IRJSE *Int. Res. J. of Science & Engineering*, 2020; Special Issue A7: 253-259 SJIF Impact Factor 6.68
ISSN: 2322-0015
RESEARCH ARTICLE OPEN ACCESS

Comparative Study of Ultrasonic Parameters of D-Proline in 5% of aqueous Potassium Bromide and Sodium Bromide solution at 283˚K and 288˚K.

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Manuscript Details
Available online on http://www.irjse.in
ISSN: 2322-0015

Cite this article as:
Pathan Neha, Mohurle Jayshree and Manik Urvashi. Comparative Study of Ultrasonic Parameters of D-Proline in 5% of aqueous Potassium Bromide and Sodium Bromide solution at 283˚K and 288˚K, *Int. Res. Journal of Science & Engineering*, February 2020, Special Issue A7: 253-259.

ABSTRACT
The Ultrasonic velocity (u), Density (ρ) and Viscosity(Ƞ) of D-Proline in Sodium Bromide and Potassium Bromide Solution at 283˚K and 288˚K are measured. From this experimental data we determine the parameters like Relaxation time (Ʈ), Gibb's Free Energy (ΔG) and Surface tension (Ϭ). On investigation the behavior of all parameter the intermolecular interaction of D-Proline + NaBr is greater than D-Proline + KBr.

Keywords D-Proline, Sodium Bromide, Potassium Bromide, Gibb's Free Energy, Relaxation time, Surface tension.

INTRODUCTION

Ultrasonic is versatile Non-destructive and highly useful technique to investigate Physical and Chemical Properties of liquid.[1] From previous few years, Ultrasonic has been used in variety of field such as geology, pharmaceutical, agriculture, medicine, chemistry and industry.[2] Ultrasonic study are extensively used for characterizing thermodynamic properties and to predict the solute-solvent, ion-solvent, solute-solute interaction in aqueous as well as non-aqueous and mixed medium.[3] Recently it has been found that thermodynamic properties of liquid solution have to be important parameter in the study of different chemical and physical reaction.[4]

The velocity of sound is used to give information about the bonding between the molecule and formation of complexes at various temperatures through different interaction.[5]

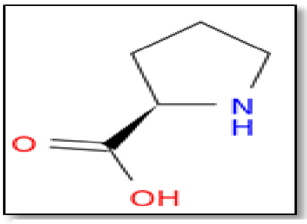

Fig A: D-Proline

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D-Proline plays an important role in the catalytic function of many enzymes. The researcher is interested to study the volumetric, viscometric as well as thermodynamics properties of aqueous amino acid.[6-7]As all the parameters depends on temperature and concentration of solute and solvent used and hence the study help us in understanding the phenomenon of molecular aggregation and arrangement of ternary solution.[8]In this paper the physical properties of amino acid namely D-Proline have been studied for different concentration at 283˚K and 288˚K temperature.

METHODOLOGY

AR grade of D-Proline having molecular weight 15.13 gm.was obtained from HIMEDIA private ltd. The purity of compound is 99.99%. Initially 5% of aqueous NaBr and KBr stock solution was prepared by using double distilled water. The various concentrations ranging from 0.01-0.08 mole/Kg were prepared from the standard formula and used on the day were prepared.

Ultrasonic velocity was measured by single crystal interferometer operating at frequency 2 MHz supplied from Vi microsystem Pvt. Ltd. Chennai. The source of ultrasonic waves was a quartz crystal excited by a radio frequency oscillator placed at the bottom of double jacket metallic cylinder container. The densities of solution were determined accurately using 10ml specific gravity bottle with the help of digital electronic balance. The viscosity has been calculated with the help of Oswald's Viscometer.

Defining relations

For derivation of several physical and thermodynamically parameters the following defining relations reported in the literature are used.

1) Relaxation time (τ):

$\tau = 4/3\eta a$ (sec)

2) Gibb's free energy (ΔG):

ΔG= -KBT ln(h/TKBT) (Jmol-1)

3) Surface Tension (ϬϬ):

Ϭ = (U)3/2*(6.3x10-4) *ρ (Nm-1)

RESULTS AND DISCUSSION

The basic experimental data of ultrasonic velocity, density and viscosity of D-Proline solution of concentration 0.01 to 0.08 mol Kg-1 in 5% aqueous KBr and NaBr solution at temperature 283˚K and 288˚K tabulated in table 1, table 2 and table 3 respectively.

