SCHIFF BASE LIGAND ITS COMPLEXES AND THEIR ANALYSIS

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Abstract—

The present investigation deals with synthesis of Furfural(A) Ethylene diamine(B) Schiff base ligands and their Co(II), Ni(II), Cu(II) and Zn(II) complex using microwave irradiation. The experimental techniques such as Elemental Analysis studies for these complexes, UV-Vis, magnetic measurements studies have been used in the present investigation.

Key words: Furfural, Ethylene diamine, Co(II), Ni(II), Cu(II) and Zn(II) complex, UV-Vis, magnetic measurements

I. INTRODUCTION

Schiff bases appear to be important intermediate in a number of enzymatic reactions involving interaction of enzyme with an amino or a carbonyl group of the substrate. One of the most catalytic mechanism in biochemical processes involves condensation of a primary amine in an enzyme, usually that of a lysine residue, with a carbonyl group of the substrate to form an imines, or Schiff bases. It plays a prominent part in the enzymatic or un enzymatic transaminating reactions of the carbonyl compounds with amino acids. Schiff bases derived from aromatic amines and aromatic aldehydes have a great utility in important fields as, *e.g*., medicine, agriculture, cosmetic products and wide variety of applications in inorganic and analytical chemistry. Schiff bases lay in their usefulness as synthons in the synthesis of bioactive molecules such as 4-thiazolidinines, 2-azetidinones, benzoxazines, formazans, etc. Due to the great flexibility and diverse structural aspects of Schiff bases, a wide range of these compounds have been synthesized and their complexation behavior studied .

In the coordinate chemistry field, a lot of Schiff bases operate as ligands . Some of the Schiff bases complex combinations with metals are used as insecticides, fungicides, herbicides .Nitro and halo derivatives of Schiff bases are reported to have antimicrobial and antitumor activities . Antimicrobial and antifungal activities of various Schiff bases have also been reported .Many Schiff bases are known to be medicinally important and are used.

Schiff bases belong to a widely used group of organic intermediates important for production of specialty chemicals Schiff base has been selected for complexation with the metal ions *viz.* Co(II), Ni(II) and Cu(II). The coordination chemistry with its growing list of applications, has paved the way to the preparation of new compounds which may possess some definite predetermined properties and thus show promising prospects in the realm of medicine and molecular biology *viz.* designing of metal complexing drugs (inorganic drugs) and metallotherapy. They used as models for biological systems and find applications in biomimetic catalytic reactions. Schiff bases and their biologically active complexes have been studied extensively over the past decade. Day by day Schiff bases are more frequently applied for the betterment of human welfare. The importance of the Schiff base is due its versatile nature. Literature survey shows that many Schiff bases exhibit biological activities such as antifungal, antibacterial, anti tumour, anti-inflammatory and antipyretic among others. Some of them have been used as complexing agents [5,6] and powerful corrosion inhibitors. The chemistry of metal complexes with Schiff base ligands and their application have aroused considerable attention, mainly because of preparative accessibility, diversity and structural variability. Schiff bases belong to a widely used group of organic intermediates important for production of specialty chemicals, e.g. pharmaceuticals, or rubber additives and as amino protective groups inorganic synthesis. They also have uses as liquid crystals and in analytical, medicinal and polymer chemistry.

II. MATERIALS AND METHODS

The chemicals, Furfural, and Acenaphthene quinone were bought in pure form from Loba Chemie. The metal salts, Cobalt(II) sulphate, Nickel(II) sulphate, Copper(II) sulphate and Zinc(II) sulphate were Analar grade chemicals from Himedia.

Preparation of Schiff base complex

Two mill mole of the Schiff base ligand and one millimole of cobalt(II) sulphate were mixed in a semi micro boiling tube. It is placed inside a conical flask and heated in the microwave oven for 5 minutes. The Schiff base complex formed was washed with ethanol and then with ether and dried. The yield was 96%.

From the Schiff base ligand furfural-Ethylene diamine, its complexes with Cobalt(II) Nickel(II), Copper(II) and Zinc(II) were prepared by identical method. Using similar procedure, the Schiff base ligand Acenaphthene quinone-Ethylene diamine were synthesised by microwave irradiation. Subsequently, their Schiff base complexes with Cobalt(II), Nickel(II), Copper(II) and Zinc(II) were synthesised.

Elemental Analysis studies: Electronic absorption spectral analysis was carried out in DMSO using a Shimadzu UV-1601 spectrophotometer. The UV-Vis spectra of the compounds were recorded

III. RESULTS AND DISCUSSION

The spectral characteristics and other analytical parameters of the Schiff base ligands and their complexes have been discussed here.Elemental analysis:The Schiff base complexes synthesised by solvent free microwave method are stable towards air. It is soluble in common organic solvents like ethanol, methanol, DMF etc.

