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Physicochemical Study of Diverse Interactions Prevalent in Metal Oxalates and Uric Acid in Aqueous Environments

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ABSTRACT

Physicochemical interactions between alkali metal oxalates and the uric acid (UA) were studied using easily available techniques such as density, viscosity and refractive index studies at three different temperatures. The values of limiting molar volume (Φ_V^0), experimental slopes (S_V^*) were calculated from the density values using Masson equation to interpret the solute- solvent and solute – solute interactions respectively. Using Jones-Dole equation viscosity A and viscosity B co-efficient were calculated to support the solute- solvent and solute – solute interactions obtained from density measurement. Again the studies were supported by the result obtained from the refractive index studies. Lorentz-Lorenz equation was used to calculate the molar refraction (R_M) values for refractive index studies.

1. Introduction

Uric acid is a hetero cyclic compound of carbon, nitrogen, and hydrogen with the formula $C_5H_4N_4O_3$. The molecular structure is shown in the Fig. 1. The uric acid is a metabolic breakdown of purine nucleotide. High uric acid concentration [1], in blood is called hyperuricemia [2,3] leads to gout and is associated with the other medical conditions such as diabetes, urate kidney stones. The lithium (Li) with the atomic number 3 is found in the various foods in variable amount. Primary food sources are grains and vegetables. The drinking water also provides significant amount of Li. Traces of Li was detected in human organs and fatal tissues already in the late nineteen centuries. Low lithium intake from water supply was associated with increased rate of suicide, homicide and arrest rate of drugs used and other crimes [4]. Sodium (Na) is essential mineral that regulates blood volume, blood pressure, osmotic equilibrium and pH in the blood. NaCl is the main source of Na in diet. Exceeding the upper limit of Na intake (2.3 g/day) hyper tension may occure. Na is important in neuron function and in osmoregulation between cells and the extra cellular liquid. This is accomplished in all animals by Na^+/K^+ ATPase. Potassium in nature occurs only in ionic salts. It is eighth of nine most common elements by mass 0.2% in human body. Potassium ions are present in a wide variety of proteins and enzymes. K+ controls hormone secretion and action, systematic blood pressure control, glucose and insulin metabolism, fluid and electrolyte balance etc.

Oxalic acid is a common organic compound. It is found in some specific plants. Plants fenestraria genus produce optical fibre made from crystalline oxalic acid to transmit light to subterranean photo synthetic site. Bacteria produce oxalates from oxidation of carbohydrate. The oxalates formed from the oxalic acids are the dianion with the common formula $C_2O_4^{2-}$. The molecular structure is shown in Fig. 2.

Here, the density, viscosity and refractive index studies were performed to investigate the solvation consequences between the alkali metal oxalates, such as Li-, Na-, K- Oxalates and uric acid using different appropriate equations.

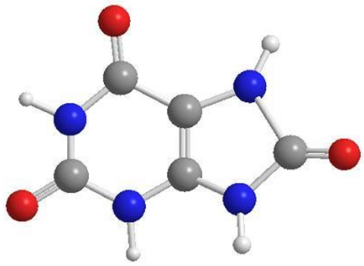

Fig. 1 Molecular Structure of Uric acid

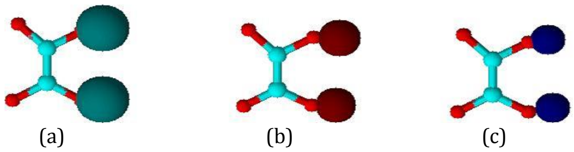

Fig. 2 (a) Potassium oxalate, (b) Sodium oxalate and (c) Lithium oxalate

2. Experimental Methods

2.1 Materials

Lithium oxalate ($Li_2C_2O_4$), Sodium oxalate ($Na_2C_2O_4$), Potassium oxalate ($K_2C_2O_4$), and Uric acid of puriss grade were purchased from Sisco Research Laboratories (SRL Pvt. Ltd. Bombay, India), whereas uric acid was purchased from SRL (S.D. Fine –Chem. Ltd., Mumbai, India). The mass fraction purity of the salts as well as Uric acid taken was ≥0.99. All the above salts were dried heating at 373K for 48 hours and they were stored in a desiccator after cooling.

