ISSN NO: 2249-3034

Ultrasonic Investigation in Aqueous Solution of Artesunate at Different Temperatures and Concentrations

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ABSATRACT:

Now days ultrasonic velocity plays an important role to understand molecular interaction in the solution. Drugs are the compound which is used to treat diseases. Artesunate is antimalarial drug. Ultrasonic velocity, density and viscosities of aqueous solution of Artesunate were measured at different concentrations and at different temperatures. From the experimental values thermodynamic parameters were calculated. From it molecular interaction predicted.

Key Words: antimalarial, artesunate, ultrasonic, molecular interaction.

INTRODUCTION

Now a day's interpreting solute-solvent, ion-solvent interaction in aqueous and non-aqueous medium was helpful from Ultrasonic velocity measurements in recent year. The acoustical properties of drugs in water have been studied and drawn conclusion from adiabatic compressibility [(1)].

Pharmaceutical and medicinal industry seek understanding of a drug's physio-chemical behaviour and intermolecular interaction with a solvent. The drug-solvent molecular interaction and its temperature dependence play an important role in the understanding of drugs action [(2)].

Ultrasound waves are similar to sound waves, where both travel through a medium. Ultrasonic is the science of acoustics and the technology of sound. The frequency range of ultrasonic wave is greater than 20 kHz up to several MHz which is beyond the audible limit. Ultrasonic studies at low amplitude provide valuable information regarding the structure and interaction taking place in pure liquids and multi component liquid mixtures [(3)].

Ultrasonic velocity depends on material density and elasticity. Ultrasonic method has become pa powerful tool in providing information regarding the physio-chemical properties of liquid system [(4)]. Ultrasonic study is the important research topic and its usefulness in the fields of biology, biochemistry, engineering, geography, geology medicine and polymer industry is found very interesting. Ultrasonic velocity (U), together with density (ρ) and viscosity (η) data furnishes a wealth of information about bulk properties and technological processes Ultrasonic techniques are best suited for physicochemical studies. The measurements of ultrasonic waves are useful in study of molecular interactions in liquids, which provides valuable information regarding internal structure, complex formation, internal pressure and molecular association [(5)].

ISSN NO: 2249-3034

This technology as a more economic, efficient, convenient and flexible approach for oil characterization in comparison to conventional method and would fulfil needs of oilseed industry in the recent years, the measurement of ultrasonic velocity and attenuation coefficient has been adequately employed in understanding biological effects induced by ultrasound in macromolecules, microorganisms, tissues, organs and bones [6] etc.

The study of carbohydrates and saccharides has become a subject of increasing interest because of the multidimensional, physical, biomedical and industrially useful properties of these compounds [7].

In the present paper ultrasonic velocity, density and viscosities of aqueous solution of Artesunate at different concentration and different temperature were measured. From the above velocity and viscosity, we can calculate the thermodynamic parameters such as adiabatic compressibility, acoustic impedance and intermolecular free length etc. from these parameter reactivity and molecular interaction of the drug is predicted [8].

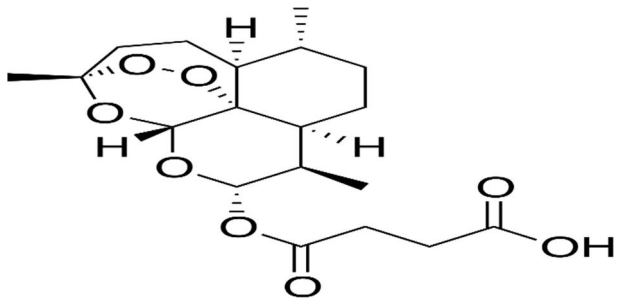

Fig. 1 Structure of Artesunate

EXPERIMENTAL:

The ultrasonic velocity (U) in liquid mixtures are measured by preparing purified AR grade samples and reading was taken by ultrasonic interferometer(Mittal type, Model F-81) working at 2MHz frequency and at temperature 298K, 303k and 308k. the accuracy of sound velocity was ±0.1 ms^{-1}.an electronically digital operated 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 liquids and liquid mixtures was determined using density bottle by relative measurement method with an accuracy of ±0.1 Kgm^{-3}.

