International Journal of Engineering & Scientific Research
Vol.4 Issue 12, December 2016,
ISSN: 2347-6532 Impact Factor: 5.900
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

ULTRASONIC INVESTIGATION OF DL- METHIONINE IN 0.01M SODIUM BENZOATE AT 303K

A.N. Sonar*

Abstract

The acoustical properties have been investigated from the ultrasonic velocity and density measurements of DL-methionine in 0.1M sodium benzoate (30% ethanol) at 303K. The measurement have been perform to evaluate acoustical parameter such as adiabatic compressibility (βs), Partial molal volume (ϕv), intermolecular free length (L_f), apparent molal compressibility (ϕ_k), specific acoustic impedance (Z), relative association (R_A), solvation number (Sn).

***Key word:* -** DL-methionine, adiabatic compressibility, apparent molal volume,

* **Shri V.S. Naik College , Raver Dist. Jalgaon, India**

INTRODUCTION

Amino acids are common components of all organisms. Protein of all species made from the amino acids. Protein play many different biological roles in living systems. Methionine is an essential amino acid in humans. Methionine is important in angiogenesis, the growth of new blood vessels, and supplementation may benefit those suffering from Parkinson's, drug withdrawal, schizophrenia, radiation, copper poisoning, asthma, allergies, alcoholism, or depression.[1-3] Methionine is coded for by the initiation codon, meaning it indicates the start of the coding region and is the first amino acid produced in a nascent polypeptide during mRNA translation.[4]. In the recent years, measurements of the Ultrasonic velocity are helpful to interpreted solute-solvent, ion-solvent interaction in aqueous and non aqueous medium [5-11**].** S. Mirikar [12-13] et al have been studied the molecular interaction between amino acid and electrolyte. Thirumaran et al [14] investigate the ultrasonic behavior of L-arginine, L-lysine and L-histidine in aq. Sodium butyrate solution. They concluded that intermolecular interaction of electristriction and hydrophilic nature exsit in system. R. Palani et al [15] has been studied the interaction between amino acid and aqueous sucrose solution.

After review of literature survey the detail study of DL-methionine under identical set of experimental condition is still lacking. It was thought of interest to study the acoustical properties DL-methionine under suitable condition.

Experimental

In the present study, the DL-methionine was used. The 30% ethanol was used for preparation of different concentration of DL-methionine 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 (βs), apparent molal volume (ϕ_v), intermolecular free length (L_f), apparent molal compressibility (ϕ_κ), specific acoustic impedance (Z), relative association (R_A), solvation number(S_n), limiting apparent molal compressibility ($\phi^0{}_\kappa$), limiting apparent molal volume($\phi^0{}_v$) and their constant (S_k, S_v).

Theory

Adiabatic compressibility (βs) is given by:

$$\beta s = \frac{1}{U_s^2 d_s} \qquad (1)$$

Apparent molal compressibility (ϕ_κ) has been calculated by using the relation

$$(\phi_\kappa) = 1000 \text{ x} \left(\frac{\beta s\ d_0 - \beta 0\ d_s}{\text{mxdsxd}_0} \right) + \frac{\beta s \text{ x } M}{ds} \qquad (2)$$

Where βs, d_0 and $\beta 0$ d_s are the adiabetic compressibility and density of solution and solvent respectively. m is molal concentration of solute ,M is molecular weight of solute.

$$\text{Apparent molal volume } (\phi_v) = \frac{M}{ds} \text{ x } \frac{(d_0\text{-}ds) \text{ x}10^3}{\text{mxdsxd}_0} \qquad (3)$$

$$\text{Specific acoustic impedance (Z) = Us ds} \qquad (5)$$

$$\text{Intermolecular free length } (L_f) = K\sqrt{\beta s} \qquad (6)$$

$$\text{Relative association } (R_A) = (ds / d_0) \text{ x } (U_0 / U_s)^{1/3} \qquad (7)$$