2.2 Apparatus and Experimental Procedure

Aqueous uric acid solution of 0.00001 M, 0.00002 M, 0.00003 M were prepared using doubly distilled de-ionised water. This was stored and used as solvent. The Solution of Li, Na and K- oxalates of 0.1 M were prepared using the prepared solvent of different concentration separately. The stock solutions of alkali metal oxalates and uric acid soln. were then used to prepare working solution. The weighing was done using Mettler Toledo AG285 with uncertainty of 0.0003 g. All the solutions were prepared at 298.15 K and kept in air tide condition. The working solutions were used to measure density with the help of vibrating U-Tube Anton Paar digital density meter (DMA 4500) with a precision of ±0.00005 gcm^{-3}

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maintained at ±0.01. Passing dry air and using triply distilled water the density meter was calibrated [5]. Viscosity of the solution were measured with the help of Brookfield DV-III Ultra Programmable Rheometer with spindle size -42, fitted to a Brookfield digital bath TC-500 with the accuracy of ±1%. The calibration of the viscometer was done using standard with the Instrument, water and $CaCl_2$ Soln. [6]. The viscosity values were obtained by means of following equation,

$$\eta = (100/RPM) * TK*Torque*SMC \qquad (1)$$

where, RPM, TK (0.09373) and SMC (0.327) are the speed, viscometer torque constant and spindle multiplier torque constant respectively. The results obtained with a precision of 0.3%. The refractive indices of the solutions were measured using Mettler Toledo digital Refractometer with uncertainty of ±0.0002 units. A LED bulb, the source of the light with λ= 589.3 nm, was used in this instrument. Calibration was done with doubly distilled water twice and checked after every two readings.

3. Results and Discussion

3.1 Density Measurement

The study of density leading to the calculation of apparent molar volume (Φ_v) and limiting apparent molar volume (Φ_v^0) help to understand the interactions taking place in the solution. Apparent molar volume is the sum of the geometric volume of the solute molecules and the change in the solvent volume due to its interaction with the solute. Using the following Eq.(2) the value of apparent molar volume (Φ_v) was measured (Table 1)

$$(\Phi_v) = M/\rho - 1000.(\rho - \rho^0) / m.\rho.\rho^0 \qquad (2)$$

where, M is the molar mass of the solute molecule, m is the molarity of the solution, ρ and ρ^0 are the densities of the solution and aqueous solvent of uric acid respectively. It is found from Table 1 that the values of Φ_v i.e., apparent molar volume are positive, which suggests that there is the interaction between the solute and the solvent molecules. The values of Φ_v are found to be decreased with the increase in the concentration of the alkali metal oxalates. The values of Φ_v^0 i.e., Limiting apparent molar volume calculated from the Masson equation [7]

$$\Phi_v = \Phi_v^0 + S_V^*. \sqrt{C} \qquad (3)$$

where, Φ_v^0 is the Partial molar volume at infinite dilution and S_V^* is the experimental slope. The plot of Φ_v against the molar concentration found to be linear and with negative slopes. The values of Φ_v^0 and S_V^* are reported in the Table 1. From the Table 1 it is found that the values of Φ_v^0 are positive and increase with the temperature as well as the mass fraction of the co-solute [8].

From the Table 1 it is seen that the values of Φ_v^0 are positive for Li, Na and K oxalates at 293.15 K, 303.15 K and 313.15 K as well as at different mass fraction of the uric acid. This indicates that there is predominant over the solute-solute interaction and the trend of solute-solvent interaction is higher for K-Oxalate compared to Na-Oxalate and which is also higher than Li-Oxalate [9-11].

