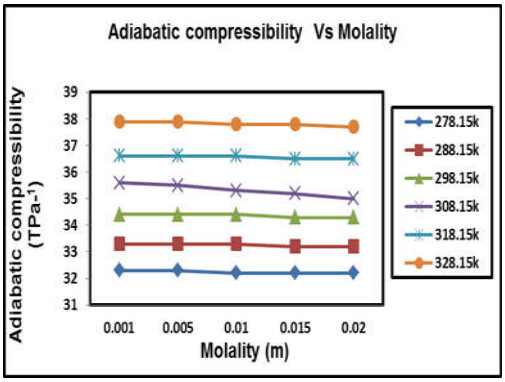
Molality(m)	278.15 K	288.15 K	298.15 K	308.15 K	318.15 K	328.15 K
0.001	32.3	33.3	34.4	35.6	36.6	37.9
0.005	32.3	33.3	34.4	35.5	36.6	37.9
0.01	32.2	33.3	34.4	35.3	36.6	37.8
0.015	32.2	33.2	34.3	35.2	36.5	37.8
0.02	32.2	33.2	34.3	35	36.5	37.7

Adiabatic compressibility (Tpa^{-1})

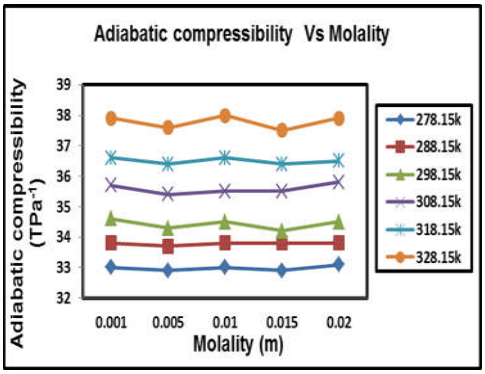
Table (2) Sulfamerazine

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

Figure (1) Benzene Sulphonamide



Figure(2) Sulfamerazine



Specific acoustic impedance (10^3)Kg.m^{-2}s^{-1}

Table (3) Benzene Sulphonamide

Molality (m)	278.15K	288.15K	298.15K	308.15K	318.15K	328.15K
0.001	1884	1848	1814	1774	1748	1711
0.005	1887	1849	1815	1776	1748	1713
0.01	1887	1850	1815	1783	1749	1714
0.015	1887	1854	1817	1787	1751	1714
0.02	1889	1857	1818	1792	1753	1716

Specific acoustic impedance (10^3) Kg.m^{-2}s^{-1}

Table (4) 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

Figure (3) Benzene Sulphonamide

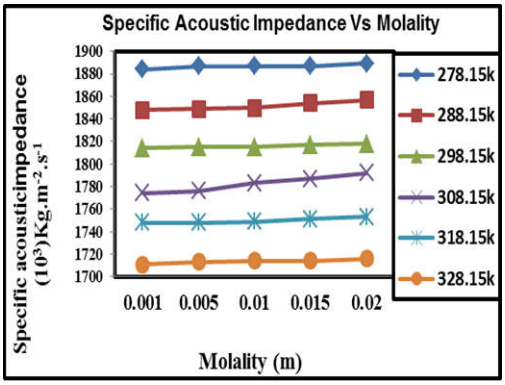
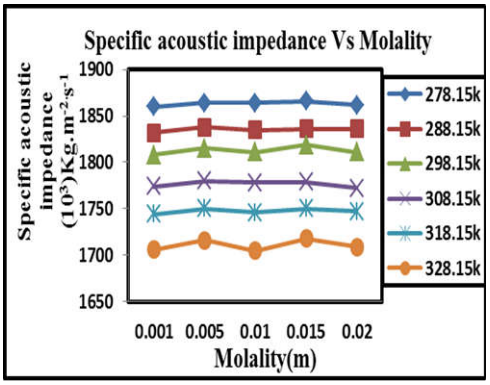


Figure (4) Sulfamerazine



The acoustical parameters, explain the nature and strength of the interactions taking place in the drug-amide solutions. Several workers have explained the acoustic properties to understand the molecular interactions of pure liquids and solutions[20-23].The variations of the acoustical parameters of sulfa drugs due to a change in temperature and molality are given in the tables (1,2) and (3,4)and the figures(1,2) and (3,4). In the present investigation, the adiabatic compressibility is found to decrease with increase in concentrations for the system Benzene Sulphonamide, as shown in table(1) and figure(1).The lowering is attributed due to the influence of the electrostatic field of the ions on the surrounding solvent molecules. Such a decrease may be due to (i) an increase in the number of incompressible molecules [24-26] and (ii) the structural change occurring in the solution. This may be due to the association taking place between the solute and the solvent. The rise and fall is observed in adiabatic compressibility of Sulfamerazine accounted for some abrupt changes at .01 molality as shown in the table(2) and figure (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 [27]. In the present work, the Specific acoustic impedance 'Z' decreases with increasing temperature and increases with increasing solute concentration of Benzene Sulphonamide as shown in the table(3) and Figure(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 [28].But in the case of Sulfamerazine there is an abrupt change occurred at .01 molality as shown in the table(4) and figure (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 [29].

CONCLUSION:

Sulphanilamide compounds identified as chemotherapeutic agents, possess broad spectrum of biological properties [30].The basic parameter values and the calculated values of acoustical parameters of Benzene sulphonamide have suggest that the existence of powerful molecular interaction in the solutions. Fairly good correlations are observed between the studied parameters. Some abrupt changes of Sulfamerazine exhibit a weak drug-amide interactions. The linear or nonlinear increases or decreases of acoustical parameters indicate the existence of strong molecular interactions in the solutions that depend on the molecular structure.

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