$$\phi_\kappa = \phi^0_\kappa + S_k C \qquad (9)$$

$$\phi_v = \phi^0_v + S_V C \qquad (10)$$

Results and Discussion

In the present investigation, different acoustical properties such as ultrasonic velocity (Us), adiabatic compressibility (βs), intermolecular free length (L_f), specific acoustic impedance (Z), are listed in table-1. Partial molal volume (ϕ_v), apparent molal compressibility (ϕ_κ), relative association (R_A), solvation number (Sn) are listed in table-2. Limiting apparent molal compressibility (ϕ^0_κ), limiting apparent molal volume(ϕ^0_v) and their constant (S_k, S_v) are listed in table-1. It was found that the ultrasonic velocity increased 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 by Eyring and Kincaud[13]. Intermolecular free length decreased linearly on increase in concentration of DL-methionine-sodium benzoate in ethanol. Hence, increased in ultrasonic velocity with increase in concentration of DL-methionine. 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 increase in concentration of DL-methionine-sodium benzoate in ethanol. When concentration of electrolyte was increased, the thickness of oppositely charged ionic atmosphere increases due to decrease in ionic strength. The increase in acoustic impedance (z) with the increase in concentration of solution can be explained on the basis of hydrophobic interaction between solute and solvent molecules [16, 17], 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 decreased due to weak force of attraction between solute and solvent. The adiabatic compressibility decreased with the increase in concentration of solution. It happened due to not 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 decreased with concentration in system. It indicates the existence of weak ion-solvent interaction. It was found that the values of apparent adiabatic compressibility were decreased with the increase in concentration of DL-methionine-sodium benzoate in ethanol. It shows weak electrostatic attractive force in the vicinity of ions. From the data, we were concluded that strong molecular association was found in DL-methionine. The value of relative association decreased with the increase in concentration in system. It has been found that there was weak interaction between solute and solvent. There were regular decreases in solvation number with the increase in concentration; it indicates the solvent molecule forms weak coordination bond in primary layer. It indicates the decrease in size of secondary layer of solvation. The value of S_k exhibits negative. It indicates not existence of ion-ion or solute-solute interactions in system. The value of S_k exhibits negative, it indicates the weak 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 DL-methionine-sodium benzoate in ethanol. The negative value of Sv indicates the weak solute-solvent interaction. This value indicates an induced effect of 30% ethanol 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 (β_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 (β_S) $x10^{-10}$ m^2N^{-1}	Intermolecular free length (L_f) $x10^{-11}$ m	Specific acoustic impedance ($Zx10^6$) kg m^{-2} s^{-1}
DL-methionine-sodium benzoate in 30%ethanol					
$1x10^{-2}$	0.9444	1537.93	2.7491	3.3347	1.4561
$2x10^{-2}$	0.9533	1552.17	2.6741	3.2889	1.4797
$3x10^{-2}$	0.9612	1574.23	2.5633	3.2199	1.5132
$4x10^{-2}$	0.9659	1592.14	2.4777	3.1658	1.5379
$5x10^{-2}$	0.9714	1621.95	2.3436	3.0789	1.5756
$6x10^{-2}$	0.9768	1641.06	2.2627	3.0253	1.6030
$7x10^{-2}$	0.9793	1665.21	2.1657	2.9597	1.6307
$8x10^{-2}$	0.9828	1682.14	2.0418	2.9152	1.6532
$9x10^{-2}$	0.9843	1698.23	2.0782	2.8738	1.6716

Table-2 Concentration (m), Relative association (R_A), Apparent molal compressibility (ϕ_κ), Apparent molal volume (ϕ_v) , Solvation number (S_n)-

Concentration(m) moles lit^{-1}	Apparent molal volume ($-\phi_v$) m^3mole^{-1}	Apparent molar compressibility (ϕ_k x10^{-11}) $m^2 N^{-1}$	Relative association (R_A)	Solvation number (S_n)
$1x10^{-2}$	1.2041	4.1943	1.0376	0.5665
$2x10^{-2}$	1.1615	4.0408	1.0003	0.5458
$3x10^{-2}$	1.1241	3.8248	1.0015	0.5166
$4x10^{-2}$	1.1017	3.6673	1.0008	0.4953
$5x10^{-2}$	1.0564	3.4296	0.9972	0.4632

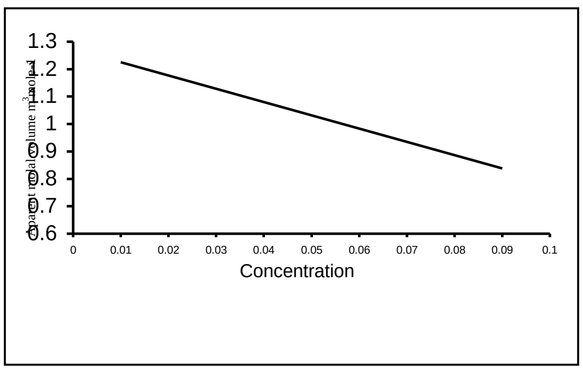
$6x10^{-2}$	1.0204	3.2795	0.9968	0.4429
$7x10^{-2}$	0.9293	3.1159	0.9921	0.4208
$8x10^{-2}$	0.8792	2.9064	0.9907	0.3925
$9x10^{-2}$	0.8065	2.9015	0.9875	0.3919