Table 1 The values of apparent molar volume (ϕ_V), limiting apparent molar volume (ϕ_V^0), SV* of Li-Ox, Na-Ox, K-Oxat different mass fractions of aqueous UA solution at 293.15 K, 303.15 K, 313.15 K

T (K)	Mol.	$\phi_V \cdot 10^6 / m^3.mol^{-1}$			$\phi_v^0 \cdot 10^6 / m^3 \cdot mol^{-1}$			$S_V^* \, 10^6 / m^3 \cdot mol^{-3/2} \, dm^{3/2}$		
W$_1$= 0.00001										
		Li	Na	K	Li	Na	K	Li	Na	K
293.15	0.010	97.04	103.15	120.4	137.92	140.24	142.71	-402.33	-353.12	-230.91
	0.025	74.81	86.12	104.8						
	0.040	57.73	70.60	95.88						
	0.055	43.42	56.99	89.10						
	0.070	30.94	46.64	82.36						
	0.085	20.28	36.05	74.46						
303.15	0.010	91.25	107.51	114.7	139.04	141.43	143.96	-456.52	-345.19	-292.95
	0.025	70.17	87.53	98.21						
	0.040	47.08	70.77	85.06						
	0.055	31.11	58.22	73.61						
	0.070	17.68	49.62	65.20						
	0.085	5.45	42.40	59.76						
313.15	0.010	92.61	109.84	126.2	140.05	142.89	145.28	-444.27	-311.78	-187.32
	0.025	73.67	95.12	116.3						
	0.040	50.54	81.62	108.3						
	0.055	35.26	68.71	99.18						
	0.070	22.21	59.88	94.68						
	0.085	8.67	50.62	91.53						
W$_1$= 0.00002										
		Li	Na	K	Li	Na	K	Li	Na	K
293.15	0.010	98.03	105.14	118.4	137.92	140.24	142.71	-402.33	-353.12	-230.91
	0.025	79.61	85.31	107.6						
	0.040	61.48	71.09	96.37						
	0.055	45.23	58.08	87.63						
	0.070	33.09	46.63	79.77						
	0.085	24.05	36.40	73.51						
303.15	0.010	96.25	106.39	113.6	139.04	141.43	143.96	-456.52	-345.19	-292.95
	0.025	68.15	89.93	98.60						
	0.040	45.57	73.02	86.81						
	0.055	32.02	60.22	76.34						
	0.070	18.40	50.47	65.19						
	0.085	8.40	41.80	56.80						
313.15	0.011	92.61	109.84	126.2	142.04	143.35	146.4	-448.5	-384.14	-202.14
	0.025	71.64	84.64	113.9						
	0.040	53.05	66.50	105.5						
	0.055	37.27	53.50	99.54						
	0.070	22.50	41.02	92.51						
	0.085	9.50	29.52	86.66						
W$_1$=0.00003										
		Li	Na	K	Li	Na	K	Li	Na	K
293.15	0.010	101.02	106.13	120.4	141.29	142.76	144.52	-402.37	-359.09	-247.22
	0.025	77.59	86.10	104.8						
	0.040	60.97	72.09	94.60						
	0.055	46.50	57.89	86.34						
	0.070	33.94	47.91	78.76						
	0.085	24.40	37.10	72.68						
303.15	0.010	96.24	108.38	112.6	142.34	144	145.76	-296.17	-350.69	-304.07
	0.025	70.15	89.11	99.39						
	0.040	48.07	73.51	87.05						
	0.055	33.11	61.31	75.42						
	0.070	19.40	51.32	64.04						
	0.085	8.52	40.97	54.90						
313.15	0.010	96.62	104.78	126.2	143.77	145.27	147.95	-453.35	-387.69	-205.72
	0.025	73.25	84.63	116.3						
	0.040	54.05	68.51	106.8						
	0.055	37.27	55.14	100.4						
	0.070	22.06	41.74	92.79						
	0.085	10.69	30.23	86.65						

