

STUDIES IN ACOUSTIC PROPERTIES OF SUBSTITUTED CHALCONES IN BINARY SOLVENT MIXTURES

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ABSTRACT

Densities and ultrasonic velocities of different concentrations of substituted chalcones with dioxane-water, acetone-water mixtures were measured at 26°C by using ultrasonic interferometer at frequency 1 MHz. The ultrasonic velocity, density and concentration were used to calculate adiabatic compressibility β_s , apparent molal volume ϕ_v , intermolecular free length L_f , specific acoustic impedance Z , relative association R_A . The results were used to discuss solute-solvent interactions.

Key words: Chalcones, ultrasonic parameters, solute-solvent interactions

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INTRODUCTION

From solute-solvent interaction, structure breaking and making properties of liquids have been considered¹⁻². The ultrasonic absorption study has extensive application to characterize physiochemical properties of system³⁻⁵. It gives information about microstructure and mechanical properties⁶. D.C. Rath and P.K. Kar⁷ studied molecular interactions of ketones with aromatic hydrocarbons, D.V. Jahagirdar *et al*⁸ studied acoustic properties of $MnCl_2$ in aqueous solution at different temperatures. D.U.N. Dash *et al*⁹ studied ultrasonic parameters of Co (III) complexes at different temperatures. Chalcones are derivatives at phenyl styryl ketones. They are used as starting material in large number of organic compound, drugs etc. They reported to have antibacterial, antiparasitic, antifungal, anti-inflammatory properties. The synthesis of substituted chalcones was carried out by microwave technique which was then used for ultrasonic study to determine. Apparent molar volume (ϕ_v), intermolecular free length L_f , specific acoustic impedance Z , relative association R_A .

EXPERIMENTAL

Substituted chalcones 2'-Hydroxy-5'-Methyl Chalcone (HMC), 2'-Hydroxy-5'-Methyl-4-Methoxy-Chalcone (HMMC), 2'-Hydroxy-5'-Chloro-4-dimethyl-Amino Chalcone (HCDMAC) were synthesized by use of green chemistry technique i.e. by microwave technique. These chalcones were recrystallised and were used for ultrasonic study. All weighings were done on Wensel Model PGB-100 Balance (± 0.001 g.). Ultrasonic velocity was measured on Interferometer (Mittal Enterprise) with accuracy 0.03 % and frequency 1 MHz.

In the present study different thermodynamics parameters such as adiabatic compressibility β_s , apparent molar compressibility $\phi_k(S)$. Apparent molar volume ϕ_v , intermolecular free length L_f , specific acoustic impedance Z , relative association R_A have been calculated with the help of following equations-

$$\beta_s = 100 / U_s^2 ds \quad (1)$$

$$\phi_v = (M / ds) + [(do-ds) \times 10^3] / m \times ds.do \quad (2)$$

$$L_f = K \beta_s \quad (3)$$

$$Z = U_s.ds \quad (4)$$

$$R_A = (ds / do) (U_o / U_s)^{1/3} \quad (5)$$

Table-1: Acoustic Parameters in 50 % dioxane-water [Temperature: 26°C; Ultrasonic Frequency - 1MHz]

HMC							
Conc. M.	U _s (m/s)	ds (g/cm ³)	β_s (bar ⁻¹ X 10 ⁻¹¹)	Z	L _f	R _A	$\phi_s \times 10^5$ (cm ³ X mole)
0.01	11544	0.9978	7.52	11518.60	0.0521920	1.1444	2.2457
0.005	115650	0.9977	7.493	115384.00	5.2098	1.14331	2.2457
0.0025	115695	0.9973	7.493	115405.76	5.2091	1.14330	2.2488
0.000125	115701	0.9970	7.492	115388.60	5.2094	1.1430	2.2488
0.000625	115762	0.9969	7.485	115403.13	5.2070	1.1414	2.2646
HMMC							
0.01	127400	1.0787	5.175	137426.38	4.5499	1.17673	2.4095
0.005	127512	1.075	5.721	137088.15	4.5523	1.73001	2.3494
0.0025	127621	1.072	5.727	136809.71	4.5546	1.16926	2.2233
0.000125	127664	1.070	5.734	136600.48	4.5574	1.1670	1.9652
0.000625	127764	1.062	5.768	135685.36	4.5709	1.1790	1.5573
HCDMAC							
0.01	138945	1.0096	4.726	150810.10	4.1375	1.145789	2.6567
0.005	138949	1.090	4.751	150781.10	4.1484	1.13951	2.5923
0.0025	138955	1.089	4.755	150852.20	4.1502	1.13847	2.4290
0.000125	138960	1.084	4.777	150792.10	4.15980	1.13283	2.1407
0.000625	138962	1.081	4.790	150723.4	4.1654	1.13010	1.5535

