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Evaluate the Stability Constant of Cu(II), Co(II), Cd(II) and Ni(II) Metal Ions with 2-p-Chlorophenylthiocarbamidophenol Spectrophotometrically

S.O.Mohod[1]* and D.T.Tayade[2]

[1,2]Department of Chemistry, Government Vidarbha Institute of Science and Humanities, Amravati, Maharashtra State, India

Abstract

Interaction of 2-p-chloro phenyl thiocarbamidophenol (L_3) with transition metal ions Cu(II),Co(II),Cd(II) and Ni(II) by using spectrophotometric method. The stability constant of complex is determined with the help of Job's variation method in ethanol-water mixture.

Keywords

Substituted thiocarbamidophenols, stability constant, spectrophotometry

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INTRODUCTION

Spectrophotometric methods have been used widely for studying equilibria in solutions. In very complex systems in which numerous equilibria exist, absorption curves of constituent species will overlap each other to give rise to complex envelopes of bands. For such complex systems methods for evaluating equilibrium constants from spectrophotometric data with the nonlinear least-squares method have been discussed by many researchers.These methods were found to be simple, rapid, sensitive and can be carried out in small laboratories in the absence of the other costly and sophisticated instrumental facilities. Gulzar*et al*[1] studied synthesis, characterization and determined the formation constants of 1,2-bis(2,5-dimethoxybenzylidene) hydrazine with zinc(II) and nickel(II) salts by spectrophotometric method. The study of complex formation constants for some water-soluble polymers with trivalent metal ions by differential pulse polarography was done by Caykara*et al*[2]. Norkus*et al*[3] studied the stability constant of Cu(II) complex formation with pentaethylenhexamine by ligand displacement method. Meshram*et al*[4] studied the conditional stability constant of substituted thiocarbamidophenol with different transition metal ions complexes in 70% ethanol-water medium. Does *et al*[5] investigated the stability constants of iron(III)-ligand complexes on insoluble polymeric matrices. Alvarado *et al*[6]determined the complex formation equilibria of copper(II), metformin and halides in methanol spectrophotometrically. Kumar *et al*[7] studied the formation constants of Sm(III) systems with different sulphonanilide ligands spectrophotometrically. Determination of the stoichiometry and stability constants of flavonoids ligand and metal ions were studied by Barolli*et al*[8].Golbedaghi*et al*[9] investigated the formation constants of complex of a new synthesized tripodal ligand with Cu^{2+} using rank annihilation factor analysis in surfactant media. Stronski*et al*[10] investigated the distribution coefficients and stability constants of complexes of nickel and uranium with quadridentate Schiff bases.

This work is mainly based on Job's method of continuous variation. It is specially associated to study of effect of solvents, effects of ligands and group as well as effect of metal ions during formation of complexes. All these things are taken into consideration this research scheme is designed. In this present work, an attempt has been made to study the interaction between Cu(II), Cd(II), Co(II) and Ni(II) and 2-p-chlorophenyl thiocarbamidophenol (L_3) at constant ionic strength spectrophotometrically.

MATERIALS

In this research work all AR grade chemicals are used. In the laboratory the ligand (L_3) has been synthesized by interacting 2-aminophenol with p-chlorophenylisothiocyanate to form 2-p-chlorophenylthiocarbamidophenol L_3. Required amount of ligand was dissolved in 70% ethanol-water mixture to form the stock solution of ligand. The nitrates of copper, cobalt, cadmium and nickel were used and their solutions were prepared in double distilled water.

METHODS

JOB'S METHOD

Job's variation method was used to know the nature of complexes. Jobs continuous variation method is reliable method to investigate the formation of complexes. Job's method consist of equimolar solutions of ligand and metal ions varying proportion in such manner that total concentration of metal plus ligand is constant in resulting mixtures. Composition of metal ion solution ($1x10^{-5}$ M) and ligands ($1x10^{-5}$ M) wereprepared in ten series and the ionic strength of these compositions was maintained at 0.1M by adding appropriate amount of 1M KNO_3 solution. The total volume of metal ion plus ligand solution is 10ml and λ_{max} of these solutions was then determined using one of the composition at which there is maximum absorption. The absorption for all the compositions was then recorded at a constant wavelength (λ_{max}). At that point the solution is again diluted upto 15 ml and absorbance recorded at same (λ_{max}). Curves were plotted using data of absorption, percentage composition of metal ion and ligand solution; at constant pH.The conditional stability constant of metal-ligand complexes were calculated for all the systems using following equation as shown in **Table 1.**

$$K = \frac{X}{(a_1 - x)(b_1 - x)} = \frac{X}{(a_2 - x)(b_2 - x)}$$

K = Conditional stability constant of complex.

X = Concentration of complex.

a_1 and a_2 = Concentration of metal ions.

$b_1$and b_2 = Concentration of ligand.

Conditional stability constant of metal ligand complexes were calculated and presented in **Table 1.**

Table 1: Determination of conditional stability constant of metal-ligand complex

System	Conditional stability constant K	Log K
L_3+Cu(II)	1.2010 X 10^{-3}	0.7954
L_3+Co(II)	5.0000 X 10^{-3}	0.69897
L_3+Cd(II)	1.2010 X 10^{-3}	0.7954
L_3+Ni(II)	5.2911 X10^{-3}	0.72354

CONCLUSION

Table 1 Indicates that the resultant values obtained are fairly good and there is no appreciable difference in log K values. LogK value of L_3 is greater for Cu(II) and Cd(II) than Ni(II), Co(II).This gives the information that L_3 forms the more stable complex with Cu(II) and Cd(II).This type of investigation helps to study of drug activity and drug effect of newly synthesized drugs.

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