Table 2 The values of a_0, a_1, a_2, φ_E^0, $(\delta^0E/\delta T)_p$ Li-Ox, Na-Ox, K-Ox at different mass fractions of aqueous UA solution at 293.15 K to 313.15 K

w$_1$	T (K)	a0	a1	a2	Φ_E^0	$(\delta^0E/\delta T)_p$
Li-Ox						
0.00001	293.15	148.92	-0.315	0.0009	0.212	0.002
	303.15	148.92	-0.315	0.0009	0.230	
	313.15	148.92	-0.315	0.0009	0.248	
0.00002	293.15	316.60	-1.408	0.0027	0.175	0.005
	303.15	316.60	-1.408	0.0027	0.229	
	313.15	316.60	-1.408	0.0027	0.283	
0.00003	293.15	319.70	-1.394	0.0027	0.190	0.005
	303.15	319.70	-1.394	0.0027	0.244	
	313.15	319.70	-1.394	0.0027	0.298	
Na-Ox						
0.00001	293.15	159.66	-0.363	0.0010	0.223	0.002
	303.15	159.66	-0.363	0.0010	0.243	
	313.15	159.66	-0.363	0.0010	0.263	
0.00002	293.15	259.54	-0.872	0.0016	0.066	0.003
	303.15	259.54	-0.872	0.0016	0.098	
	313.15	259.54	-0.872	0.0016	0.130	
0.00003	293.15	129.07	-0.153	0.0007	0.258	0.001
	303.15	129.07	-0.153	0.0007	0.272	
	313.15	129.07	-0.153	0.0007	0.286	
K-Ox						
0.00001	293.15	297.15	-1.273	0.0025	0.192	0.005
	303.15	297.15	-1.273	0.0025	0.242	
	313.15	297.15	-1.273	0.0025	0.292	
0.00002	293.15	104.08	-0.014	0.0004	0.221	0.001
	303.15	104.08	-0.014	0.0004	0.229	
	313.15	104.08	-0.014	0.0004	0.237	
0.00003	293.15	269.42	-1.075	0.0022	0.215	0.004
	303.15	269.42	-1.075	0.0022	0.259	
	313.15	269.42	-1.075	0.0022	0.303	

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3.2 Limiting Apparent Molar Volume

Using the polynomial Eq.(4) the variation with temperature of $\Phi v^0$of alkali metal oxalates with aqueous uric acid solution can be explained.

$$\Phi v^0 = a_{0} + a_1 T + a_2 T^2 \qquad (4)$$

where, a_0, a_1,a_2 are the empirical coefficients depending on the solute, mass fraction (w_1) of the co-solute uric acid and T is the temperature range in kelvin. In Table 1, the values of the coefficient are given. The Limiting molar expansibilities (Φ_E^0) can be obtained by the Eq. (5).

$$\Phi_E^0 = (\delta \Phi v^0/\Delta T)_P = a_1 + 2a_2 T^2 \qquad (5)$$

The values of Φ_E^0obtained for different temperatures and different mass fraction of Li, Na, K –oxalates are reported in Table 2.

It is seen from the table that the values of Φ_E^0 are positive for all the alkali metal oxalates at different temperatures and different mass fraction of co-solute uric acid. Loren G. Hepler [12] developed a technique to examine the sign of $(\delta \Phi v^0/\Delta T)_P$ in term of long range structure-making and structure-breaking capacity of the solute in the mixed solvent system using the general thermodynamic equation.

$$(\delta \Phi_E^0/\delta T)_P = (\delta^2 \Phi v^0/\delta T^2)_P = 2a_2 \qquad (6)$$

If the sign of $(\delta^2 \Phi v^0/\delta T^2)_P$is positive or a small negative, the molecule is structure maker and otherwise structure breaker. The values of $(\delta \Phi_E^0/\delta T)_P$ are found to be positive from Table 2, which explains that the alkali metal oxalates are predominantly structure maker in the said solvent system.