From fig. (1) it is found that the speed of sound of D-proline in KBr and NaBr increases with increase in concentration as well as with temperature. The increase in ultrasonic velocity into different solution suggests the greater association among the molecule of solution. The ultrasonic velocity of amino acid depend on temperature where the ultrasonic velocity found to amplify with the boost in the temperature.[9] As shown in fig. (2) the density of D-proline in KBr and NaBr increases with increasing concentration of D-proline and decrease with increase in temperature. This is because due to electrostriction in that solution. This electrostriction decreases the volume and hence increases the density.[10] As shown in fig. (3) it is observed that viscosity of D-proline solution in 5% of KBr and NaBr salts increase in concentration and decreases with increase in temperature this is because cohesive and frictionless force.

Fig. (4) Indicates that Surface tension increases with addition of solute. The observation is in accordance with the change in mean free length. The surface tension increase non-linearly in both solutions as the molal concentration goes increasing.

Table (1): Ultrasonic Velocity of D-Proline in aqueous solution of KBr and NaBr at 288°K and 283°K respectively

Concentration	D-proline+KBr		D-proline+NaBr	
(mol Kg-1)	At T=283K	At T=288K	At T=283K	At T=288K
0.01	1462.164	1479.732	1471.329	1487.528
0.02	1462.718	1480.111	1471.643	1488.676
0.03	1463.273	1481.247	1472.205	1489.250
0.04	1464.939	1481.816	1472.767	1489.825
0.05	1465.496	1482.955	1473.329	1490.976
0.06	1466.052	1483.525	1474.455	1491.553
0.07	1467.167	1483.817	1475.019	1492.707
0.08	1467.543	1484.666	1475.583	1493.284

Table(2): Density of D-Proline in Aqueous Solution of Potassium Bromide and Sodium Bromide at 288K and 283K

Concentration	D-proline+KBr		D-proline+NaBr	
(Mol Kg-1)	At T=283K	At T=288K	At T=283K	At T=288K
0.01	1.0413484	1.0318817	1.04110	1.0211
0.02	1.0434979	1.0329086	1.04512	1.0291
0.03	1.0440175	1.0350234	1.05344	1.0424
0.04	1.0452297	1.0360706	1.06046	1.0429
0.05	1.0465439	1.0381142	1.07452	1.0431
0.06	1.0471246	1.0398223	1.0860	1.0452
0.07	1.0510060	1.0404832	1.10287	1.0466
0.08	1.0560181	1.0408492	1.13324	1.0575

Table (3): Viscosity of D-Proline in Aqueous Solution of Potassium Bromide and Sodium Bromide at 288K and 283K

Concentration	D-proline+KBr		D-proline+NaBr	
(mol Kg-1)	At T=283K	At T=288K	At T=283K	At T=288K
0.01	1.2981	1.1601	1.3474	1.1843
0.02	1.3112	1.1922	1.3661	1.1964
0.03	1.3222	1.2098	1.3972	1.2084
0.04	1.3342	1.2148	1.4171	1.2142
0.05	1.3463	1.2241	1.4425	1.2196
0.06	1.3572	1.2469	1.4898	1.2325
0.07	1.3730	1.2685	1.5398	1.2499
0.08	1.3901	1.2794	1.6048	1.2681

Table (4): Surface Tension D-Proline in Aqueous Solution of Potassium Bromide and Sodium Bromide at 288K and 283K

