Biochemical studies of transition metal ion of Co(II), Ni(II) and Cu(II) with Tetra dentate Schiff base having Nitrogen, Oxygen/Sulphur donor atoms

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Abstract : The new tetradenate Schiff base have been synthesized by condensing 2-hydroxy-5-bromo acetophenone with ethylene diamine. The metal complexes were obtained as a result of interaction of Schiff base ligand and metal ions: Co(II), Ni(II) and Cu(II). The complexes have been characterized on the basis of elemental analysis, infrared, molar conductance and magnetic Susceptibilities. The bioefficacy of the ligands and their complexes have been examined against the growth of bacteria.

Keyword: Schiff base, Molar conductance, Bacteria, Ethylene diamine.

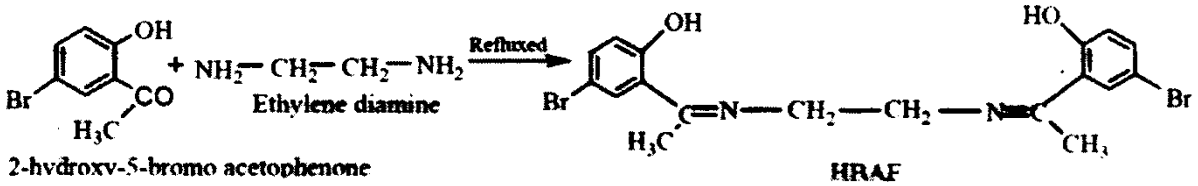
I. INTRODUCTION

Schiff base complexes have an important and popular area of research due to their simple synthesis, versality and diverse range of applications. The Schiff bases play a significant role in the area of coordination chemistry. The Schiff base prepared by using variety of aldehydes and amines possessed antitubercular, antitumor, anticancer, fungicidal medicinal and agrochemical activities. Schiff base and their metal complexes are becoming increasingly important in recent years due to their biological activity and their used as catalysts. Schiff bases and their complexes have a variety of applications in biological clinical and analytical fields. Recently there has been a considerable interest in the chemistry of hydrazine and hydrazones compounds because of their potential pharmacological applications. This paper discusses the molar conductance, magnetic Susceptibilities and biological activity for Schiff base complexes of Co(II), Ni(II) and Cu(II).

II. EXPERIMENTAL

All the chemicals were of A. R. grade and used as received. The solvents were purified by standard methods. Synthesis of 2-Hydroxy-5-bromoacetophenone-N, N`-ethylenedi-imine (HBAE):

A hot ethanolic solution of ethylene diamine (0.05 mol) was added to an ethanolic solution of respective acetophenone (0.05 mol). The reaction mixture was refluxed in a water-bath for 4-5 h. The colour product was filtered off and recrystallised. Yield 70% M. P. 2700C.



Preparation of complexes:

All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HBAE (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was refluxed on a water bath for 4-6 h. The precipitated complexes were filtered, washed with ethanol followed by ether and dried over fused calcium chloride Yield: 45-50%.

Table-1

Analytical data and molar conductance of the compounds (L=HBAE^{2-})

compound	colour	Mol.w t.	Analysis% Found (calc.)				μeff B.M.	LM (Ω-1 cm^2 mol^{-1})
			M	C	H	N		
$C_{18}H_{18}N_2O2Br_2$	Yellow	453.8	--	47.83 (47.59)	3.85 (3.96)	6.07 (6.17)	--	--
$[CuL(H_2O)_2]H_2O$	Brown	564.7	10.32 (10.43)	38.12 (38.25)	3.72 (3.89)	4.80 (4.95)	4.27	6.1
$[NiL]H_2O$	Black	528.5	11.02 (11.10)	40.72 (40.87)	3.25 (3.40)	5.17 (5.29)	Dia	5.6
$[CuL(H_2O)2]2H_2O$	Brown	587.3	10.61 (10.81)	36.61 (36.77)	3.95 (4.08)	4.62 (4.76)	2.02	18.8