3.3 Viscosity Calculation

The experimentally obtained data was analysed using Jones-Dole equation [13]

$$(\eta/\eta_0 - 1).m^{1/2} = A + B.m^{1/2} \qquad (7)$$

where η and η_o are the viscosity coefficients of the solution and the pure solvent respectively. M is the molarity of the ternary solution. A and B are the empirical constants, known as viscosity A co-efficient and B co-efficient [14, 15]. A signifies the solute – solute interaction and B signifies the Solute- Solvent interaction. The values are listed in the Table 3 and Table 4. It is seen that with the increase in the mole fraction of alkali metal oxalates in the solutions the values of A increases slightly which indicates that there is a slight solute-solute interaction. This is also supported from the values obtained for Sv*. The B values also increase with the increase in the mass fraction of the Uric acid in the solvent mixture. It can be explained from the significantly growing values of B with mass fraction that the solute-solvent interaction is predominating over the solute-solute interaction. The higher B co-efficient values for higher viscosity values are due to the solvated solute molecules associated by the solvent molecules all-round to the formation of associated molecules by solute- solvent interactions, would present greater resistance. This solute-solvent interaction is increased with the increase of the mass fraction of Uric acid in the solvent.

It is also found that the B value decreases with the increase in the temperature for a particular alkali metal oxalate (Table 5 and Fig. 3).

Table 3 The values of density (ρ_0), viscosity (η_0) and refractive index (n_D) of Li-Ox, Na-Ox, K-Ox at different mass fractions of aqueous UA solution at 293.15 K, 303.15 K, 313.15 K

w_1	293.1 K	303.1 K	313.1 K	293.1 K	303.1 K	313.1 K	298.1 K
	ρ_0 X 10^{-3} (Kgm^{-3})			η_0 (mPa.S)			n_D
0.00001	0.99862	0.99620	0.99230	1.02	0.80	0.66	1.3310
0.00002	0.99868	0.99635	0.99243	1.04	0.82	0.68	1.3322
0.00003	0.99881	0.99647	0.99255	1.06	0.84	0.70	1.3327

Table 4 The values of density (ρ), viscosity (η) of Li-Ox, Na-Ox, K-Ox at different mass fractions of aqueous UA solution at 293.15 K, 303.15 K, 313.15 K

W_1= 0.00001							
T (K)	molality	ρ x10^{-3} (Kgm^{-3})			η(mPa.S)		
		Li-Ox	Na-Ox	K-Ox	Li-Ox	Na-Ox	K-Ox
293.15	0.010	0.998	0.998	0.999	1.04	1.04	1.04
	0.025	0.999	0.999	1.000	1.05	1.06	1.06
	0.040	1.000	1.001	1.002	1.07	1.07	1.08
	0.055	1.001	1.002	1.003	1.08	1.09	1.09
	0.070	1.003	1.004	1.000	1.09	1.10	1.11
	0.085	1.005	1.006	1.007	1.11	1.12	1.12
303.15	0.010	0.996	0.996	0.996	0.81	0.82	0.82
	0.025	0.996	0.997	0.998	0.82	0.83	0.83
	0.040	0.997	0.998	1.000	0.83	0.84	0.84
	0.055	0.999	1.000	1.002	0.84	0.85	0.86
	0.070	1.000	1.002	1.004	0.85	0.86	0.87
	0.085	1.002	1.004	1.006	0.86	0.88	0.88
313.15	0.010	0.992	0.992	0.992	0.67	0.67	0.67
	0.025	0.993	0.993	0.994	0.68	0.68	0.69
	0.040	0.994	0.994	0.995	0.69	0.69	0.70
	0.055	0.995	0.996	0.997	0.69	0.70	0.71
	0.070	0.997	0.997	0.998	0.70	0.71	0.72
	0.085	1.000	1.000	1.000	0.71	0.72	0.72
W_1= 0.00002							
293.15	0.010	0.998	0.998	0.999	1.06	1.06	1.06
	0.025	0.999	0.999	1.000	1.08	1.08	1.08
	0.040	1.000	1.001	1.002	1.09	1.10	1.10
	0.055	1.001	1.002	1.004	1.11	1.11	1.12
	0.070	1.003	1.004	1.006	1.12	1.13	1.13
	0.085	1.005	1.006	1.008	1.14	1.14	1.15
303.15	0.010	0.996	0.996	0.997	0.84	0.84	0.84
	0.025	0.997	0.997	0.998	0.85	0.85	0.85
	0.040	0.998	0.998	1.000	0.86	0.86	0.87
	0.055	1.000	1.000	1.002	0.87	0.88	0.88
	0.070	1.002	1.002	1.004	0.88	0.89	0.89
	0.085	1.004	1.004	1.007	0.89	0.90	0.90
313.15	0.010	0.992	0.992	0.993	0.69	0.69	0.70
	0.025	0.993	0.993	0.994	0.70	0.71	0.71
	0.040	0.994	0.995	0.995	0.71	0.72	0.72
	0.055	0.996	0.996	0.997	0.72	0.73	0.73
	0.070	0.998	0.998	0.998	0.73	0.74	0.74
	0.085	1.000	1.001	1.000	0.74	0.75	0.75
W_1= 0.00003							
293.15	0.010	0.998	0.999	0.999	1.08	1.08	1.08
	0.025	0.999	1.000	1.000	1.10	1.10	1.10
	0.040	1.000	1.001	1.002	1.12	1.12	1.12
	0.055	1.001	1.003	1.004	1.13	1.13	1.14
	0.070	1.003	1.004	1.006	1.15	1.15	1.16
	0.085	1.005	1.007	1.008	1.16	1.16	1.17
303.15	0.010	0.996	0.996	0.997	0.86	0.86	0.86
	0.025	0.997	0.997	0.998	0.87	0.87	0.88
	0.040	0.998	0.998	1.000	0.88	0.89	0.89
	0.055	1.000	1.000	1.002	0.90	0.90	0.90
	0.070	1.002	1.002	1.004	0.91	0.91	0.92
	0.085	1.004	1.004	1.007	0.92	0.92	0.93
313.15	0.010	0.992	0.992	0.993	0.71	0.72	0.72
	0.025	0.993	0.993	0.994	0.73	0.73	0.73
	0.040	0.994	0.995	0.995	0.74	0.74	0.75
	0.055	0.996	0.996	0.997	0.75	0.75	0.76
	0.070	0.998	0.999	0.999	0.76	0.76	0.77
	0.085	1.000	1.001	1.001	0.77	0.77	0.78