RESULT AND DISCUSSION

Table: 1 Ultrasonic velocities, densities, viscosities adiabatic compressibility's, intermolecular free length acoustic impedance of aqueous solution of Artesunate at different concentration and at 298k.

ISSN NO: 2249-3034

Sr. no	Concentration (M)	Ultrasonic velocity (m/s^{-1})	Density ($kg.m^{-3}$)	Viscosity ($N.s.m^{-2}$)	Adiabatic compressibility 10^{-10} $N^{-1}.m^2$	Intermoliculara free length 10^{-11} (m)	Specific impedance 10^{10}
1	0.001	1350.6	1050	0.9597	5.22	0.0143	141.81
2	0.01	1360.8	1052	0.9906	5.13	0.0142	143.15
3	0.1	1376.8	1053.6	1.002	5.01	0.0140	145.05

Table: 2 Ultrasonic velocities, densities, viscosities adiabatic compressibility's, intermolecular free length acoustic impedance of aqueous solution of Artesunate at different concentration and at 303k.

Sr. no	Concentration (M)	Ultrasonic velocity (m/s^{-1})	Density ($kg.m^{-3}$)	Viscosity ($N.s.m^{-2}$)	Adiabatic compressibility 10^{-10} $N^{-1}.m^2$	Intermoliculara free length 10^{-11} (m)	Specific impedance 10^{10}
1	0.001	1362.2	1045.6	0.8832	5.15	0.0142	142.43
2	0.01	1372.5	1049.6	0.8957	5.05	0.0141	144.06
3	0.1	1382.2	1052.4	0.9256	4.97	0.0139	145.46

Table: 3 Ultrasonic velocities, densities, viscosities adiabatic compressibility's, intermolecular free length acoustic impedance of aqueous solution of Artesunate at different concentration and at 308k.

Sr. no	Concentration (M)	Ultrasonic velocity (m/s^{-1})	Density ($kg.m^{-3}$)	Viscosity ($N.s.m^{-2}$)	Adiabatic compressibility 10^{-10} $N^{-1}.m^2$	Intermoliculara free length 10^{-11} (m)	Specific impedance 10^{10}
1	0.001	1373.52	1042.4	0.7289	5.08	0.0141	143.15
2	0.01	1380.72	1047.6	0.7662	5.00	0.0140	144.64
3	0.1	1401.52	1049.23	0.7927	4.85	0.0138	147.05

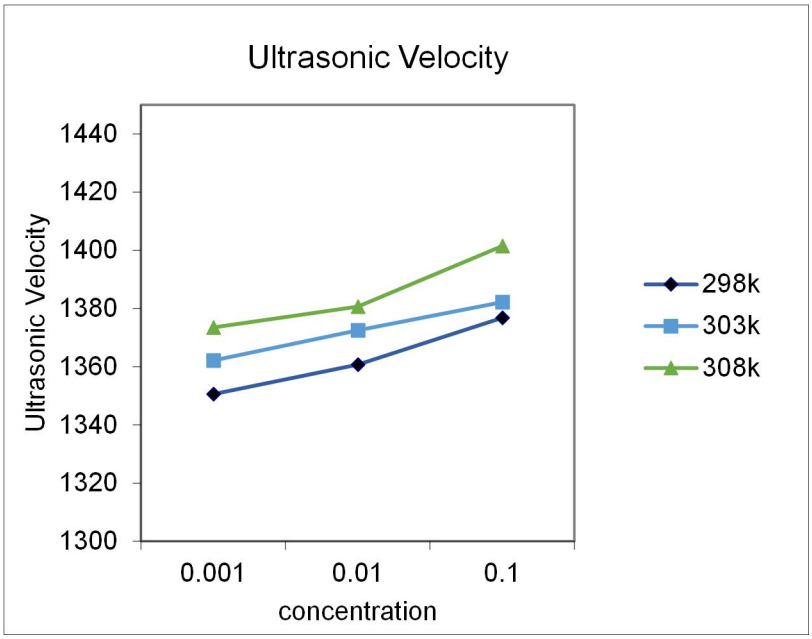

Fig.1 ultrasonic velocity of 0.001, 0.01 and 0.1 of Artesunate at 298,30 and 308k temperature

