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NOTE

Conductometric Equilibrium Study of Methylmethionine Sulfonium Chloride

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In this study, the determination of dissociation constant of methylmethionine sulfonium chloride (MMSC) by conductance measurements at different concentrations had been carried out. The measurements were carried out at 25 ± 0.1 ºC and 35 ± 0.1 ºC. Equivalent conductance, degree of dissociation, K, pK and dissociation constants are also calculated.

Key Words: Conductometric study, Equilibrium, Methylmethionine sulfonium chloride.

Due to a number of important biological applications, some authors prefer to write methylmethionine sulfonium chloride (MMSC) as vitamin-U[1]. Methylmethionine sulfonium chloride has beneficial power of action on gastric[2], peptic ulcer[2], antiulkas factor, antiinflammatory activity[3], *etc*. This is the major motive to explore methylmethionine sulfonium chloride for its various biochemical properties[4].

Methylmethionine sulfonium chloride has a unique combination of α-amino acid unit as well as ionic chlorine in it which is responsible for its high water solubility and physiological activities. This mostly exists in zwitter ionic form. Whether an amino acid will produce excess H^+ or excess OH^-, depends on the pH of the solution. When a metal ion is added to an aqueous solution, there exists a competition between the hydrogen and a metal ion for the ligand. Determination of dissociation constant of a weak acid by conductance measurements is one of the oldest methods. From the value of molar conductance, free ligand concentration, dissociation constants and degree of dissociation are found. These values are useful to explain of the role of methylmethionine sulfonium chloride. Looking to the fact that methylmethionine sulfonium chloride is having predominate importance in prevention as well as treatment of several diseases in human beings. If necessary precautions are taken care of, the method is fairly reliable. Ostwald was the first person to determine the dissociation constant of a weak electrolyte[5].

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Methylmethionine sulfonium chloride, sodium hydroxide, oxalic acid and perchloric acid used are of AR grade. Solutions were prepared by different dilutions and standardized[6]. The first thermodynamic dissociation constant pK was determined by measuring conductance of methylmethionine sulfonium chloride at different concentrations. Stock solutions of methylmethionine sulfonium chloride 0.05-0.01 M were prepared. From the stock solutions, different concentrations of methylmethionine sulfonium chloride were prepared by dilution. The conductance was measured by conductometer (Equiptronics EQ-361). Specific conductance of water used had conductance less than 1.0×10^{-6} mhos. The measurements were carried out at 25 ± 0.1 ºC and 35 ± 0.1 ºC. The equivalent conductance, degree of dissociation and dissociation constant are calculated[7] (Tables 1 and 2).

TABLE-1
FIRST DISSOCIATION CONSTANT OF METHYLMETHIONINE SULFONIUM CHLORIDE BY CONDUCTOMETRIC METHOD AT 25 ºC

Cell constant: 1.02 cm^{-1} Debye Huckel constant A = 0.5115
λ^o = 119 mhos $cm^2 eq^{-1}$ Debye Huckel constant B = 0.3291

C m molar	Cond. mmho	Equivalent cond. (λ_c)	$\propto = \lambda_c/\lambda^o$	λ^1	pK = [-log k]
0.2	0.023×10^{-3}	118.0140	0.98330	119.43	1.9366
0.4	0.045×10^{-3}	117.0450	0.97540	119.21	1.8096
0.6	0.068×10^{-3}	116.4500	0.97080	119.03	1.7131
0.8	0.091×10^{-3}	116.0250	0.96670	118.89	1.6478
1.0	0.113×10^{-3}	115.2000	0.96000	118.76	1.6375
1.5	0.168×10^{-3}	114.2667	0.95220	118.49	1.5458
2.0	0.223×10^{-3}	113.7300	0.94775	118.26	1.4651
4.0	0.435×10^{-3}	110.9250	0.92500	117.57	1.3407
6.0	0.641×10^{-3}	108.9700	0.90830	117.05	1.2678
8.0	0.834×10^{-3}	106.3375	0.88610	116.63	1.2585
10.0	1.030×10^{-3}	105.0600	0.87550	116.26	1.2107
15.0	1.510×10^{-3}	102.6800	0.85570	115.47	1.1187
20.0	1.940×10^{-3}	98.9400	0.82450	114.86	1.1109
25.0	2.380×10^{-3}	97.1040	0.80920	114.31	1.0666
30.0	2.810×10^{-3}	95.5400	0.79580	113.82	1.0315
35.0	3.191×10^{-3}	92.9900	0.77500	113.41	1.0295
40.0	3.590×10^{-3}	91.5500	0.76250	113.02	1.0090
45.0	3.949×10^{-3}	89.4900	0.74580	112.67	1.0067
50.0	4.310×10^{-3}	87.9240	0.73330	112.33	0.9965

