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Research Article

IMPACT OF THE SOLVENT ON STABILITY CONSTANT

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ABSTRACT

pH – metric determination has been used for the simultaneous equilibrium of Cu^{+2}, Co^{2+}, Zn^{2+} & Ni^{+2} are studied in aqua-organic media with Tazo acid and isonazide using Irving Rossotti method. Ionic strength was maintained by using 1.0M $NaClO_4$.

Keywords: pH-metric determination, simultaneous equilibrium, aqua-organic.

INTRODUCTION

In recent years, medicinal chemistry has undergone a revolutionary change transition metal ion complexes medicinal ligand[1]. Newer technologies used either in solution or on the surface of stable micelles.

The efficient design and optimization of these technologies therefore requires knowledge of chemical equilibria[2-4].

Metal complexes are now a days have wide applications in medicine, biology and metallurgy etc., therefore much work is done on the complexation. pH-metry being the most widely used method for determination of stability constant so we have adopted this technique.

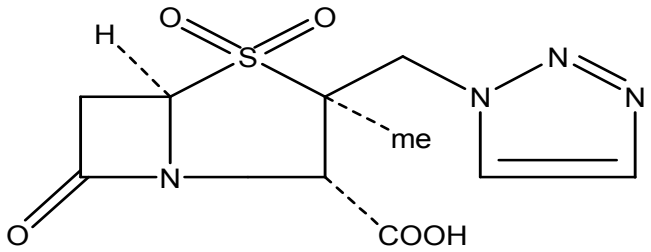
Transition metals have capacity to form complexes because they have vacant d-orbital which can accommodate the electron pairs donated by the ligands. The determination of stability constant is of paramount importance in the knowledge of chelates. pH-metric study of mixed ligand system was made by Irving-Rossotti[5].

The stability constant gives the formation of metal-ligand. For the present investigation Tazo acid and Isonazide used as a ligand with d-block metal ion such as Fe(III), Co(II), Ni(II) & Cu(II).

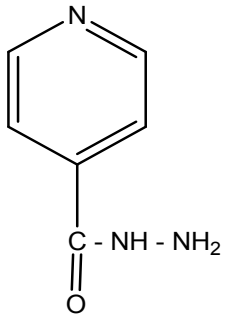
Tazo acid is a medicinal ligand. It contains Azosperillium, a bacteria that has been shown to fix atmospheric nitrogen.

It is a white crystalline powder. Literature survey reveals that a very few researchers have done such type of work using medicinal drugs as a ligand[6-9].

Literature survey shows that the work of co-ordination chemistry was first begins in the 20th Century. It is related with stepwise formation of complexes[10].



Isonazide-used as tuberculosis bacterial infection (isonicotinyl hydrazine)



Molecular weight is 137.14.
Molecular formula $C_6H_7N_3O$
Melting point is 170 – 173^{0}C.

As metal play important role in biological processes. The concentration of these metals[11] in blood and urine in human being can be reduced by ligand therapy.

Co – Is a essential metal for many organisms[12-13]. Co – is conined to functions of Vitamin B_{12} and enzymes. Co – is used as catalyst to handle compounds such as CH_4, H_2, Co is toxic moderately when injected intravenously to mammals.

Cu – Cu is essential element present in large number of enzymes. The trace amount of Cu are required for normal metabolic process, it can be extremely toxic in excess.
Zn – is an essential element for the normal functioning of most of the organisms and its deficiency can lead to reduction of normal growth.
Ni – rare metal in biology. Ni is toxic and risk to the health of humans from Ni – poisoning is essential.

MATERIALS AND METHODS

The chemicals used for pH – metric determination was Ar – Grade SD-fine chemicals. NaOH, metal nitrates, Perchloric acid, sodium perchlorate were used. These are prepared in double distilled water and the alcohol was also distilled. pH – measurements were carried out by ELICO India pH – meter (accuracy 0.01 unit). The titrations were carried out at 25 ± 0.5 in an inert atmosphere.
Procedure for binary and ternary system adopted is standard and shown as Acid Titration (A) were carried out by taking 2ml (0.2M) $HClO_4$ and 5ml (1.0M) $NaClO_4$ solution in 50ml standard flask and diluted upto the mark with the help of double distilled water and alcohol. This was titrated against 0.2N NaOH. Reading was noted as 'A'.

1. Free $HClO_4$ (A) …….A
2. Free $HClO_4$ + Ligand (L_1) ……X = A + L_1
3. Free $HClO_4$ + Ligand (L_1) + metal ion (M) ……. M x = (A + M + L_1)
4. Free $HClO_4$ + Ligand (L_2) ……. y = (A + L_2)
5. Free $HClO_4$ + Ligand (L_1) + Ligand (L_2) + Metal ion (M) MXY = (A + L_1 + L_2 + M)

The use of higher ligand to metal ion has been suggested by several workers in order to show that pH – range of complex formation.

RESULTS AND DISCUSSION

The present investigation has great importance in the development of co-ordination chemistry. The ligand selected are isoniazide and tazo acid when metal forms series of step complexes with ligand a general decrease in step stability constant is usually found. The pH – metric titrations were carried out by keeping 1:5 metals to ligand ratio. The observed trend in stability constant of metal ions with medicinal ligands obeys Irving – William[14] in the case of tazo acid is Co^{2+} < Ni^{+2}.
The mixed ligand complexation of Co(II), Ni(II), Cu(II) and Zn(II) with Tazo acid as primary ligand and Isonazide as secondary ligand in aqueous, 50% alcohol and 100% alcohol studied in the ration of 1:5:5. The stability constant lies in the range of 4 – 7.0.

Table 1: Protonation constant of ligands

Ligands	Aqueous		50% alcohol		100% alcohol	
	$\log K_1^H$	$\log K_2^H$	$\log K_1^H$	$\log K_2^H$	$\log K_1^H$	$\log K_2^H$
Tazo acid	2.31	9.54	4.01	5.81	2.16	8.10
Isonazide	3.17	9.61	4.89	8.32	3.89	9.80

Table 2: Metal ligand stability constant

Metal ion	Aqueous solution		50% alcohol		100% alcohol	
	Tazo acid	Isonazide	Tazo acid	Isonazide	Tazo acid	Isonazide
Co(II)	2.16	5.81	7.61	4.92	3.50	4.61
Ni(II)	3.96	5.95	7.92	5.69	6.19	7.26
Cu(II)	3.50	5.96	7.96	5.89	6.89	7.85
Zn(II)	4.10	6.10	8.23	5.99	7.21	8.01

Table 3: Stability constant of Mixed ligand complexes

Metal ion	Ligands	Aqueous solution		50% alcohol		100% alcohol	
		log KMXY	ΔlogK	log KMXY	ΔlogK	log KMXY	ΔlogK
Co(II)	Tazo acid - Isonazide	4.10	0.90	5.89	1.20	4.91	2.0
Ni(II)	Tazo acid – Isonazide	4.62	1.44	5.97	2.16	5.93	2.4
Cu(II)	Tazo acid – Isonazide	4.96	1.46	6.88	2.56	6.89	2.5
Zn(II)	Tazo acid – Isonazide	5.12	2.56	7.0	3.01	6.98	3.9

From the present investigation we have selected Co, Ni, Cu and Zn as metal ions. The 100% alcohol shows highest Δlog K values. The positive Δlog K values indicates the formation of complexes.

CONCLUSION

The ligand tazo acid and isonazide selected were medicinal compounds found to form complexes in aqua-organic media under experimental condition. The order of stabilities can be explained on the basis of basic nature of ligand, size of metal ions, etc. The study also suggests the formation of complexes.

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