Preparation of Cobalt(II) Complexes with Schiff Base 2(2-hydroxy benzylidine) iminoHydroxamic Acid in the Presence of Bases

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Abstract : The complexes of Cobalt(II) metal have been prepared with Schiff base ligand 2(2-hydroxy benzylidine) imino benzo hydroxamic acid in presence of bases. On characterisation of the ligand and the complexes by usual physico-chemical methods such as elemental analysis, measurement of electrical conductivity, magnetic moment, electronic and I.R. spectra, all the complexes were found to be non-electrolyte, monomeric, paramagnetic and octahedral in structure.

Key-words : Paramagnetic, Octahedral, Ligand, Complex, Characterisation, Filteration, Product, Band, Divalent transition metal, Solution, etc.

I. INTRODUCTION

A large number of research work with respect to complex formation of transition metals with Schiff base have been carried out in details. But at least work has been done for the formation of complexes of transition metals with such Schiff bases which contain hydroxamic acid as functional group in its moiety. Therefore, in this paper, I report the formation of complexes of divalent transition metals with 2(2-hydroxy benzylidine) iminohydroxamic acid.

II. PREPARATION OF CO(II) COMPLEXES

Preparation of Co(II) complexes with 2(2-hydroxy benzylidine) iminohydroxamicacidas ligand were carried out in presence of various bases like water, ammonia, quinoline, pyridine, phenyl isocyanide and different picolines by a general procedure detailed here under:-

0.272g (0.001 mole) of the ligand dissolved in the minimum volume of ethyl alcohol was added to 0.23g (0.001 mole) of Co(II) chloride hexa hydrate (BDH) dissolved in ethanolic-aqueous solution with regular shaking and stirring. The resulting solution was then refluxed for an hour on water bath. The colour of the solution was gradually changed and chocolate crystals separated out by allowing the solution to stand overnight. The product was separated by filtration, washed with a small amount of acetone and then dried over KOH in a desiccator.

The complexes of Co(II) ions with the ligand were prepared separately, keeping the metal-ligand ratio as 1:1 in each case, with oxygen and nitrogen containing bases like water, ammonia, quinoline, pyridine, phenyl isocyanide and different picolines.

On the basis of elemental analysis, the complexes were found to possess the general molecular formula $[Co(L)(B)_3]$, where L = Ligand and B = water, ammonia, quinoline, pyridine, phenyl isocyanide, α-picoline, β-picoline and γ-picoline.

Table-1

Analytical date of $[Co(L)(B)_3]$ complexes.

Elements: Found (Calculated)→ %

S.N.	Complexes	Metal	Carbon	Hydrogen	Nitrogen
1.	$[Co(C_{14}H_{10}N_2O_3)(H_20)_3$	15.95 (16.05)	45.65 (45.78)	4.32 (4.36)	7.58 (7.63)
2.	$[Co(C_{14}H_{10}N_2O_3)(NH_3)_3$	16.10 (16.18)	46.06 (46.16)	5.17 (5.22)	19.15 (19.23)
3.	$[Co(C_{14}H_{10}N_2O_3)(C_5H_5N)_3$	9.88 (9.95)	64.72 (64.87)	5.18 (5.23)	11.75 (11.82)
4.	$[Co(C_{14}H_{10}N_2O_3)(C_6H_5NC)_3$	9.40 (9.47)	67.40 (67.50)	3.95 (4.01)	11.20 (11.25)
5.	$[Co(C_{14}H_{10}N_2O_3)(C_6H_7N)_3$ α-picoline	9.88 (9.95)	64.72 (64.87)	5.18 (5.23)	11.75 (11.82)
6.	$[Co(C_{14}H_{10}N_2O_3)(C_6H_7N)_3$ β-picoline	9.85 (9.95)	64.70 (64.87)	5.17 (5.23)	11.72 (11.82)
7.	$[Co(C_{14}H_{10}N_2O_3)(C_6H_7N)_3$ γ-picoline	9.86 (9.95)	64.72 (64.87)	5.18 (5.23)	11.75 (11.82)

CHEMICALS REQUIRED: Methyl benzoate, hydroxylamine hydroxhloride, salicylaldehyde, ethyl alcohol, acetone, acetate/chlorides of Cobalt(II), Nickel(II) and Copper(II) metals, ammonia, quinoline, phenyl isocyanide, pyridine and different picoline.All the chemicals taken were either of E. Merck extra pure or BDH (A.R.) quality.

III. ANALYTICAL METHOD

The estimation of metals and non-metals present in the ligand and the complexes has been done by standard methods:-

(i) Cobalt: Cobalt has been estimated volumetrically by oxinate method.

(ii) Nickel: Nickel has been estimated gravimetrically by dimethyl glyoximato method

(iii) Hydrogen, carbon and nitrogen have been estimated by semi-micro combustion method.

Conductivity Measurement: The measurement of electrical conductivity of the solutions of the complexes was done by conductivity meter bridge manufactured by Wiss-TechenWearchStathen-LBR at room temperature. Pure DMF and conductivity water were used as solvent.

U.V.: Visible SPECTROPHOTOMETRIC MEASUREMENT: Hitachi-320 spectrophotometer were used to record the electronic absorption spectra of the complexes.

I.R.: Perkin Elemer 577 spectrophotometer has been used to record the infra-red spectra of the ligand and complexes in ruijol mull.