The limitation of the conductometric method restricts the measurement of second dissociation constant[7]. For different temperatures, values obtained by conductometry for the first dissociation constant (Table-3) agrees well with those obtained by other analytical methods. With the help of the values of dissociation constants at various temperatures, the ionic behavior of methylmethionine sulfonium chloride, solubility and distribution of it in aqueous and non-aqueous phases, consequently biological response can be understood.

TABLE-2
FIRST DISSOCIATION CONSTANT OF METHYLMETHIONINE SULFONIUM CHLORIDE BY CONDUCTOMETRIC METHOD AT 35 ºC

Cell constant: 1.02 cm^{-1} Debye Huckel constant A = 0.5210

λ^o = 120 mhos cm^2 eq^{-1} Debye Huckel constant B = 0.3310

C m molar	Cond. mmho	Equivalent cond. (λ_c)	$\propto = \lambda_c/\lambda^o$	λ^1	pK = [-log k]
0.2	0.023×10^{-3}	117.50	0.9873	118.44	1.8138
0.4	0.045×10^{-3}	116.53	0.9792	118.21	1.7347
0.6	0.068×10^{-3}	116.02	0.9749	118.03	1.6437
0.8	0.090×10^{-3}	115.45	0.9701	117.89	1.5989
1.0	0.113×10^{-3}	115.01	0.9664	117.76	1.6560
1.5	0.168×10^{-3}	114.04	0.9583	117.49	1.4810
2.0	0.222×10^{-3}	113.11	0.9505	117.26	1.4376
4.0	0.434×10^{-3}	110.64	0.9297	116.56	1.3076
6.0	0.639×10^{-3}	108.65	0.9130	116.04	1.2404
8.0	0.841×10^{-3}	107.20	0.9008	115.61	1.1837
10.0	1.034×10^{-3}	105.54	0.8868	115.24	1.5820
15.0	1.504×10^{-3}	102.25	0.8592	114.47	1.1040
20.0	1.956×10^{-3}	99.75	0.8382	113.83	1.6012
25.0	2.391×10^{-3}	97.54	0.8196	113.29	1.0311
30.0	2.809×10^{-3}	95.50	0.8025	112.81	1.0095
35.0	3.208×10^{-3}	93.48	0.7855	112.38	0.9970
40.0	3.588×10^{-3}	91.51	0.7689	112.00	0.9900
45.0	3.958×10^{-3}	89.70	0.7538	111.65	0.9835
50.0	4.315×10^{-3}	88.01	0.7395	111.32	0.9789

$\lambda^o = \lambda c \rightarrow \sqrt{C}$ as per graph (intercept = λ^o), $\alpha = \lambda_c/\lambda^o$, $KD_1 = \alpha^2.c/1-\alpha$, $\lambda^1 = \lambda^o-(A + B\lambda^o)\sqrt{\propto c}$ (Debye-Huckel law), Dissociation constant $pKD_1 = -\log KD_1$ = as per graph.

TABLE-3
ACID DISSOCIATION CONSTANT VALUES OBTAINED FROM GRAPH BY CONDUCTOMETRY

Temperature	25 ± 0.1 ºC	35 ± 0.1 ºC
pk_1	2.12	2.02

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