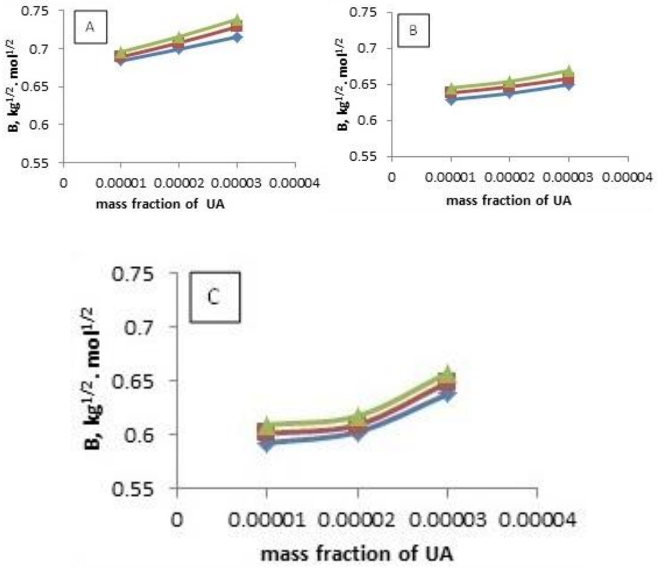

Fig. 3 Plot of viscosity B-coefficient of Li-Ox (♦), Na-Ox (■), K- Ox (▼) at 293.15K (A), 303.15K (B), 313.15K (C) in aqueous Uric acid (UA) solution

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Table 5 Values of viscosity A and *B*-coefficient for Li-Oxalate, Na-Oxalate, K-Oxalate against different mass fraction of aqueous UA (w_1) solution