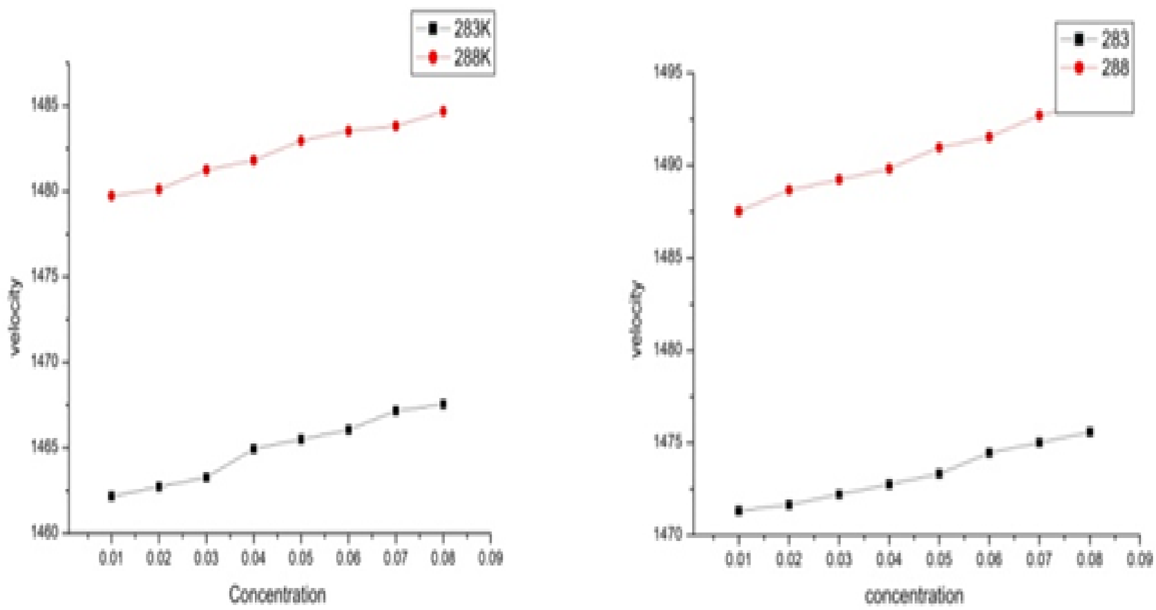
Concentration	D-proine+KBr		D-proline+NaBr	
(mol Kg-1)	At T=283K	At T=288K	At T=283K	At T=288K
0.01	36680.12	37003.69	37016.7	36906.81
0.02	36776.72	37054.75	37171.53	37239.03
0.03	36815.98	37173.37	37488.91	37742.13
0.04	36921.69	37232.42	37760.34	37821
0.05	36989.2	37348.88	38282.89	37833.15
0.06	37030.79	37431.91	38736.26	37931.32
0.07	37210.46	37466.76	39360.56	38026.22
0.08	37402.29	37512.11	40467.64	38044.453

Table(5): Relaxation time D-Proline in Aqueous Solution of Potassium Bromide and Sodium Bromide at 288K and 283K

Concentration (mol Kg-1)	D-proline+KBr		D-proline+NaBr	
	At T=283K	At T=288K	At T=283K	At T=288K
0.01	7.77E-13	6.84E-13	8.04E-13	6.98E-13
0.02	7.83E-13	7.02E-13	8.10E-13	6.91E-13
0.03	7.88E-13	7.10E-13	8.15E-13	6.96E-13
0.04	7.93E-13	7.11E-13	8.21E-13	6.99E-13
0.05	7.98E-13	7.16E-13	8.24E-13	7.01E-13
0.06	8.04E-13	7.26E-13	8.41E-13	7.06E-13
0.07	8.09E-13	7.38E-13	8.55E-13	7.14E-13
0.08	8.14E-13	7.43E-13	8.67E-13	7.17E-13

Table(6): Gibb's Free Energy of D-Proline in Aqueous Solution of Potassium Bromide and Sodium Bromide at 288 and 283K

Concentration (mol Kg-1)	D-proline+KBr		D-proline+NaBr	
	At T=283K	At T=288K	At T=283K	At T=288K
0.01	5.96E-21	6.13E-21	6.09E-21	5.7E-21
0.02	5.99E-21	6.16E-21	6.12E-21	5.66E-21
0.03	6.01E-21	6.19E-21	6.14E-21	5.69E-21
0.04	6.04E-21	6.21E-21	6.17E-21	5.71E-21
0.05	6.06E-21	6.24E-21	6.19E-21	5.72E-21
0.06	6.27E-21	6.27E-21	5.75E-21	6.09E-21
0.07	6.29E-21	6.33E-21	5.79E-21	6.11E-21
0.08	6.32E-21	6.38E-21	5.81E-21	6.14E-21



