Determination Of Stability Constant And Thermodynamic Parameter Between Zn^{2+} And Paracetamol ConductometricallyAt Constant Temperature

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Abstract : Stability constant of complex formed between Zn2+ and paracetamol was estimated by Job's method by measuring conductance of solution using method of continuous variation. The measurement was performed by using conductometric method. The titration should performed between Zn2+ and paracetamol solution to find out ratio of complexation at 308^0K . experiments were performed by using analytical grade $ZnSO_4$with paracetamol by using equiptronics conductivity meter, conductivity cell having cell constant one. The ratio of complexation between Zn^{2+} and paracetamol is 1:1. Negative value of free energy change indicate spontaneity of complexation process.

KEYWORDS*:* Conductometry, Zn^{2+} Free energy change, Paracetamol, Stability constant.

I. INTRODUCTION

Paracetamol (N-acetyl para amino phenol) is widely used as antipyretic drug to control fever and to get relief from pain, known for their antipyretic and analgesic action [1]. Less soluble in water but moderately soluble in hot water. Ethylalcohol, methyl alcohol and ester [2.3]. Various methods such as, Potentiometry, spectrophotometry, Calorimetry, Polarography, Colorimetry, Hpoint standard addition method and other methods have been employed [4-9] . Stability constant of levofloxacinfarfloxacin was measured conductometrically [10]. stability constant also measured by conductometrically [11].For measurement of stability constant by using Conductometric technique is very versatile method used for determination of stability constant.

II. RESEARCH METHODOLOGY

2.1 Experimental: -

Material and methods: -The chemicals used for experiments were of Analytical Grade. Pure sample of paracetamol was make available from apex. Metal salt $ZnSO_4$ $7H_2O$ was make available from Merck. The solvents used were conductivity water. Conductometric measurement is carried out using Equiptronics digital conductivity meter model no. EQ 660A.

III. RESULT AND DISCUSSION

3.1 Ligand – Metal ratio:

The solution of 0.01 M concentrated ZnSO4 and paracetamol solution are prepared in conductivity water10 ml of ligand was diluted to 20 ml with conductivity water[Table 3.1]. The ligand was titrated against metal salt solution. Conductance was recorded after each addition. Graph was plotted between corrected conductance and volume of metal salt added. [Figure 1] From the equivalence point in the graph , it has been concluded that the complex formation has taken place in the ratio of 1:1 (Ligand: Metal) .Stability constants and free energy change was calculated by using Job's method [12] of continuous variation modified by Turner and Anderson [13].

Table 3.1: Conductometric Titration between paracetamol and $ZnSO_4$

S. No.	Vol. of Metal Salt (ml)	Observed Conductance(ms)	Corrected Conductance(ms)
1.	0	0.053	1.053
2.	0.5	0.219	1.269
3.	1	0.381	1.481
4.	1.5	0.503	1.653
5.	2	0.635	1.835
6.	2.5	0.726	1.976
7.	3	0.821	2.121
8.	3.5	0.902	2.252
9.	4	0.986	2.386
10.	4.5	1.055	2.505
11.	5	1.119	2.619
12.	5.5	1.168	2.718
13.	6	1.227	2.827
14.	6.5	1.278	2.928
15.	7	1.331	3.031
16.	7.5	1.374	3.124
17.	8	1.418	3.218
18.	8.5	1.458	3.308
19.	9	1.498	3.398
20.	9.5	1.536	3.486
21.	10	1.572	3.572
22.	10.5	1.599	3.649
23.	11	1.632	3.732
24.	11.5	1.664	3.814
25.	12	1.717	3.917
26.	12.5	2	3.99
27.	13	1.765	4.065
28.	13.5	1.795	4.145
29.	14	1.81	4.21
30.	14.5	1.825	4.275
31.	15	1.848	4.348
32.	15.5	1.86	4.41
33.	16	1.891	4.491
34.	16.5	1.903	4.553
35.	17	1.924	4.624
36.	17.5	1.932	4.682
37.	18	1.949	4.749
38.	18.5	1.964	4.814
39.	19	1.978	4.878
40.	19.5	1.884	4.834
41.	20	1.89	4.89