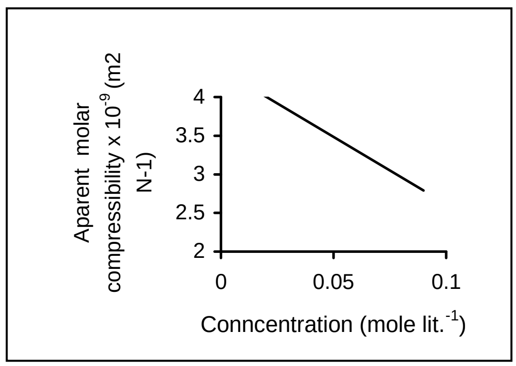
Table-3 Limiting Apparent molal compressibility (ϕ^0_κ), Limiting Apparent molal volume ($\phi^{\square}_v$), S_v and S_k

Limiting Apparent molal volume ($\phi^{\square}_v$) m^3mole^{-1}	Limiting Apparent molal compressibility(ϕ^0_κ) $10^{-9}m^2 N^{-1}$	S_v $m^3kg^{1/2}$ mole-$^{3/2}$	S_k $m^3mole^{-2}kg. N^{-1}$
1.2738	4.3495	-4.847	-17.3

Fig.-1 -Apparent molal volume (m^3mole^{-1}) Concentration (mole lit^{-1})

Fig.-2- Aparent molar compressibility10^{-11} Vs ($m^2 N^{-1}$) Vs Concentration (mole lit^{-1})





Conclusion

The present study shows the experimental data for ultrasonic velocity, density and viscosity at 300K for DL-methionine - sodium benzoate in ethanol. From experimental data, the acoustical properties were calculated. The solute-solvent interaction and ion-ion / solute-solute interaction existing between DL-methionine and sodium benzoate in ethanol were also studied with the help of experimental data. Lastly it has been concluded from the experimental data, that the solute-solvent interaction between DL-methionine –sodium benzoate in ethanol systems are weak.

REFERENCES

1. http://www.webmd.com/vitamins-supplements/ingredientmono-42-methionine.aspx?activeingredientid.
2. Dawson, R.M.C.; et al. (1959). Data for Biochemical Research. Oxford: Clarendon Press.
3. Weast, Robert C., ed. (1981). CRC Handbook of Chemistry and Physics (62nd ed.). Boca Raton, FL: CRC Press. p. C-374. ISBN 0-8493-0462-8..
4. Guedes, R. L.; Prosdocimi, F; Fernandes, G. R.; Moura, L. K.; Ribeiro, H. A.; Ortega, J. M. (2011). BMC Genomics. 12 Suppl 4: S2. McCue K. "Chemistry.org: Thanksgiving, Turkey, and Tryptophan". Archived from the original Retrieved 2007-08-17.
5. S. Baluja and S. Oza , Fluid phase equlibria. , **2005**, 200(1): 49-54.
6. M. K. Rawat and Sangeeta, Ind. J. pure Appl. Phy. , **2008**, 46: 187-192.
7. A Ali. and A K Nain, Acoustics Lett. **, 1996,** 19: 53.
8. H. Ogawa and S J Murakami, J. Solution. Chem., **1987**, 16:315.
9. D. Ubagaramary, Dr.P.Neeraja, Journal of Applied Chemistry, . 2012, Volume 2, Issue 5 , PP 01-19.
10. A.V. Kachare , D.D.Patil, S.R.Patil, and A.N.Sonar, *Journal of Applicable Chemistry*, 2013, 2 (5):1207-1215.
11. G. R. Bedare, V. D. Bhandakkar ,B. M. Suryavanshi, *Science park*, 2013, Volume-1, Issue-4, 15:1-32.
12. S. Mirikar , P. Pawar and G. Bichile , *International Journal of Advanced Research in Physical Science , Volume 1, Issue 4, August 2014, PP 41-44.*
13. S.A Mirikar1, Pravina P. Pawar and Govind K. Bichile . Journal of Applicable Chemistry , 2013, 2 (6): 1565-1573.
14. S. Thirumaran and A.N. Kannappan, Global J. of mole. Sci., 2009, 4(2) :160-166.
15. R. Palani, S. Balakrishnan and G. Arumugam, Journal of Physical Science, Vol. 22(1), 131–141, 2011.
16. Charke R.G.; Hnedkovsky I, Tremaine P R and Majer V;J.Phys Chem., 2000 104B, 11781.
17. Vankatesu P, Lee M J, Lin H M,Biochemical Engineering J., 2006, 32, 157.