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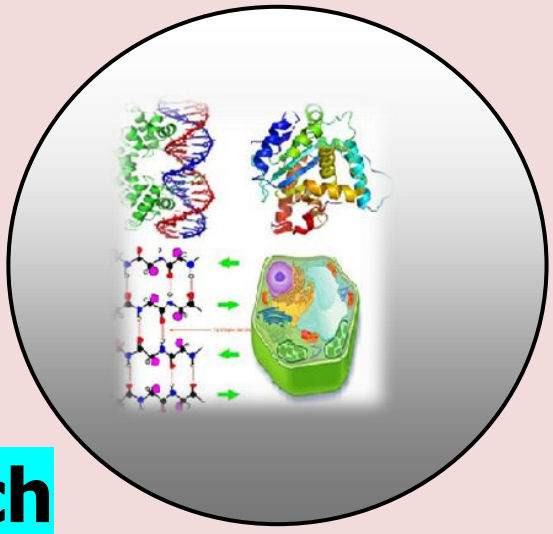

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RESEARCH PAPER

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Characteristics of N^+-DTT in Water and Aqueous Maltose Solutions at 303ºK

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ABSTRACT

The present paper deals with ultrasonic study on the solution properties of Dithieno-thiophenetrimethyl ammonium iodide (N^+-DTT) in binary and ternary solution. The measurement of ultrasonic velocity, density and viscosity were studied with water maltoase at 303ºK. N^+-DTT is a cationic surfactant having molecular weight 736.5. It is white crystal type solid. It is 100% soluble in water. Maltose is also known as malt sugar and is obtained by the action of diastase upon starch.
Key words— N^+-DTT, Aqueous Maltose and Ultrasonic Velocity.

INTRODUCTION

Maltose is 4[(⍰-D-glucopyransyl) or (⍰-D-glucopyransyl)]. It is also known as malt sugar, and is obtained by the action of diastase (an enzyme in malt) upon starch. Acid hydrolysis of starch also gives maltose as an intermediate product which is further hydrolyzed to glucose on complete hydrolyzed its molecular formula is $C_{12}H_{22}O_{11}$ and its molecular weight is 360.32 gm. The values of specific rotation of (⍰) Dare + 1680 for – maltose + 112^0 for ⍰-maltose and + 136^0 the equilibrium mixture.

N^+-DTT play significant role in several fields of chemistry. Role of biomolecules such as carbohydrates on thermodynamic characteristics of ternary and quaternary solution and their interaction with electrolytic are biologically and physico-chemically significant. Ultrasonic technique has not been used for studying such a system. It is newly developed technique for investing intermolucular interaction, structural characteristics and hydraction of detergents biomolecular solution. In recent past, the interactions and thermodynamic characteristics of ternary system consisting of electrolytes have been subjected to several, physico-chemical investigation (Chattopadhyay and Lahiri, 1982, Gavish, et al., 1983) because of their physico-chemical importance.

Robinson *et al.* (1962) have extensively studied the aqueous and non-aqueous ternary systems containing poly-hydroxy compounds.

The present paper deals the structural behaviour of maltose aqueous N^+-DTT solution by ultrasonic measurements. This study also deals with the interaction of N^+-DTT with maltose in its aqueous solutions in terms of various acoustical parameters.

EXPERIMENTAL

Binary solutions of N^+-DTT of different molarities (0-10M) were prepared by weight-dilution method. The ternary solutions of N^+-DTT of different molarities were also prepared in similar way.

Ultrasonic interferometer has been used for measuring ultrasonic velocity of solutions at 300K in present study single crystal ultrasonic interferometer was used at a fixed frequency of MHz.

The viscosity of N^+-DTT solution in water and in 0.5M. Maltose solution were measured at 303 K by calibrated Ostwald's Viscometer in conventional way using same thermostat.

RESULT AND DISCUSSION

Results of ultrasonic velocity (U) Vs N^+-DTT molarity (mM) in water and in 0.5M maltose solution at 303ºK are shown in the Table 1. The table indicates the presence of short range weak interactions and no distinct structural interaction of N^+-DTT in present system.

A adiabatic compressibility in most significant thermodynamic and acoustic parameter related to ultasonic velocity. The data of compressibiity N^+-DTT in binary and ternary solution at 303ºK are given in the table 2. From the table it is clear that there is short range weak interaction and no distinct structural interaction of N^+-DTT system being studied.

Table 1. Ultrasonic Velocity (U)/mS^{-1}, Density ( ) $\times 10^{-3}$/Kgm^{-3} and Viscosity ( ) NM^{-1} of N^+-DTT in Water and in 0.5M Maltose Solution at 303ºK.

N^+-DTT Molarity (mM)	0.0M Water			0.5M Maltose		
	U			U		
00	1508	0.9956	0.8007	1568	1.0438	1.0493
01	1516	0.9946	0.7142	1566	1.0455	1.0510
02	1520	0.9959	0.7437	1565	1.0452	1.0206
0.3	1522	0.9951	0.7145	1568	0.0457	1.0212
0.4	1522	0.9943	0.7425	1569	1.0467	1.0222
0.5	1518	0.9948	0.7143	1575	1.0472	1.0526
0.6	1520	0.9955	0.6862	1570	1.0467	1.0522
0.7	1524	0.9956	0.7434	1569	1.0458	0.9912
08	1522	0.9952	0.7143	1568	1.0466	1.0222
09	1519	0.9959	0.7152	1569	1.0467	1.0222
10	1520	0.9952	0.7146	1573	1.0492	1.0547

Table 2. Adiabatic Compressibility (s)/TPa^{-1} and Hydration Number (Hn) $\times 10^7$ of N^+-DTT in Water and in 0.5M Maltose Solution at 303ºK.