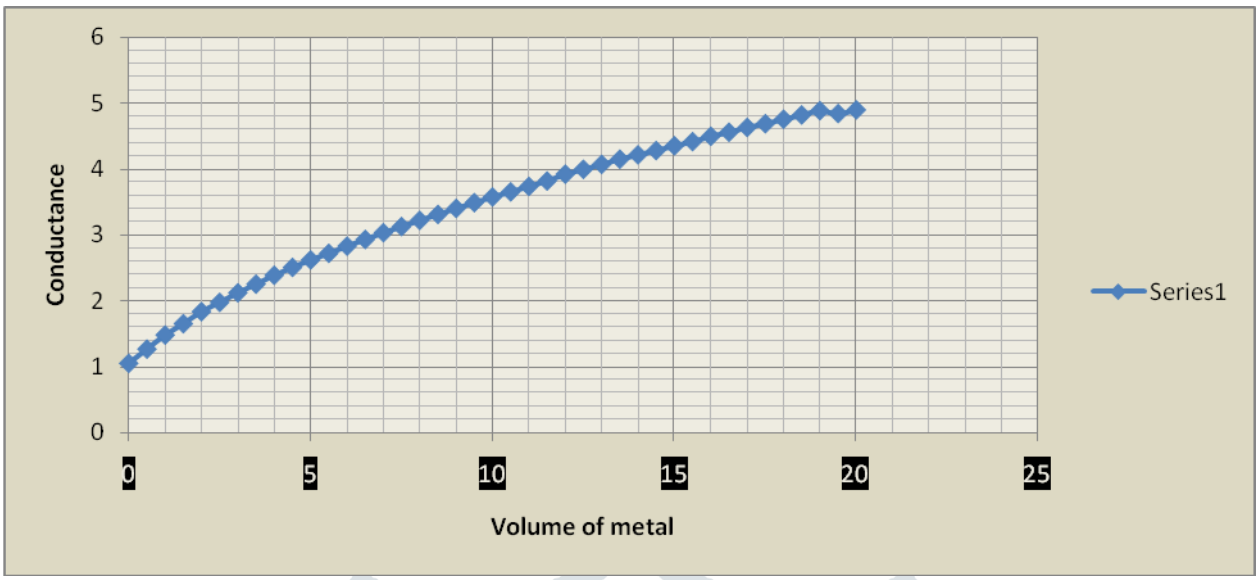

Figure – 1 Conductometric titration between paracetamol ZnSO4

3.2 Modified Job's Method of continuous variation for determining composition and stability constant of complex

From equimolar solution of ZnSO4 and paracetamol three sets were prepared A1,A2and A3 for concentration 0.01. set A1 was prepared by mixing ZnSo4 from 2ml to 20ml and paracetamol 20ml to2ml ,In, set A2 ZnSO4 was filled with volume 2ml to 20ml and in set3 paracetamol solution was filled with volume 2ml to20ml, Conductance was recorded for each solution. Change in conductance(ΔA) was calculated from difference between set (A2+A3)- setA1.The same procedure was adopted for measurement of conductance for concentration 0.005. Graph were plotted between change in conductance versus mole fraction. The stability constant composition ratio were determined from the graph 2. The result are recorded in table 3.2 and 3.3

TABLE 3.2: Modified Job's Method (0.01M at 35^0C)

Ratio	Conductance (mS)				
	Metal: Ligand(A1)	Metal: Solvent (A2)	Ligand: Solvent (A3)	(A2+A3)	(A2+A3 – A1) ΔA
1:9	0.279	0.28	0.037	0.317	0.038
2:8	0.365	0.366	0.046	0.412	0.047
3.33: 6.67	0.43	0.436	0.047	0.483	0.053
4:6	0.517	0.529	0.048	0.577	0.06
5:5	0.579	0.593	0.047	0.64	0.061
6:4	0.684	0.695	0.046	0.741	0.057
6.67:3.33	0.78	0.784	0.047	0.831	0.051
8:2	0.882	0.882	0.046	0.928	0.046
9:1	0.957	0.95	0.046	0.996	0.039

TABLE 3.3: Modified Job's Method (0.005M at 35^0C)

