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# ULTRASONIC VELOCITY, DENSITY MEASUREMENT OF DRUG IN DMSO-WATER AT 303.15 K

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**ABSTRACT**
The acoustical properties have been investigated from the ultrasonic velocity and density measurements of substituted heterocyclic drugs 9-methyl-3-[(2-methyl-1H-imidazol-1-yl)methyl]-2,3-dihydro-1H-carbazol-4(9H)-one in 20% DMSO at 303.15K. The measurement have been perform to evaluate acoustical parameter such as adiabatic compressibility (□s), Partial molal volume (□v), intermolecular free length (Lf), apparent molal compressibility (□k), specific acoustic impedance (Z), relative association (RA), solvation number (Sn).

**KEYWORD:** Ultrasonic velocity, viscosity, adiabatic compressibility, apparent molal volume.

## INTRODUCTION

The selected drug used to prevent nausea and vomiting caused by chemotherapy, radiation therapy, migraines, or surgery.[1] In the recent years, measurements of the Ultrasonic velocity are helpful to interpreted solute-solvent, ion-solvent interaction in aqueous and non-aqueous medium.[2-7] The researcher have been studied the acoustical properties of complex in water. Jahagirdar et. al. has studied the acoustical properties of four different drugs in methanol and he drawn conclusion from adiabatic compressibility.[6] The four different drugs compress the solvent methanol to the same extent but it shows different solute-solvent interaction due to their different size, shape and structure.[7] An studies the different acoustical properties of some substituted Pyrazolines in binary mixture acetone-water and observed variation of ultrasonic velocity with concentration.[8] Have investigated the measurement of ultrasonic velocity and density of amino acid in aqueous magnesium acetate at constant temperature.[9] The ion-dipole interaction mainly depends on ion size and polarity of solvent. The strength of ion-dipole attraction is directly proportional to the size of the ions, magnitude of dipole. But inversely proportional to the distance between ion and molecules. Researcher has been studied the structural properties of solution of lanthanide salt by measuring ultrasonic velocity.[10] Studied the ultrasonic velocity of PEG-8000, PEG- study of acoustical properties of substituted heterocyclic compounds under suitable condition.[11] Investigator have studied the acoustical and thermodynamic properties of citric acid in water at different temperature.[12] Researcher have investigated ultrasonic velocity and density in non aqueous solution of metal complex and evaluate acoustic properties of metal complex.[13] Have determined the acoustic properties for the mixture of amines with amide in benzene at 303K-313K. They also determined thermodynamic parameters.[14] The researcher have studied the different acoustical parameters of binary mixture of 1-propanol and water.[15] Invertigator studied the molecular interaction between liquids.[16]

The present detail study of substituted heterocyclic drug under identical set of experimental condition is still lacking. It was thought of interest to study the acoustical properties of substituted heterocyclic drug under suitable condition.

**Experimental:** In the present study, the drugs Ondansetron was used. DMSO was purified by Vogel's standard method.[17] The double distilled dioxane was used for preparation of different concentration of drug solution. The densities were determined by using specific gravity bottle by relative measurement method with accuracy □ $1x10^{-5}$ gm/cm$^3$. The ultrasonic velocities were measured by using ultrasonic interferometer having

frequency 3MHz. The constant temperature was maintained by circulating water through the double wall measuring cell, made up of steel.

In the present investigation, different properties such as adiabatic compressibility (□s), apparent molal volume (□$_v$), intermolecular free length ($L_f$), apparent molal compressibility (□□), specific acoustic impedance (Z), relative association ($R_A$), solvation number($S_n$), limiting apparent molal compressibility (□°□), limiting apparent molal volume(□°$_v$) and their constant ($S_k$, $S_v$).