The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal bromide content of complexes were analyzed by standard methods. The 1H NMR spectra of ligand was recorded and obtained from RSIC Chandigarh. IR spectra of the compounds were recorded on Perkin Elmar 842 spectrophotometer in the region 400-4000cm-1, Carbon, Hydrogen and Nitrogen analysis were carried out at CDRI, Lucknow. The molar conductance of the complexes at 10-3 M dilution in DMF were determined using equiptronic digital conductivity meter EQ-660 with a cell constant 1.00 cm-1 at room temperature. The magnetic moment measurement were made on a Gouy balance at room temperature using [HgCo(SCN)4] as the calibrant. The thermo gravimetric analyses were performed on laboratory set up apparatus in air atmosphere at 100c min-1 heating rate. The molecular weights of the complexes were determined by Rast method.

III. Results and Discussion

The Schiff base ligand HBAE and its complexes have been characterized on the basis of 1H NMR, IR spectral data, elemental analysis, molar conductance and magnetic succeptibility. All these values and analytical data is consistent with proposed molecular formula of ligand. All the compounds are coloured solid and stable in air. They are insoluble in water but soluble in coordination solvents like DMF and DMSO. The molar conductance values in DMF (10-3) solution at room temperature (Table-1) shows all the complexes are non electrolytes. The 1H NMR spectra of ligand HBAE shows signals: δ15.97(1H, s, phenolic OH); 8.06(1H, s, phenyl); 7.67 and 7.31(2H, m, phenyl), 3.29(4H, S,CH_2-CH_2); 2.51 ppm (3H, s, methyl).

Table-2
IR spectra of ligand and metal complexes

Compound	n(O-H) hydrogen bonded	ν(C=N) imine	ν(C-O) phenolic	ν(M-O)	ν(M-N)	H_2O
$C_{18}H_{18}N_2O2Br_2$	2900	1614	1480	--	--	--
$[CuL(H_2O)_2]H_2O$	--	1589	1440	520	455	3400, 1640, 815, 770
$[NiL]H_2O$	--	1586	1460	510	495	3326, 1630
$[CuL(H_2O)2]2H_2O$	--	1595	1440	590	490	3406, 1642, 818, 780

BIOLOGICAL ACTIVITY:

The ligand HBAE and its complexes are found to show considerable biological activity against E. coli, A. aerogenes, S. aureus and B. Subtilis are almost inactive against B. megatherium, P. vulgaris and P. fluorescen. The ligand inhibits the growth of S. aureus more than all its complexes. In contrast, biological nature of the ligand is dominated by its complexes against S. aureus. All the complexes show moderate to good zone of inhibition against S. aureus. The Cu(II) complex is resistant towards E. Coli, B. subtilis, B. megatherium and P. fluorescen but shows moderate activity towards other biological species. The Co(II) complex strongly inhibits the growth of B. subtilis and has no activity against E. coli. The results reveal that the sensitivity of the ligand HBAE and its complexes is shows in Table-3.

Table-3
Biological activity

Ligand and its complexes	B. Subtilis (mm)	P. vulgaris (mm)	S. aureus (mm)	E. Coli (mm)	P. fluorescen (mm)	A. aerogenes (mm)	B. megatherium (mm)
$C_{18}H_{18}N_2O2Br_2$	S_8	R	S_{14}	S	R	R	R
$[CuL(H_2O)_2]H_2O$	S_{15}	S_7	S_{18}	R	S_{16}	R	S_{11}
$[NiL]H_2O$	S_{11}	S_{13}	S_{10}	R	S_{17}	S_{16}	R
$[CuL(H_2O)2]2H_2O$	R	S_{17}	S_{12}	R	R	S_{11}	R

IV. CONCLUSION

The results revealed that the ligands and their complexes show considerable biological activity. However, the zone of inhibition of ligand varies with organisms as well as metal ions. Thus, it can be concluded that most of our ligands and their complexes possess biological activities.

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