Ratio	Conductance (mS)				
	Metal: Ligand(A1)	Metal: Solvent (A2)	Ligand: Solvent (A3)	(A2+A3)	(A2+A3 – A1) ΔA
1:9	0.214	0.215	0.023	0.238	0.024
2:8	0.289	0.291	0.026	0.317	0.028
3.33: 6.67	0.405	0.414	0.028	0.442	0.037
4:6	0.46	0.474	0.029	0.503	0.043
5:5	0.5	0.516	0.028	0.544	0.044
6:4	0.607	0.62	0.028	0.648	0.041
6.67:3.33	0.695	0.705	0.027	0.732	0.037
8:2	0.813	0.816	0.026	0.842	0.029
9:1	0.884	0.885	0.025	0.91	0.026

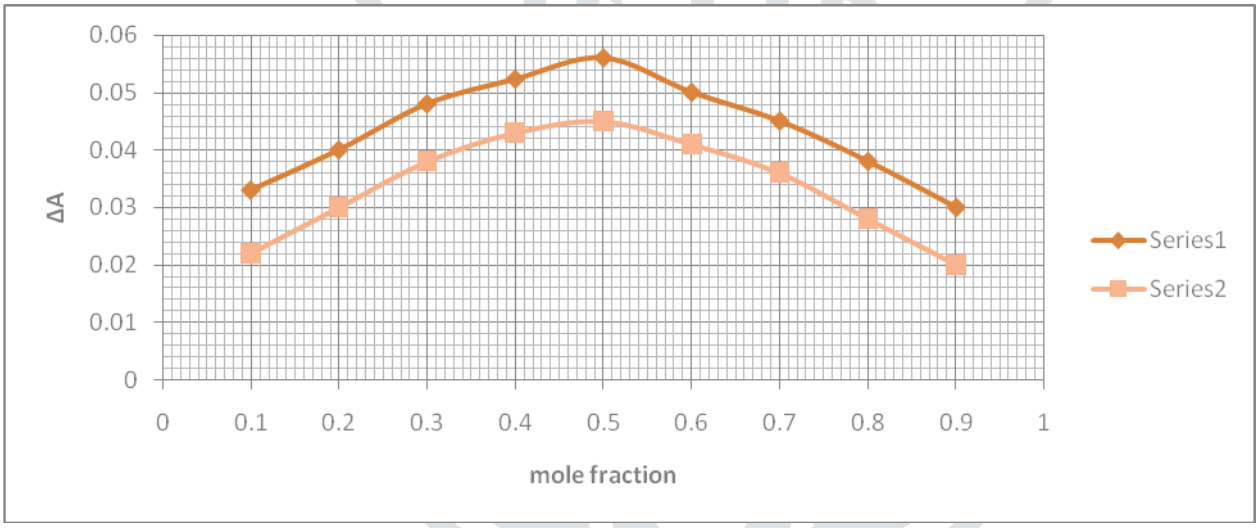

Figure 2 Metal ratio Versus Change in Conductance (35^0C)

For the determination of stability constants, Turner and Anderson's Modified Job's Method were used. The initial concentration of metal ions are 'a' and that of ligands 'b' then the stability constant 'K' is calculated by

$$X = \frac{a2b2 - a1b1}{(a2-a1)+(b2-b1)} \qquad \text{(I)}$$

$$K = \frac{X}{(a - x)(b - x)} \qquad \text{(II)}$$

At temperature 35^0C
Values of a1,a2, b1and b2 are determined from figure [2]
a1= 0.0011 b1= 0.00445
a2 = 0.00125 b2= 0.00375
equation (I),
Value of X = 0.000377

From equation (II),
K = 128.1727
Log K = 2.107796
Free energy change ΔG can be calculated as,
ΔG = -2.303 RT log K
ΔG = -2.303 x1.987 x308 x2.107796
ΔG =-2970.78 Cal/mole

Table-3.4: log K and ΔG of Zn(II) with paracetamol.

Complex	Temperature (^{0} K)	Log K	**Free Energy Change ΔG (Cal/ Mol)**
Zn Paracetamol	308	2.107	-2970.78

IV. CONCLUSION

Stability constant of complexation (Log K) of Zn paracetamol at 308^0K was found to be 2.107(Table 3.4). Free energy change ΔG was -2970.78 Cal/mol at temperature 308^0K indicate spontaneity of complexation process

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