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# Study of Stability constants of Transition Metal Complexes using pH – meter

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## Abstract:

pH-metric study has been used for simultaneous equilibrium of metal ion with different ligands such Leucine, cystein, glycine & tyrosine. p-amino benzoic acid is used as a primary ligand where as other are used as secondary ligand in ternary complexes. The ionic strength was maintained i.e. 1.0μ $NaClO_4$ and complex formation was observed. The results were computed using SCOGS software program.

**Key words:** pH-metric, ligand, metal ions, simultaneous equilibrium.

## Introduction:

Transition metals have capacity to form complexes because they have d-orbital which is vacant and to be accommodate the electron pairs donated by the ligands. As the metal ions plays an important role in a vast number of widely differing biological processes. Such as Iron is an essential component of haemoglobin, chromium is essential for mammalian metabolism and together with insulen is responsible for maintaining blood sugar level.

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 metal ions with simple and biologically important compounds [1-8]. Mixed ligand complexes are formed in the solutions containing metal ions with two or more different ligands.

Potentiometric study of mixed ligand system was made by Irving-Rossotti titration technique in $NaClO_4$ ionic strength and the values obtained were found to be in good agreement with literature value reported [9]. J. Bjerrum and Ido Leden's work enlightened the interest in the investigation of equilibrium between metal-ligand. Schwarzenback and Ackermann [10] found that stability of chelates decreases as the size of ring increases.

The stability constant gives the formation of metal-ligand. The study of ternary complexes of different metal ions with ligands such as amino acids and other ligands by different workers [11-12].

During past several decades, di-amines and their derivatives are studied for important applications are stable complexes in the fields like biotechnology, environmental science and biochemistry [13].

In present communication, an attempt has been made to determine the stability constants of binary and ternary complexes of Fe with leucine, cystain, glycine and tyrosine.

**Experimental:**

All the chemicals used were of A.R. Grade. The metal nitrate was used and the other chemicals such as ligands, NaoH, perchloric acid and sodium perchlorate were prepared in Double distilled water. The titrations 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-Rossotti [14] technique.

**Result and Discussion:**

The present study has great importance as formation of amono acid complexes in many biological processes. The formation constant of the binary complexes formed due to interaction of metal and ligand ions. The proton-ligand stability constant is represented in Table no. 1.

**Table 1: Protonation Constant**

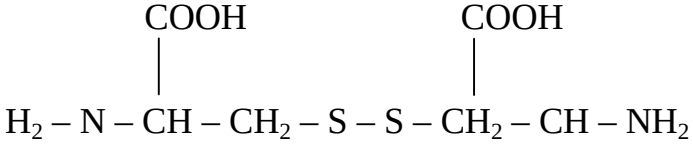
| **Ligands** | **log $k_1^H$** | **log $k_2^H$** | **Fe (III)** |
|---|---|---|---|
| Leucine | 5.27 | 8.60 | 3.66 |
| Glucine | 4.9 | 7.21 | 4.09 |
| Cystein | 3.60 | 8.29 | 4.69 |
| Tyrosine | 8.62 | 10.88 | 5.16 |

Structure of ligand:

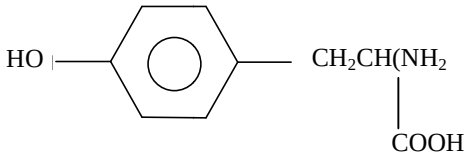
Leucine:

$(CH_3)_2$ CH $CH_2$ CH $(NH_2)$ COOH

Cystein:



Tyrosine:




Glycine:

$CH_2 – (NH_2)\ COOH$

The present study has great importance in the development of co-ordination chemistry metal-ligand stability constant of Fe (III) given in table 2.

The ternary complexes serve as useful models for many biological reactions. A connection between metal-chelation and at least type of cancer was suggested by Furst [15].

The stability of mixed ligand complexes of Fe (III) with p-amino benzoic acid, glycine, tyrosine and cystein studied in the ratio of 1:5:5. The stability constant lies in between 3:0 to 8:00 ternary complexes of Fe (III) shows positive log k value which give them extra stability [16].

**Table 2: Stability constant of Mixed-ligand complexes**

| Metal ion | Mixed-ligand system | log KMXY | Δ log k |
|---|---|---|---|
| Fe (III) | leucine + Cystein | 3.91 | 0.79 |
| | leucine + tyrosine | 5.75 | 1.95 |
| | leucine + glycine | 7.69 | 2.30 |

Earlier reported log k values are positive for ternary complexes indicating the primary ligand anion and secondary ligand anion form complexes [17].

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