Received: 01-12-2013
Accepted: 24-01-2014

ISSN: 2321-4902
Volume 1 Issue 5

Online Available at www.chemijournal.com

International Journal of Chemical Studies

A Study of stability constant of co-ordination compounds

Ayesha Durrani [1*]

1. Dr. Rafiq Zakaria College for Women, Navkhanda, Jubilee Park, Aurangabad – 431001 (M.S). [Email: drayeshanuzhat101@gmail.com]

A pH metric method used for the simultaneous equilibrium of Co^{+2} and Cu^{2+} with salicylic acid, cinnamic acid, acetyl salicylic acid and picolinic acid. picolinic acid used as primary ligand and others as secondary ligands. The stability constants of the complexes have been studied at 25±0.5 ^{0}C and μ = 1.0 M ($NaClO_4$). The results are computed using software program SCOGS.

Keyword: pH-metric, stability constant, Cu^{+2}, Co^{+2}.

1. Introduction

pH-metry has been successfully adopted for the determination of stability constant. J. Bjerrum and Ido-Laden's work enlightened the interest in the investigation of equilibrium of metal-chelates and ionic complexes in solution. Schwarzenbach and Ackermann [1] found that stability of the chelates decreases as the increase of size ring.

The present work provides a systematic solution study of the complex formation of Cu and Co with different acids. As the Co-ordination chemistry of metal-complex play a vital role in biological system of organism.Various researchers have studied the mixed ligand complexes of transition metals with the Simple or substituted acid [2]. Mixed-ligand complexes are formed in solutions containing metal-ion with two or more different ligands. A number of reviews have appeared on the stability of mixed-ligand complexes [3]. The study of ternary complexes of different metal ions with amino acids and carboxylic acids have been carried out by many workers [4-5].

During the past decades, di-amines and their derivatives are studied for important applications are stable complexes in the field like biotechnology, biochemistry and environmental science [6].

For the present study an attempt has been made to determine the stability constants of binary complexes of Cu and Co with some acids. Various factors influencing the formation and stabilities of binary and ternary complexes.

2. Experimental

All the chemical used for titration were of Sd-fine chemical limited i.e. metal ions used are cobalt and copper and similarly the salicylic acid, cinnamic acid, acetyl salicylic acid and picolinic acid and NaoH etc. All the chemicals likeNaoH, perchloric acid, sodium perchlorate, metal ions & ligands were prepared in glass distilled water. The titration were carried out at 25 ± 0.5 and inert atmosphere were maintained by bubbling oxygen free nitrogen gas throughout the course of technique. Stability constant of these ligands were determined by Irving – Rossotto technique [7].

pH-metric measurements carried out by ELICO INDIA pH-meter. The combined electrode was washed with 2N HCl and distilled water after every set of reading as pH range was 2 to 11 pH.

Titration was carried out at constant temperature; glass wares used are calibrated by method described in vogel [8].

3. Result and Discussion:

The present study has great importance in the development of Co-ordination chemistry. When metal form a series of step complexes with the ligand a general decrease in Stability constant is usually found. The potentiometric titration was carried out keeping 1:5 metals to ligand ratio. The observed trend in stability constant of metal ion with amino acids obey Irving-William order [9] in the case of threonine is $Co^{2+} > Ni^{+2}$ and $Co^{+2} < Cu^{+2}$. The literature survey reveals that many workers studied the complexation. The ionic strength was maintained to 1.0M with sodium perchlorate.

Table 1: Protonation constant of ligands

Ligands	$\log K_1^H$	$\log K_2^H$
Picolinic acid	10.84	7.56
Salicylic acid	10.64	8.53
Acetyl salicyclic acid	10.49	8.45
Cinnamic acid	10.97	8.92

Table 2: Metal ligand stability constant

Metal ions	Ligands			
	Picolinic acid	Salicylic acid	Acetyl salicylic acid	Cinnamic acid
Co (II)	5.71	4.02	4.46	3.53
	-	3.97	4.25	-
Cu (II)	6.04	4.67	4.95	3.79
	-	2.95	3.20	2.61

The mixed ligand complexation of Co (II) and Cu (II) with picolinic acid as a primary ligand and other acids as the secondary studied in the ration of 1:5:5. The stability constant lies in the range of 2.5 to 6.1.

Table 3: Stability Constant of Mixed-Ligand Complexes

Metal ion	Mixed ligand	Log KMXY	Δ log K
Co (II)	Picolinic acid + salicylic acid	6.60	1.32
	Picolinic acid + Acetyl salicylic acid	7.04	0.79
	Picolinic acid + Cinnamic acid	9.23	2.01
Cu (II)	Picolinic acid + salicylic acid	5.21	1.0
	Picolinic acid + Acetyl salicylic acid	6.03	1.96
	Picolinic acid + Cinnamic acid	7.89	2.60

The log KMXY of ternary complexes and chelates were determined by Loraas and Thomas method [10] in the pH-region where there was a maximum difference between composite curve and mixed-ligand titration curve. Earlier reported log K value are negative for the ternary complexes of Cu (II) with amino acids indicating the primary-ligand anions and secondary ligand anions forms mixed-ligand complex [11].

The ternary complexes serve as useful models for many biological reactions such as metal-chelation apparently play a definite role in the case of treatment of malignancy [12]. The mixed-ligand complexes are generally more stable than the corresponding binary system.

In the present study we observed an increasing trend in the log KMXY value of metal-ligand chelation. The Δ log K values are positive showing the ternary complex formation.

4. References

1. Schwarzenbach G, Ackemann H. Komplexone XII. Die Homologen der Äthylendiamin-tetraessigsäure und ihre Erdalkalikomplexe. Helv Chem Acta 1948; 31:1029.
2. Naik SC, Das PK, Sahea KK. J. Indian Chem. Soci. 2003; 80: 49.
3. Karadia C, Sharma S, Gupta OD. Formation constants of mixed ligand complexes of indium (III) with some amino acids (alanine, phenylalanine and serine) and phthalic acid at DME. Oriental J of Chemistry 2009; 25(3):567-573.
4. Vermaet MK et.al. Oriental J. of Chem., 2001; 17(2): 239.
5. Malhotra V, Chandel C.P.S, J. Ultra, Scientist, Phy. Sci. 2006; 18(2): 203-214.
6. Vora JJ, Patel DR, Patel AD, Patel K, Sharma S, Bhutadiya LS. A Solution Study of Complex Formation of Some Diamines with Lanthanones. E-Journal of Chemistry 2009; 6(1):270-272.
7. H. Irving and H.S. Rossotti, J. Chem. Soci., 1954; 3397: 1953-2901.
8. Voegl AI. A text book of quantitative inorganic analysis, Longmans. 1978; London 305.
9. Irving HM, William R.J.P, Nature. London. 1948; 162:s 746.
10. Thompson LC, Lorass. Inorg. Chem. 1963; 2: 89.
11. Ayesha Durrani et. al. Asian J. of Chem. 2006; 18(4): 3114–3116.
12. J. Schubert, Sci., 1966, Am. 214, 40.