Fig(1): Variation of velocity with concentration at different temperature of D-proline in KBr and NaBr

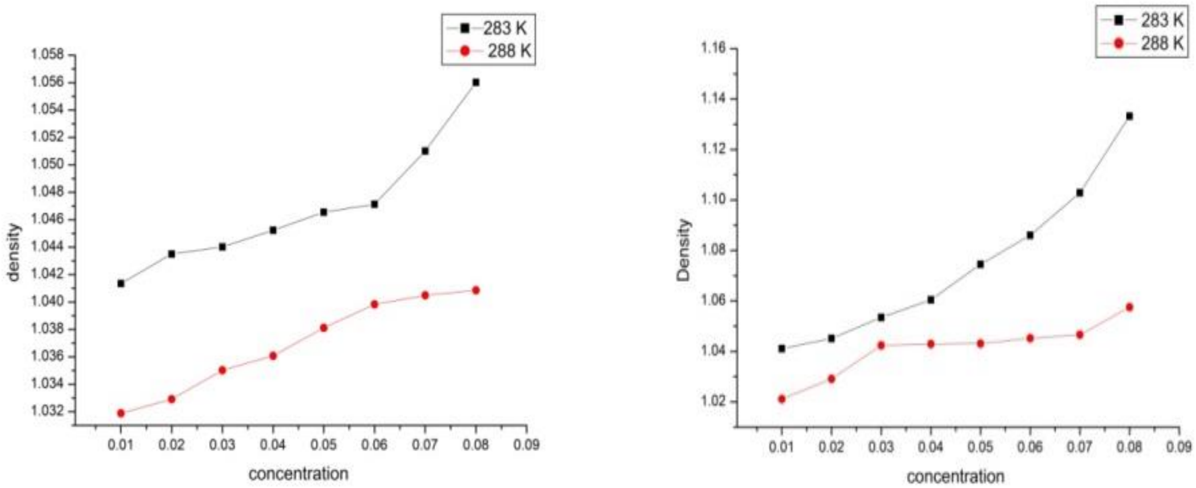
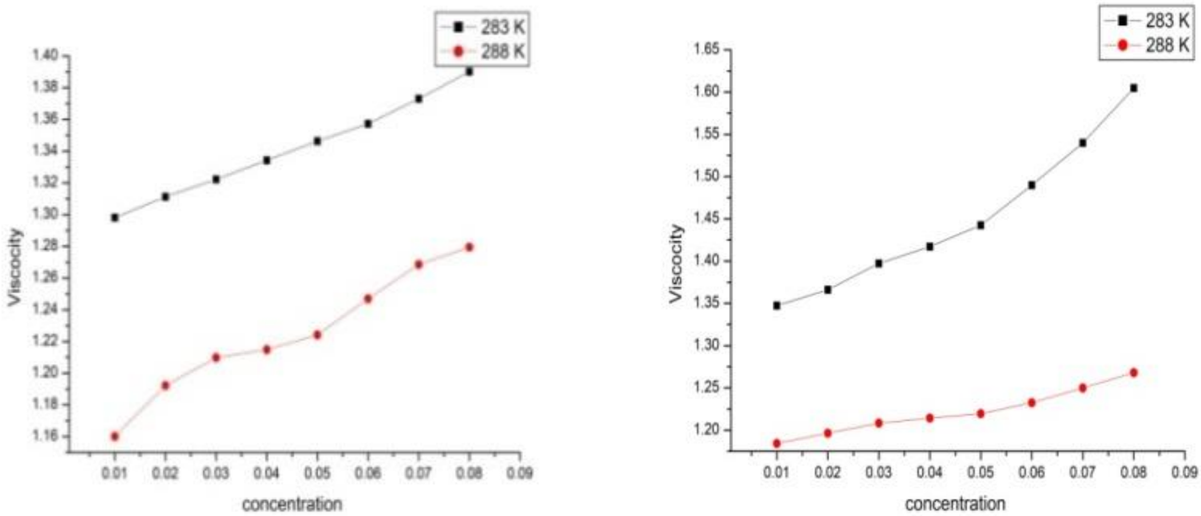