**RESULTS AND DISCUSSION**

In the present investigation, different acoustical properties such as ultrasonic velocity (Us), adiabatic compressibility (□s), intermolecular free length ($L_f$), specific acoustic impedance (Z), are listed in table-1. Partial molal volume (□$_v$), apparent molal compressibility (□□), relative association ($R_A$), solvation number (Sn) are listed in table-2. Limiting apparent molal compressibility (□°□), limiting apparent molal volume□□°$_v$) and their constant ($S_k$, $S_v$) are listed in table-3. It was found that the ultrasonic velocity decreased with the increase in concentration for system (Table-1). Variation of ultrasonic velocity in solution depends upon the increase or decrease of molecular free length after mixing the component. This is based on a model for sound propagation proposed. Intermolecular free length increased linearly on increase in concentration of substituted heterocyclic drugs Ondansetron in 20% DMSO. Hence, decreased in ultrasonic velocity with increase in concentration of drug. It happened because there was significant interaction between ions and solvent molecules suggesting a structure promoting behavior of the added electrolyte. The specific acoustic impedance (Z) increased with the decrease in concentration of drug in 20% DMSO. When concentration of electrolyte was increased, the thickness of oppositely charged ionic atmosphere increases due to decrease in ionic strength. This is suggested by decrease in acoustic impedance with concentration in system. It was seen that the intermolecular free length increased with the increase in concentration in system. The intermolecular free length increased due to greater force of attraction between solute and solvent by forming hydrogen bonding. The adiabatic compressibility increased with the increase in concentration of solution. It happened due to collection of solvent molecule around ions, this supporting weak ion-solvent interaction. This indicates that there is significant solute-solvent interaction.

It was observed that apparent molal volume increased with concentration in system. It indicates the existence of strong ion-solvent interaction. It was found that the value of apparent adiabatic compressibility was increased with the increase in concentration of Ondansetron in dioxane. It shows strong electrostatic attractive force in the vicinity of ions. From the data, we were concluded that strong molecular association was found in Ondansetron. The value of relative association increased with the increase in concentration in system. It has been found that there was strong interaction between solute and solvent. There were regular increases in solvation number with the increase in concentration; it indicates the solvent molecule forms strong coordination bond in primary layer. It indicates the increase in size of secondary layer of Solvation. The value of $S_k$ exhibits positive. It indicates the existence of ion-ion or solute-solute interactions in Acarbose system. The value of $S_k$ exhibits positive, it indicates the strong existence of ion-ion or solute-solute interactions. From table-3, it was found that the value of limiting apparent molal volume was positive. It indicates that the ion-dipolar interaction in Ondansetron and DMSO. The positive value of Sv indicates the strong solute-solvent interaction. These value indicates an induced effect of DMSO on solute-solvent interaction. The value of $S_k$ and Sv has been determine from fig. 1 and 2.

**Table 1: Ultrasonic velocity, density, adiabatic compressibility (□$_S$), Specific acoustic impedance (Z) Intermolecular free length ($L_f$).**

| Concentration moles lit$^{-1}$ (m) | Density (ds) kg m-$^3$ | Ultrasonic velocity (Us) m s$^{-1}$ | Adiabatic compressibiliy □□□□ x10$^{-10}$ m$^2$N$^{-1}$ | Intermolecular free length ($L_f$) x10$^{-11}$ m | Specific acoustic impedance (Zx10$^6$) kg m$^{-2}$ s$^{-1}$ |
|---|---|---|---|---|---|
| **Ondansetron + 20% DMSO** | | | | | |
| 1x10$^{-3}$ | 1031.96 | 1574.90 | 3.86039 | 3.95175 | 1.634576 |
| 2x10$^{-3}$ | 1032.26 | 1569.92 | 3.88374 | 3.96328 | 1.629867 |
| 3x10$^{-3}$ | 1032.53 | 1560.56 | 3.92918 | 3.98640 | 1.620619 |
| 4x10$^{-3}$ | 1032.79 | 1543.76 | 4.01360 | 4.02900 | 1.603689 |
| 5x10$^{-3}$ | 1033.05 | 1529.26 | 4.08850 | 4.06642 | 1.589139 |
| 6x10$^{-3}$ | 1033.32 | 1516.36 | 4.15693 | 4.10031 | 1.576188 |
| 7x10$^{-3}$ | 1033.56 | 1502.98 | 4.23008 | 4.13622 | 1.562645 |
| 8x10$^{-3}$ | 1033.74 | 1488.25 | 4.31283 | 4.17650 | 1.547717 |
| 9x10$^{-3}$ | 1033.93 | 1470.12 | 4.41913 | 4.22840 | 1.528989 |