Table-2: Acoustic Parameters in 50 % Acetone-water [Temperature: 26°C; Ultrasonic Frequency - 1MHz]

HMC							
Conc. M.	U _s (m/s)	ds (g/cm ³)	β_s (bar ⁻¹ X 10 ⁻¹¹)	Z	L _f	R _A	$\phi_s \times 10^5$ (cm ³ X mole)
0.01	138500	0.7918	6.576	109664.3	4.8806	0.8289	2.8292
0.005	139100	0.7914	6.530	110083.74	4.8635	0.8264	3.3535
0.0025	139280	0.7911	6.516	110184.40	4.9309	0.8256	3.4849
0.000125	139585	0.7906	6.491	110355.90	4.8489	0.8247	4.9361
0.000625	139681	0.7902	6.486	110375.92	4.8463	0.8240	7.0506
HMMC							
0.01	138400	1.0897	4.790	150814.48	4.1654	1.14125	2.3750
0.005	138662	1.0890	7.725	151002.91	5.3069	1.14043	2.2957
0.0025	138691	1.0877	7.779	150854.20	5.3083	1.13793	2.1333
0.000125	138714	1.0871	4.780	150795.98	4.1611	1.13793	- 4.8394
0.000625	138844	1.0847	4.782	150604.08	4.1619	1.134383	1.1892
HCDMAC							
0.01	145012	1.082	4.395	156902.98	3.9001	1.10710	2.7055
0.005	145081	1.080	4.399	156687.48	3.9918	1.10505	2.6348
0.0025	145088	1.076	4.414	156114.68	3.9986	1.10096	2.5068
0.000125	145204	1.072	4.424	155658.68	4.0499	1.09611	2.5068
0.000625	145205	1.070	4.432	155369.35	4.0067	1.094071	1.73429

RESULTS AND DISCUSSION

In present investigation, ultrasonic velocity and density of chalcones has been studied in 50 % dioxane-water and 50 % acetone-water mixtures. From these values, apparent molar volume ϕ_v , adiabatic compressibility β_s , intermolecular free length L_f , Relative association R_A , specific acoustic impedance Z

are calculated. For calculations, acoustic parameters Jacobson constant $K = 6.0186 \times 10^4$ and $\beta_0 = 44.6330 \times 10^{-6} \text{ bar}^{-1}$ are used. The values of these acoustic parameters were used to discuss the interactions of solute with solvent molecules. It is observed that.

Relative association R_A decreases linearly with decrease in concentration. It is influenced by breaking of ions. The values R_A are found to be lesser in acetone-water mixture as compared to dioxane-water mixture.

The apparent molal volume ϕ_v values increases with decrease in concentration of chalcones in binary mixtures. These volumes are move in acetone-water than in dioxane-water in HMC and HCDMAC. The same values contradict with HMMC. This represents strong and variable interactions between ion and solvents. The values of intermolecular free length indicate that with increase in concentration there is increase in ion-solvent interactions.

Increase in β_s with increase in concentration of solution may be due to departure of solvent molecules around ions supporting weak ion-solvent interactions. Decrease in R_A with decrease in concentration suggests that breaking up of solvent aggregation predominates the solvation of ions.

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