Fig (2): variation of density with concentration at different temperature of D-proline in KBr and NaBr



Fig(3): variation of viscosity with concentration at different temperature Of D-proline in KBr and NaBr

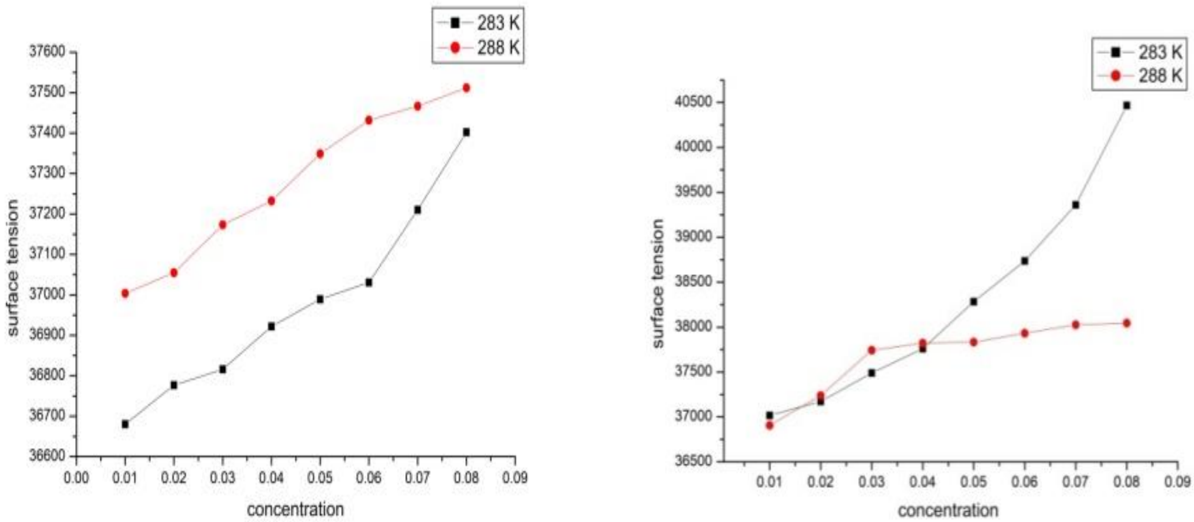
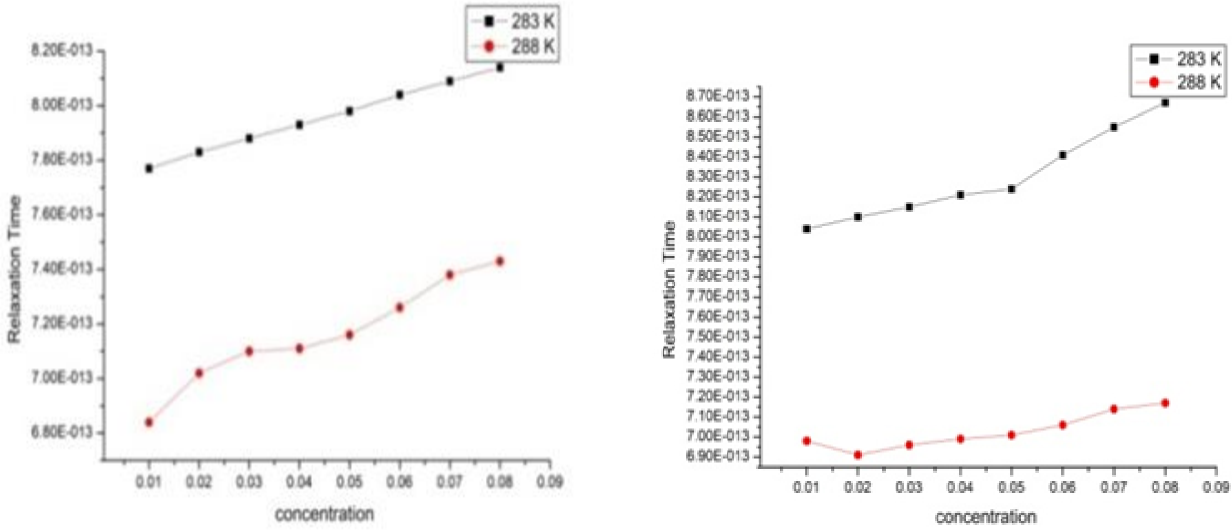


