

Conductometric study of copper (II) and Rifampicin in aqueous medium at 303K.

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Abstract:

A conductance study of the interaction between copper (II) and Rifampicin in aqueous medium at 303K. The stability constant of the resulting 1:1 complex was determined by conductometry technique. The free energy change of the studied complex was evaluated at 303K using thermodynamic relations, the negative values of ΔG means that the complex formation process is spontaneously.

Key word: Stability constant, conductometry, Rifampicin

Introduction:

Rifampicin (5,6,9,17,19,21-Hexahydroxy-23-methoxy-2,4,12,16,18,20,22-heptamethyl-8-[N-(4-methyl-1-piperazinyl)formimidoyl]-2,7-(epoxypentadeca [1,11,13] trienimino)-naphtho [2,1-*b*]furan-1,11(2*H*)-dione 21-acetate.) is an anti-tuberculous, protein transporter, anti-hyperglycemics, antiepileptic, neuropsychiatry therapeutics and anti-bacterial[1]. The complex of Rifampicin with Cyclodextrin is used as an anti-tubercular drug[2]. Rifampicin is always used in combination with Dapsone and Clofazimine in the treatment of leprosy[3]. Rifampicin is used in combination with Imipenem or Salbactam in the treatment of pneumonia[4]. Rifampicin is used in inhibition of bile acid. Synthesis may be a protective mechanism against drug and bile acid induced cholestasis[5]. The presence of another group or atoms like O, N, and S created a heterocyclic compound, having wide applications in pharmaceutical chemistry [6-7]. Mohammad Hakimi[8] et.al studied the stability constant of complexes of copper(II) ion with 4-amino-3-ethyl-1,2,4-triazol-5-thione in various percentage of ethanol-water mixture conductometrically. Gholam Hossein Rounaghi [9] have been studied the complexation reaction between Cd^{2+} with 1,13-bis(8-quinolyl)-1,4,7,10,13-penta oxatri decane (kryptofix5) in various binary solvent system. Dhruvi et al[10] studied the stability constant for complexes of Cd^{+2} , Cu^{+2} , Co^{+2} and Ni^{+2} with 8-Hydroxy 5-Quinolinesulfonic acid [HQS] in water, methanol and water-methanol binary solvent systems at different temperature. The number of researchers studied the stability constant of metal complex [11- 12]. The various techniques are used for the evaluating the stability constant of metal complex like pHmetry[13], potentiometry[14], conductometry[12], polarography[15], spectrophotometry[16], ion exchange[17]etc. Out of these techniques, conductometry technique

is considered the same study because this technique is a very sensitive, simple, cheap and accurate technique.

After review of literature survey the detail study of substituted heterocyclic drug under identical set of experimental condition is still lacking. It was thought of interest to study the stability constant and free energy change of substituted heterocyclic drug with copper ion under suitable condition.

Material and method:

The conductance measurements were carried out with equip-tronic EQ-664A using cell with cell constant one at 303 K. The metal ion and drug solution prepared in 20% ethyl alcohol and concentration was estimated by standard method. All chemical reagent used in this work are A.R. grade. The modified Job’s method of continuous variation used for determination of stability constant of metal complex [12]. The both metal ion and ligand concentration was taken equal concentration. Three series C₁, C₂, C₃ of solutions were prepared. In set C₁ metal salt solution was filled with volume 1.0ml to 9.0 ml and volume was made to 10.0ml in each solution. Similarly, in C₂ ligand solution and C₃ was prepared by mixing metal ion solution from 1.0ml to 9.0ml and ligand solution from 9.0ml to 1.0ml. Conductance was recorded for each solution. Conductance Was determined as “C₁+C₂-C₃”[26].Graphs were plotted between corrected conductance and metal-ligand ratio.

For the evaluation 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 given by

$$K = \frac{x}{(a - x)(b - x)} \text{ --- (1)}$$

$$\frac{a_2 - a_1}{a_1 - x} + \frac{b_1 - b_2}{b_2 - x} \text{ --- (2)}$$

K= Conditional stability constant, X=Concentration of complex, a₁ and b₁ were concentration of metal ion and ligand before dilution. a₂ and b₂ were concentration of metal ion and ligand after dilution.

By using the of log K values, free energy change of the system can be calculated by using equations

$$\Delta G = -2.303RT \log K$$

Result and discussion:

The value of corrected conductance first increases then decreases with metal-ligand ratio. The value of conductance changes due to change in number of ions. It has been observed that the formation of complex between Cu (II) and Rifampicin was found to be 1:1. It is proved that the Modified Job’s Method of continuous variation was used to calculate stability constants. The free energy change of the studied complex was evaluated at 303K using thermodynamic relations, the negative values of ΔG means that the complex formation process is spontaneously.

Table-1 : Conductance (μS) of Cu(II) with Rifampicin

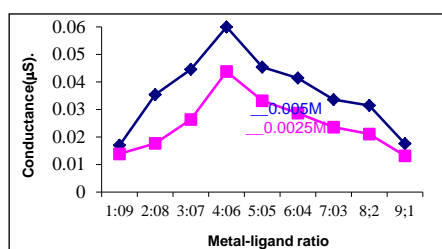
Concentration of metal ion: 0.005M

Concentration of Ligand: 0.005M

Sr.No.	Ratio	M:S (C_1)	S:L (C_2)	M:L (C_3)	Conductance ($C_1 + C_2 - C_3$)
1	1:9	0.1459	0.01546	0.1541	0.00726
2	2:8	0.302	0.01642	0.283	0.03542
3	3:7	0.442	0.01461	0.412	0.04461
4	4:6	0.511	0.01701	0.468	0.06001
5	5:5	0.686	0.01639	0.657	0.04539
6	6:4	0.804	0.01644	0.779	0.04144
7	7:3	0.916	0.01656	0.899	0.03356
8	8:2	1.022	0.01649	1.007	0.03149
9	9:1	1.039	0.01656	1.038	0.01756
Concentration of metal ion :0.0025M		Concentration of Ligand :0.0025M			
1	1:9	0.0789	0.076	0.141	0.0139
2	2:8	0.156	0.0097	0.148	0.0177
3	3:7	0.239	0.0104	0.223	0.0264
4	4:6	0.322	0.0118	0.29	0.0438
5	5:5	0.388	0.0142	0.369	0.0332
6	6:4	0.4	0.0157	0.387	0.0287
7	7:3	0.485	0.0166	0.478	0.0236
8	8:2	0.576	0.0161	0.571	0.0211
9	9:1	0.618	0.167	0.653	0.0132

Table-2 : log K and ΔG of Cu(II) with Rifampicin

System	LogK	$\Delta G(JK^{-1}Mole^{-1})$
Cu(II)- Rifampicin	1.0584	-6140.40



Conclusion:

The stability constant of the resulting 1:1 complex was determined by conductometry technique. The free energy change of the studied complex was evaluated at 303K using thermodynamic relations, the negative values of ΔG means that the complexation process is spontaneously.

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