MAGNETIC SUSCEPTIBILITY: The measurement of the magnetic susceptibility of the complexes has been done by Gouy's method by using Mercury tetra thio cyanate cobaltate, $[HgCo(SCN)_4]$.

IV. RESULT AND DISCUSSION

The values of electrical conductance of Cobalt(II) complexes have been found in the range of 9 to 13 which indicates non-electrolyte nature of the complexes.

The values of magnetic moment of Cobalt(II) complexes have been found in the range of 4.88-4.98BM which certainly suggest the high spin octahedral geometry for all the complexes.

Three bands obtained due to electronic transition of Cobalt(II) complexes: 1. ν_1, $^4T_{1g}(F) \rightarrow {}^4T_{2g}(F)$ (8000-8650cm^{-1}), 2. ν_2, $^4T_{1g}(F) \rightarrow {}^4T_{1g}(P)$ (20,800-21,580cm^{-1}) and ν_3, $^4T_{1g}(F) \rightarrow {}^4A_{2g}(F)$ (16,200-17,500cm^{-1}) indicate octahedral geometry for all the complexes.

The ligand molecule and the complexes have so many bands but they have no importance but bands obtained due to the vibrations of phenolic-OH, azomethine>C=N, oxime C⋯⋯N and (N-O) groups in the ligand molecule have been appreciably changed after complex formation. The strong and sharp bands obtained due to the vibrations of (O-H) and (N-H) bonds of the ligand at 3240cm-^{1} disappears in all the complexes of the ligand and a new broad and strong band obtained in the range of 3400-3460cm^{-1} in the complexes confirms the presence of at least one free (-OH) group even in the complexes. The disappearance of the strong band at 3240cm^{-1} further confirms the deprotonation of the second (-OH) group i.e. (N-OH) proton located at hydroxamic acid moiety. A sharp and strong band obtained at 1650cm^{-1} in the ligand molecule has been reduced to 1590cm^{-1} in the complexes. This reduction in the band position indicates the participation of nitrogen atom of azomethine group in the complex formation. A medium and sharp band obtained at 1310cm^{-1} in the ligand molecule due to the vibration of phenolic (-OH) group disappears in all the complexes supporting the deprotonation of phenolic (-OH) and coordination of phenolic oxygen atom in the complex formation.

The band obtained at 1310cm^{-1} due to the vibration of phenolic (C-O) bond has been shifted to higher frequency in the complexes supporting the increase in bond length in the complexes due to the participation of oxygen atom in the bond formation with the metal cation. The band obtained at 1310cm^{-1} in the ligand due to the vibration of (N-O) bond has been increased in the complexes supporting the coordination of nitrogen atom of (N-O) group. Thus by the comparison of I.R. spectra of the ligand and complexes, it is suggested that two oxygen atoms of deprotonated (-OH), one nitrogen (oxime nitrogen) and one nitrogen atom of azomethine group are the bonding sites of the ligand. Thus ligand behaves as bi-anionic tri-dentate molecule.

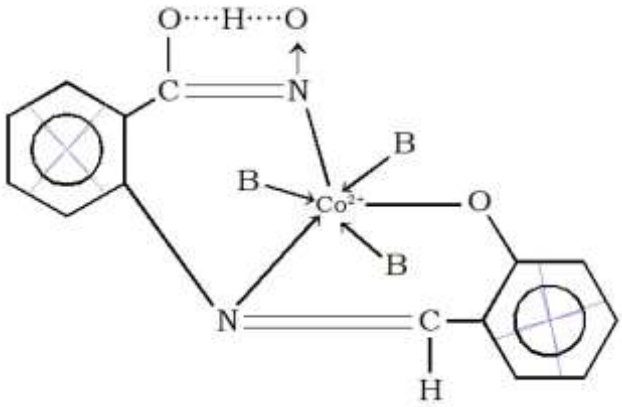
A broad and strong band has been obtained at 3400cm^{-1} in the complexes due to overlapping of bands obtained due to the vibrations of aquo and amine group. The coordination of nitrogen atom of phenyl isocyanide group has been ascertained due to the increase in the band position, 2130cm^{-1} in the ligand and 2240cm^{-1} in the complexes.

In quinoline, pyridine and different picolines complexes, three medium and sharp bands obtained around 1440cm^{-1} and around 920-1050cm^{-1} in addition to finger print and far infra-red region have been obtained respectively indicate the participation of nitrogen atoms of quinoline, pyridine and different picolines in bond formation with metal cation.

A sharp and medium band obtained in the range of 410-425cm^{-1} due to the vibrations of (M-N) bond in the complexes further confirms the coordination of nitrogen atom in the bond formation with the metal cation.

Similarly, a sharp and medium band obtained in the range of 450-470cm^{-1} due to the vibrations of (M-O) bond further confirms the coordination of oxygen atom in the bond formation with the metal cation.

Thus on the basis of elemental analysis, measurement of electrical conductance, magnetic moment, electric and I.R. spectral behaviour, the complexes of Cobalt(II) with the ligand in presence of bases such as water, ammonia, quinoline, phenyl isocyanide, pyridine and □-picoline, octahedral geometry for all the complexes has been suggested with general molecular formula $[Co(L)(B)_3]$.



Where L = Ligand

B = water, ammonia, quinoline, phenyl isocyanide, pyridine, picoline.

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