ISSN NO: 2249-3034

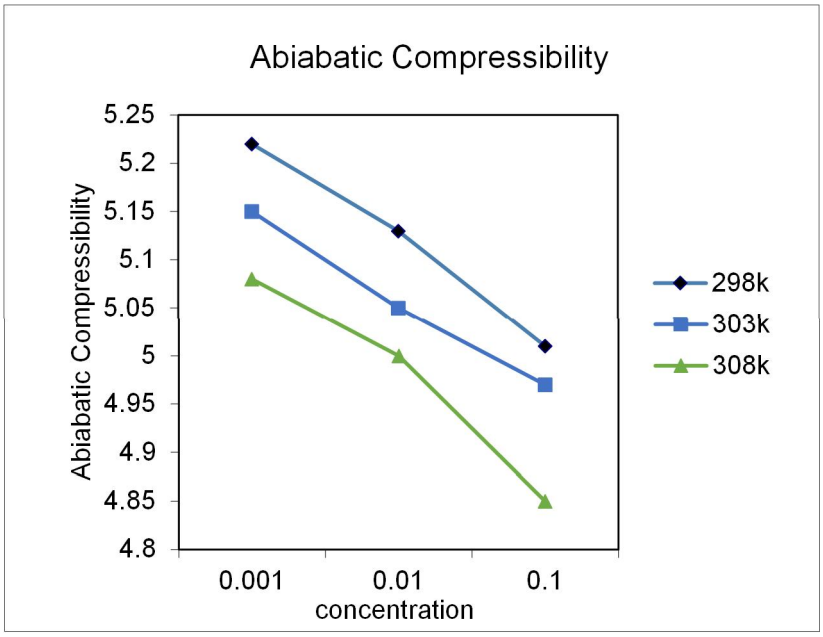

Fig.2 adiabatic compressibility of 0.001, 0.01 and 0.1 of Artesunate at 298,30 and 308k temperature

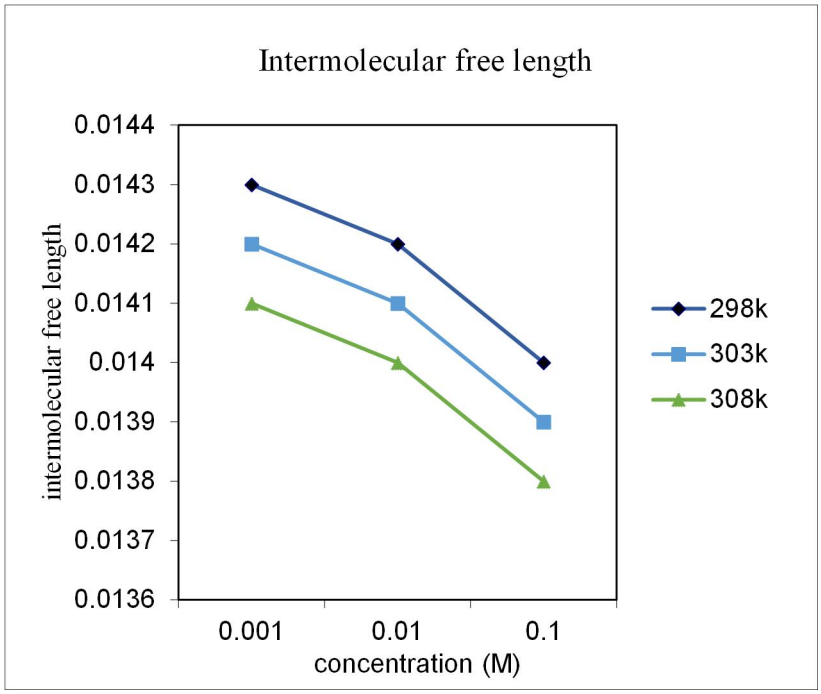

Fig.3 Intermolecular free length of 0.001, 0.01 and 0.1 of Artesunate at 298,30 and 308k temperature