**Table 2: Concentration (m), Relative association ($R_A$), Apparent molal compressibility ($\phi_k$), Apparent molal volume ($\phi_v$), Solvation number ($S_n$)-.**

| Concentration(m) moles lit$^{-1}$ | Apparent molal volume ($\phi_v$) m$^3$mole$^{-1}$ | Apparent molar compressibility ($\phi_k$x10$^{-10}$) m$^2$ N$^{-1}$ | Relative association ($R_A$) | Solvation number ($S_n$) |
|---|---|---|---|---|
| 1x10$^{-3}$ | 0.15252 | 1.75164 | 1.003824 | 1.013789 |
| 2x10$^{-3}$ | 0.16189 | 1.76176 | 1.005513 | 1.019651 |
| 3x10$^{-3}$ | 0.17438 | 1.78199 | 1.008593 | 1.031367 |
| 4x10$^{-3}$ | 0.18296 | 1.81996 | 1.014099 | 1.053358 |
| 5x10$^{-3}$ | 0.18809 | 1.85359 | 1.018945 | 1.072835 |
| 6x10$^{-3}$ | 0.18991 | 1.88423 | 1.023301 | 1.090579 |
| 7x10$^{-3}$ | 0.19524 | 1.91707 | 1.027867 | 1.109599 |
| 8x10$^{-3}$ | 0.20628 | 1.95436 | 1.032956 | 1.131196 |
| 9x10$^{-3}$ | 0.21381 | 2.00233 | 1.039303 | 1.158978 |

**Table 3: Limiting Apparent molal compressibility ($\phi_k^0$), Limiting Apparent molal volume.**

| Drugs | Limiting Apparent molal volume ($\phi_v^0$) m$^3$mole$^{-1}$ | Limiting Apparent molal compressibility ($\phi_k^0$)x 10$^{-9}$ m$^2$ N$^{-1}$ | $S_v$ m$^3$kg$^{1/2}$ mole$^{-3/2}$ | $S_k$ m$^3$mole$^{-2}$kg. N$^{-1}$ |
|---|---|---|---|---|
| Ondansetron | 0.1492 | 1.6980 | 7.1166 | 31.917 |

($\phi_v^0$), $S_v$ and $S_k$

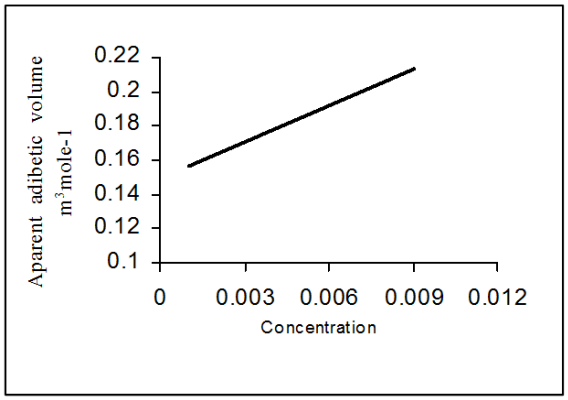


**Fig. 1: Apparent molal volume (m3mole-1) Concentration (mole lit.-1)**

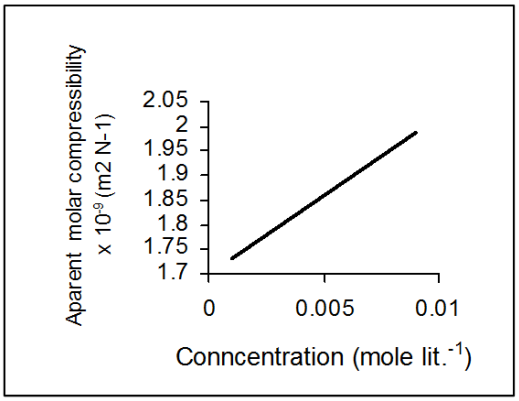


**Fig. 2: Aparent molar compressibility10-9 Vs (m2 N-1) Vs Concentration (mole lit.-1).**

## CONCLUSION

The present study shows the experimental data for ultrasonic velocity, density and viscosity at 300.15K for substituted heterocyclic drug in 20% DMSO. From experimental data, the acoustical properties were calculated. The solute-solvent interaction and ion-ion / solute-solute interaction existing between drugs and DMSO were also studied with the help of experimental data. Lastly it has been concluded from the experimental data, that the solute-solvent interaction in drug - DMSO systems are weak.

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