



TERNARY COMPLEXES OF TRANSITION METALS USING PH-METRIC STUDIES

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Abstract:

The ternary complexes with Ligands p-aminobenzoic acid and adipic acid with Mn (II), Cr (II) and Ag (II) are studied in aqueous solution using Irving-Rossotti methods. Stability constant of the complexes are at $25 \pm 0.5^{\circ}\text{C}$ in aqueous solution at a constant ionic strength 1.0M NaNO_3 have been determined. The results are computed using software program SCOGS.

Key words: Stability constant, metal ions, Ligands.

Introduction:

The co-ordination chemistry play a vital role in the biological system and have studied the mixed ligand complexes of transition metal ions with different Ligands like acids ¹. Mixed-ligand complexes are formed in solution containing metal with 2-different Ligands. A number of reviews have reported the stability constant of mixed ligand complexes ². As the mixed ligand complexes play an important role in numerous chemical and biological systems. Therefore the formation of stable complexes is of interest to the analytical chemists and bio-inorganic researchers.

During past several years, di-amines and their derivatives are studied for important applications are stable complexes in the field of biotechnology



environmental science and biochemistry³. In the present study, an attempt has been made to determine the stability constants of binary and ternary complexes of Mn (II), Cr (II) and Ag (II) with adipic acid and p-amino benzoic acid.

Experimental:

The Ligands and metal nitrates used were of A.R. grade. NaOH, sodium nitrate, HNO₃ and metal nitrates are prepared in double distilled water. The stability constant for the complexes formed were determined pH-metrically by Irving-Rossotti⁴ pH-metric method.

Results & Discussion:

The formation constant of the binary complexes formed due to the interaction of metal and ligand ions is presented in table 1.

Table No. 1: Protonation Constant of Ligands

Ligands	$\log k_1^H$	$\log k_2^H$
Adipic acid	10.12	8.56
p-amino benzoic acid	10.61	7.84

The ligand selected for the present investigation have common donors like oxygen and nitrogen. The pH-metric titrations were carried out by keeping 1:5 metal to ligand ratio and 1:5:5 for the ternary complexes.



Metal-ligand Stability Constant

Metal ions	Ligands Adipic acid	p-amino Benzoic acid
Mn (II)	4.62	5.86
Cr (II)	4.06	4.72
Ag (II)	3.37	4.50

The mixed ligand complexation of Mn (II), Cr (II) and Ag (II) with Adipic acid are primary ligand and p-aminobenzoic acid as secondary Ligands in aqueous solution.

Stability Constant of Mixed Ligand Complexes

Metal ions	Mixed ligand	log K _{MX_Y}	Δ log k
Mn (II)	Adipic acid + P-amino benzoic acid	10.67	3.16
Cr (II)	Adipic acid + P-amino benzoic acid	8.93	2.13
Ag (II)	Adipic acid + P-amino benzoic acid	6.12	0.98

The present work shows the stability constant for mixed-ligand complexes are in the range of 6 to 11:0 and confirmed the complexation as earlier workers showed in their work mixed ligand complexes of amino acids⁵.

The Δ log k values are positive. It shows that primary and secondary Ligands forms the ternary complexes. Glycine, alanine, valine, cysteine and penicillamine of the associated proton P^{ka6}.



The first proton association constant of neutral, H.L., was determined potentiometrically in aqueous solution. The higher stability of glycine complex than another one may be due to the formation of neutral complexes. A steric effect⁷, affects the mode of packing of Ligands round a central metal ion, and imposes a particular geometric arrangements like planar, tetrahedral to the complex.

The low value of stability constants shows that the interaction of drugs with metal ions is ionic⁸.

The highest value of \bar{n} for Mg(II), Ca(II) with medicinal Ligands was around one⁹, indicating the formation of 1:1 complexes.

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