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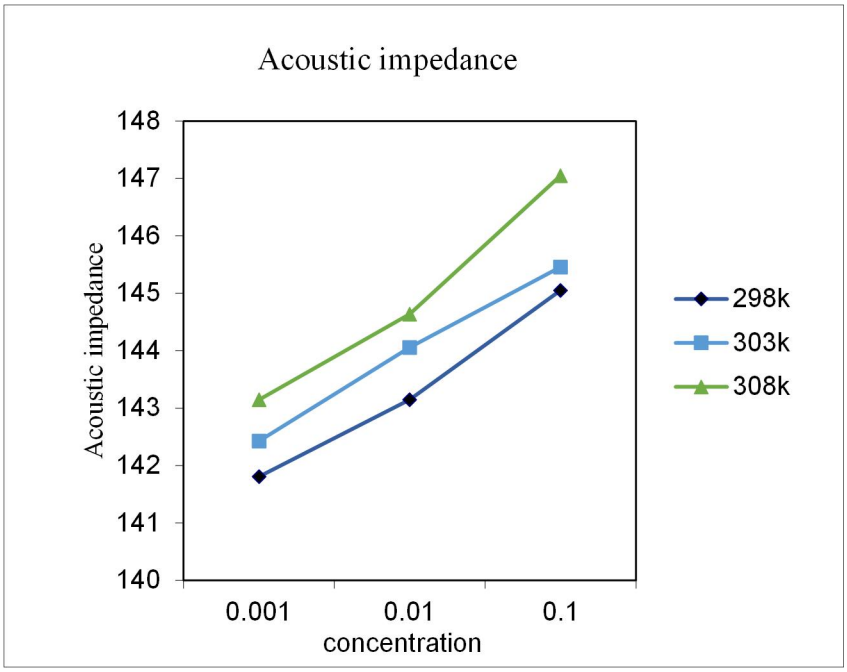

Fig.4 Acoustic impedance of 0.001, 0.01 and 0.1 of Artesunate at 298,30 and 308k temperature

Discussion:

From the above table 1,2 and 3 we understood that the density and ultrasonic velocity of the artesunate solution increases with increase in concentration and temperatures. This linear increase in velocity, density with concentration and temperature it cleared that an increase cohesive forces because of compact structure.

From fig. 2 decrease of adiabatic compressibility with increase of concentration and temperatures supports solvent-solute interactions. This indicates a strong intermolecular interaction between solute and solvent molecules dur to formation of Hydrogen bonding between Artesunate and water molecule [(9)].

From fig.3 shows that intermolecular free length decreases with decrease in concentration and increase with temperature these decreasing trends of free length with increase in concentration is due to decrease in spacing between the molecules of aqueous solution of artesunate.as a result of weakening of molecules interaction forces between donor and acceptor free length decreases and hence strong solute solvent interaction exist in the solution. [(10)].

Fig. 4 represents the variation of acoustic impedance with concentration, and temperature. It is cleared that increase in concentration and temperature acoustic impedance also increases in the present aqueous solution is due to the change in inertial properties and elastic properties of the solution. This indicates the molecular association of solute and solvent through the hydrogen bonding

Conclusion

From the values of ultrasonic velocity, density, adiabatic compressibility, free length and acoustic impedance it shows that strong solute solvent interaction presents in the solution of artesunate at 308K.

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