T= 293.15 K						
w_1	Li	Na	K	Li	Na	K
	A (Kg. mol^{-1})			B (Kg $^{1/2}$ $mol^{-1/2}$)		
0.00001	0.090	0.117	0.142	0.684	0.689	0.696
0.00002	0.113	0.131	0.148	0.700	0.708	0.716
0.00003	0.114	0.118	0.149	0.716	0.729	0.739
T= 303.15 K						
0.00001	0.088	0.133	0.146	0.629	0.638	0.645
0.00002	0.121	0.147	0.155	0.637	0.647	0.654
0.00003	0.127	0.141	0.165	0.650	0.658	0.669
T= 313.15 K						
0.00001	0.082	0.133	0.153	0.593	0.601	0.610
0.00002	0.124	0.150	0.164	0.603	0.609	0.617
0.00003	0.142	0.174	0.190	0.638	0.649	0.657

3.4 Refractive Index

To investigate the ion solvent interaction measurement of refractive index is the convenient method. The values of the refractive index are supplied in Table 6. The Lorentz-Lorenz relation [16] can be used to evaluate the molar refraction.

$$R_M = \{(n_D^2-1)/(n_D^2+2)\}. M/\rho \qquad (8)$$

where, R_M is the molar refraction, n_D is the refractive index, m is the molar mass of the solute and ρ is the density of the solution. The refractive index of a substance, C_0/C, $C_0$and C are the speed of light in the vacuum and the solution respectively, describes its ability to refract light as it moves from one medium to another and thus the higher the surface index of the compound the more the light is refracted [17].

The higher refractive index value indicates the molecules are more closely packed or the density is higher [16]. Thus the molar refraction R_M increases with the increase with the mass fraction of the aqueous uric acid mixture.

It is seen from the Table 6 that the values of R_M for K-Oxalate are higher compared to that of the Na-Oxalate and which are higher than Li-Oxalate. Thus the values indicate that the solute-solvent interaction trend is K-Oxalate>Na-Oxalate>Li-Oxalate. This trend is also supported by the density and viscosity analysis.

Table 6 The values of refractive index (n_D) and molar refractive index (R_M)of Li-Ox, Na-Ox, K-Oxat different mass fractions of aqueous UA solution at 298.15 K

		n_D (298.15 K)			R_M $m^3.mol^{-1}$ (at 298.15 K)		
W_1	molality	Li-Ox	Na-Ox	K-Ox	Li-Ox	Na-Ox	K-Ox
0.00001	0.010	1.332	1.333	1.333	20.921	27.571	37.940
	0.025	1.332	1.333	1.333	20.943	27.579	37.969
	0.040	1.333	1.334	1.334	20.973	27.587	37.986
	0.055	1.334	1.334	1.334	20.974	27.589	38.004
	0.070	1.335	1.335	1.335	20.975	27.597	38.016
	0.085	1.335	1.336	1.337	20.982	27.607	38.032
0.00002	0.010	1.333	1.333	1.334	20.999	27.622	37.984
	0.025	1.334	1.334	1.334	21.011	27.634	37.998
	0.040	1.334	1.335	1.335	21.023	27.643	38.010
	0.055	1.335	1.335	1.336	21.031	27.649	38.024
	0.070	1.336	1.336	1.337	21.041	27.656	38.041
	0.085	1.337	1.337	1.338	21.049	27.663	38.053
0.00003	0.010	1.334	1.334	1.334	21.031	27.671	28.051
	0.025	1.334	1.335	1.335	21.053	27.691	28.092
	0.040	1.335	1.335	1.336	21.071	27.708	28.132
	0.055	1.336	1.336	1.337	21.087	27.728	28.170
	0.070	1.337	1.337	1.338	21.102	27.744	28.209
	0.085	1.338	1.338	1.339	21.114	27.750	28.245

4. Conclusion

The viscosity, density and refractive index study of the solution of Li-Oxalate, Na-Oxalate, K-Oxalate in aqueous uric acid solvent of different concentration leads to the conclusion that solute solvent interaction is predominant over the solute-solute interaction and solute-solvent interaction is higher in case of K-Oxalate than sodium oxalate and which is greater than Li-Oxalate. One plausible reason is the size of the metal ion. The hydrated size of the K^+ is less compared to that of the Na^+ and which is less than Li^+. Due to this size factor the K^+ comes more closer compared to that of the others. The same can be concluded for Na-Oxalate than the Li-Oxalate. This result indicates that potassium oxalate can more easily penetrate into the accumulated uric acid in the joints of the human body than that of sodium and lithium oxalates thereby releasing the accumulated uric acid rendering the recovery of gout pain due to stronger solute solvent interactions as discussed above. This is an excellent agreement with that as reported earlier [18].