N^+-DTT Molarity (mM)	0.0M Water		0.5M Maltose	
	s	H_n	s	H_n
00	442	0.00	389	0.00
01	437	2.03	390	-0.04
02	435	5.70	391	-1.83
0.3	434	9.77	389	0.00
0.4	434	11.40	385	7.33
0.5	436	12.22	384	11.46
0.6	435	17.10	385	9.63
0.7	432	28.50	386	9.63
08	434	26.06	387	7.33
09	435	25.65	385	16.50
10	434	32.57	383	27.52

The hydration number (Hn) is a solution parameter related to adiabatic compressibility (s) of a solution. The hydration number of N^+-DTT in water and in 0.5M maltose solution have been shown in Table 2. This table reveals that in the binary system N^+-DTT shows the maximum hydration number at 7.0mM and 8.0mM.

The result of $_{ks}$ vs N^+-DTT molarity at 303ºK are also given in the Table 2. This table shows maximum deviation from linearity indicating strong solute-solute interactions.

Table 3. Apparent Molar Compressibility ($\varnothing_{Ks}$)×1022/^{m} 5$m^{-1}mol^{-1}$ and Apparent Molar Volume (vs)×10^3/m^3Mol^{-1} of N^+-DTT Water and in 0.5M Maltose Solution at 303ºK.

N^+-DTT Molarity (mM)	Square root of Molarity ($\sqrt{C}\times10^3$)	0.0M Water		0.5M Maltose	
		$\varnothing_{Ks}$	$\varnothing_{vs}$	$\varnothing_{Ks}$	$\varnothing_{vs}$
00	0.0	0.00	0.01	0.13	0.34
01	31.6	-45.80	947.93	3.88	-1569.13
02	44.7	-35.60	-138.39	7.56	-621.05
0.3	54.7	-25.90	160.48	-2.27	-583.42
0.4	63.2	-16.04	327.22	-12.60	-673.63
0.5	70.7	-11.30	150.16	-12.42	-629.95
0.6	77.4	-11.54	21.703	-8.41	-455.98
0.7	83.6	-14.22	4.02	-5.27	-260.77
08	89.4	-9.76	43.28	-3.77	-330.47
09	94.8	-7.87	-30.47	-5.60	-302.82
10	100	-5.82	38.82	-8.00	-516.33

Table 4. Classical Absorption (/F)×10^{30}/mS^{-2} and Relaxation Frequency (F_r) × 10^{-14} /S^{-1} of N^+-DTT in Water and in 0.5M Maltose Solution at 303ºK.

N^+-DTT Molarity (mM)	0.0M Water		0.5M Maltose	
	/F	F_r	/F	F_r
00	7.72	35.99	6.86	29.23
01	5.42	38.23	6.90	29.10
02	5.60	36.88	6.72	29.90
0.3	5.36	38.47	6.67	30.63
0.4	5.58	36.94	6.59	30.32
0.5	5.40	38.31	6.76	29.52
0.6	5.17	39.97	6.79	29.45
0.7	5.55	37.15	6.45	31.15
08	5.36	38.48	6.63	30.16
09	5.39	38.35	6.59	30.32
10	5.38	38.47	6.25	29.79

Table 5. Relaxation Time ( )×10/s and Relaxation Strength ( ) of N-DTT in Water and in 0.5M Maltose Solution at 303ºK.

N^+-DTT Molarity (mM)	0.0M Water		0.5M Maltose	
00	471.87	-8882.06	544.23	-9603.00
01	416.14	-8976.56	546.52	-9566.28
02	431.34	-9024.50	532.07	-9554.06
0.3	413.45	-9047.76	529.62	-9603.00
0.4	430.65	-9035.87	524.67	-9676.64
0.5	415.24	-9000.25	538.93	-9701.25
0.6	397.99	-9024.00	540.12	-9676.64
0.7	428.19	-9071.56	510.13	-9615.25
08	413.34	-9047.76	527.40	-9639.78
09	414.75	-9012.12	524.67	-9676.64
10	413.51	-9024.00	533.88	-9701.25

Classical Absorption (relaxation amplitude) (α/f^2) is an another ultrasonic parameter co-related with ultrasonic velocity, density and viscosity. The result of classical absorption (α/f^2) vs N^+-DTT (mM) in water and 0.5M maltose solution at 303ºK are shown in Table 4. This table shows maximum deviation from linearity further indicating strong interactions.

The variation of relaxation frequency is also the significant Relaxation parameter for investigation solute-solvent interaction in the system and has been estimated, using equation (3.39). This equation indicates that relaxation frequency is inversely proportional to relaxation time.The results of relaxation frequency (fr) vs N^+-DTT (mM) in water and in maltose solution at 303ºK are shown in the Table-5. The result showing deviations from linearity which further support strong solute-solvent interactions and solute-solute interactions (Conway, and Verrall, 1966, Jasra and Ahluwalia, 1982, Prakash S Srivastava and Sobhay Laxmi (1964).

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