Fig. (4): variation of surface tension with concentration at different temperature of D-proline in KBr and NaBr



Fig(5):- Variation of relaxation time with concentration at different temperature of D-proline in KBr and NaBr

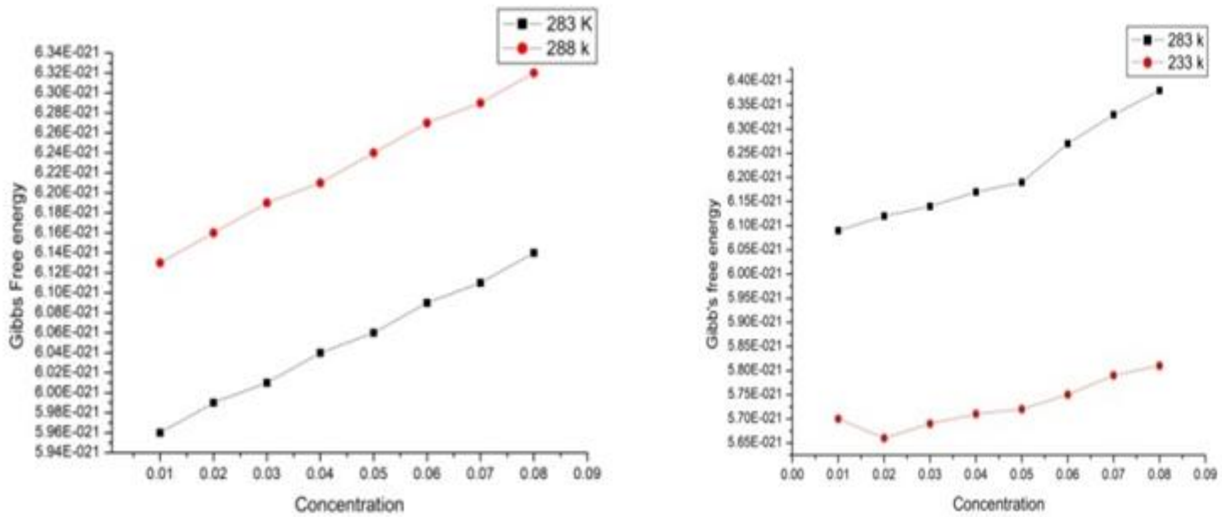


Fig (6):- Variation of Gibb's free energy with concentration at different temperature of D-proline in KBr and NaBr.

As shown in fig. (5) The relaxation time increases with increase concentration. It is confirming the structure making effect whereas adverse effect on relaxation time with rise in temperature shows structure breaking effect. Thus higher concentration is favorable for structure making effect whereas the higher temperature is likely unfavorable.

Fig. (6) it shows that the Gibb's free energy increases with increasing concentration in both the solution because of the amount of solute increase. There is increasing viscosity and hence Gibb's free energy increases. [1] It is observed as temperature increase the value of Gibb's free energy and relaxation time in KBr increases while the value of Gibb's free energy in NaBr solution decreases.

CONCLUSION

The densities, viscosities and ultrasonic velocities ofproline in aqueous KBr and aqueous NaBr were calculated at different concentration and temperature. From this measurement surface tension (Ϭ), relaxation time (τ) and Gibb's free energy are calculated. The surface tension values increases with on increases in concentration of both the system. The sigma value of NaBr becomes more than KBr indicating that strong hydrogen bond of D-proline + NaBr occurs. Further from all the values of U, ρ, η. Are aligned parameters like, Gibb's free energy relaxation time, we conclude that the D-proline+ aqueous NaBr possess strong solute-solute, solute-solvent interaction than D-proline +aqeous KBr.

Conflicts of interest: The authors stated that no conflicts of interest.

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