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References

[1] A. M.Elasbali. Association of serum uric acid with body mass index amongst saudi civilians, Jour. Sci. 4 (2014) 394-397.

[2] L.H. Lai, S.Y. Chou, F.Y Wu, J.J. Chen, H.W. Kuo, Renal dysfunction and hyperuricemia with low blood lead levels and ethnicity in community-based study, Sci. Total Environ. 401 (2008) 39-43.

[3] N.A. Shadick, R. Kim, S. Weiss, M.H. Liang, D. Sparrow, H. Hu, Effect of low level lead exposure on hyperuricemia and gout among middle aged and elderly men: the normative aging study, J. Rheumatol. Jul. 27 (2000) 1708-1712.

[4] A.B. Garrod, The nature and treatment of gout and rheumatic gout, London, Walton, 1859.

[5] C. Zhao, P. Ma, J. Li, Partial molar volumes and viscosity B-coefficients of arginine in aqueous glucose, sucrose and L-ascorbic acid solutions at T = 298.15 K, J. Chem. Thermodyn. 37 (2005) 37-42.

[6] D. Ekka, M.N. Roy, Quantitative and qualitative analysis of ionic solvation of individual ions of imidazolium based ionic liquids in significant solution systems byconductance and FT-IR spectroscopy, RSC Adv. 4 (2014) 19831–19845

[7] D.O. Masson, Solute molecular volumes in relation to solvation and ionization, Philos. Mag. 8 (1929) 218-225.

[8] T.S. Banipal, G. Singh, B.S. Lark, Partial molar volumes of transfer of some amino acids from water to aqueous glycerol solutions at 25 °C, J. Sol. Chem. 30 (2001) 657-670.

[9] M.N. Roy, B. Sinha, R. Dey, A. Sinha, Exploring solute–solvent interactions of α-amino acids in aqueous [EPyBF4] arrangements by volumetric, viscometric, refractometric, and acoustic approach, Int. J. Thermophys. 26 (2005) 1549-1563

[10] M.N. Roy, A. Bhattacharjee, P. Chakraborti, Investigation on molecular interactions of nicotinamide in aqueous citric acid monohydrate solutions with reference to manifestation of partial molar volume and viscosity B-coefficient measurements, Thermochim. Acta 507-508 (2010) 135-141.

[11] F.J. Millero, The molal volumes of electrolytes, Chem. Rev. 71 (1971)147-174.

[12] L. Hepler, Thermal expansion and structure in water and aqueous solutions, Can. Jour. Chem. 47 (1969) 4613-4717.

[13] G. Jones, M. Dole, The viscosity of aqueous solutions of strong electrolytes with special reference to barium chloride, J. Am. Chem. Soc. 51 (1929) 2950-2964.

[14] F.J. Millero, A. Losurdo, C. Shin, The Apparent molal volumes and adiabatic compressibilities of aqueous amino acids at 25° C, J. Phys. Chem. 82 (1978) 784-792.

[15] V. Minkin, O. Osipov, Y. Zhdanov, Dipole moments in organic chemistry, Plenum Press, New York, 1970.

[16] M. Deetlefs, K. Seddon, M. Shara, Predicting physical properties of ionic liquids, Phys. Chem. Chem. Phys. 8 (2006) 642-649.

[17] M.N. Roy, M.C. Roy, S. Basak, Exploring solute–solvent interactions of α-amino, acids in aqueous [EPyBF4] Arrangementsby volumetric, viscometric, refractometric, and acoustic approach, Int. J. Thermophys. 35 (2014) 853-864.

[18] A. Kanbara, M. Hakoda, I. Seyama, Urine alkalization facilitates uric acid excretion, Nutrit. Jour. 9 (2010) 1-5.