Table 1.Analytical data of the Schiff base ligand and its complexes

S. No	Complexes	Molecular Weight	% Metal	% Carbon	% Nitrogen	% Hydrogen	% Oxygen
1.	$C_{24}H_{20}N_4O_4$ (Ligand)	428	-	(67.28) 66.97	(13.08) 13.01	(4.67) 4.58	(14.95) (4.82
2.	$Co(C_{24}H_{20}N_4O_4)$	482	(11.20) 11.05	(59.75) 59.69	(11.61) 11.57	(4.14) 4.05	(13.27) 13.16
3.	$[Ni(C_{24}H_{20}N_4O_4)]$	484	(11.57) 11.51	(59.50) 59.43	(11.57) 11.54	(4.13) 4.05	(13.22) 13.17
4.	$[(CuC_{24}H_{20}N_4O_4)]$	486	(11.93) 11.88	(59.25) 59.13	(11.52) 11.46	(4.11) 4.03	(13.16) 13.09
5.	$[Zn(C_{24}H_{20}N_4O_4)]$	488	(12.29) 12.21	(59.01) 58.98	(11.47) 11.38	(4.09) 4.04	(13.11) (13.05)

Electronic Spectral Studies

The electronic spectra of the Schiff base complexes CoAB, NiAB, CuAB and ZnAB were recorded at room temperature in DMSO solution and the spectral data are given in Table 2 and the spectra are illustrated in Fig.1

The electronic spectrum of Co(II),Ni(II),Cu(II) and Zn(II) complexes of Schiff base ligand(AB)furfural–en are is shown in Fig. Generally, the electronic spectrum of tetrahedral Co(II) complexes is reported to have only one absorption band in the visible region due to $^4A_2(F) \rightarrow {}^4T_1(P)$ transition. The spectrum of CoAB complex has only one band in the visible region at 520 nm, which indicates tetrahedral geometry for the complex. The spectrum of the NiAB complex shows an intense absorption band at 510 nm, which is due to the $^3T_1(F) \rightarrow {}^3T_1(P)$ transition indicating tetrahedral geometry. The spectrum of CuAB complex exhibits a broad band centered at 750 nm due to $^2B_{1g} \rightarrow {}^2A_{1g}$ transition corresponding to square planar geometry[15]. ZnAB complexes does not exhibit any d-d electronic transition due to its completely filled d^{10} electronic configuration. However, Four coordinate Zn(II) complexes, in general, would have tetrahedral geometry.

Table 2 Electronic spectral data of Schiff base metal complexes

Sl.No	Complex	Absorption (nm)	Transition	Geometry
1	CoAB	520	$^4A_2(F) \rightarrow {}^4T_1(P)$	Tetrahedral
2	NiAB	510	$^3T_1(F) \rightarrow {}^3T_1(P)$	Tetrahedral
3	CuAB	750	$^2B_{1g} \rightarrow {}^2A_{1g}$	Square planar
4	ZnAB	275, 292	π-π*, n-π*	Tetrahedral

Magnetic measurements

The magnetic moment values of the synthesised Schif base complexes, CoAB, NiAB, CuAB and ZnAB complexes are given in Table 3 . The CoAB complex has a magnetic moment of 4.48 B.M, which is in agreement with the reported value for tetrahedral Co(II) complex. Generally, square planar Ni(II) complexes are diamagnetic while tetrahedral complexes have moments in the range 3.2-4.1 B.M. The present NiAB complex reported herein has a room temperature magnetic moment value of 3.37 B.M, which is within the normal range observed for tetrahedral Ni(II) complex. The magnetic moment value of the CuAB complex was observed to be 1.87 B.M, which indicates that the complex is monomeric and paramagnetic. ZnAB Cl complex with d^{10} electronic configuration is diamagnetic and would have tetrahedral geometry

IV. CONCLUSION:

The Schiff base ligand Furfural(A)Ethylene diamine(B), derived by condensing Furfural and Ethylene diamine was characterized by electronic spectral studies. Co(II), Ni(II), Cu(II), and Zn(II) complexes of this ligand were synthesized and characterized. Electronic spectral and magnetic measurements indicate tetrahedral geomentry and diamagnetic property for the Co(II), Ni(II), and Zn(II) complexes and square planar geomentry and paramagnetic property for the Cu(II) complex.

Table 3 Magnetic data of the Schiff base metal complexes

χ_M = molar susceptibility, χ_D = diamagnetic correction, χ'_M = corrected molar susceptibility

Complex	$\chi_D \times 10^6$ c.g.s. unit	$\chi_M \times 10^6$ c.g.s. unit	$\chi'_M \times 10^6$ c.g.s. unit	μ_{eff} BM	Geometry
CoAB	157	8113	8270	4.48	Tetrahedral
NiAB	157	4523	4680	3.37	Tetrahedral
CuAB	157	1284	1441	1.87	Square planar
ZnAB	-	-	-	-	Tetrahedral

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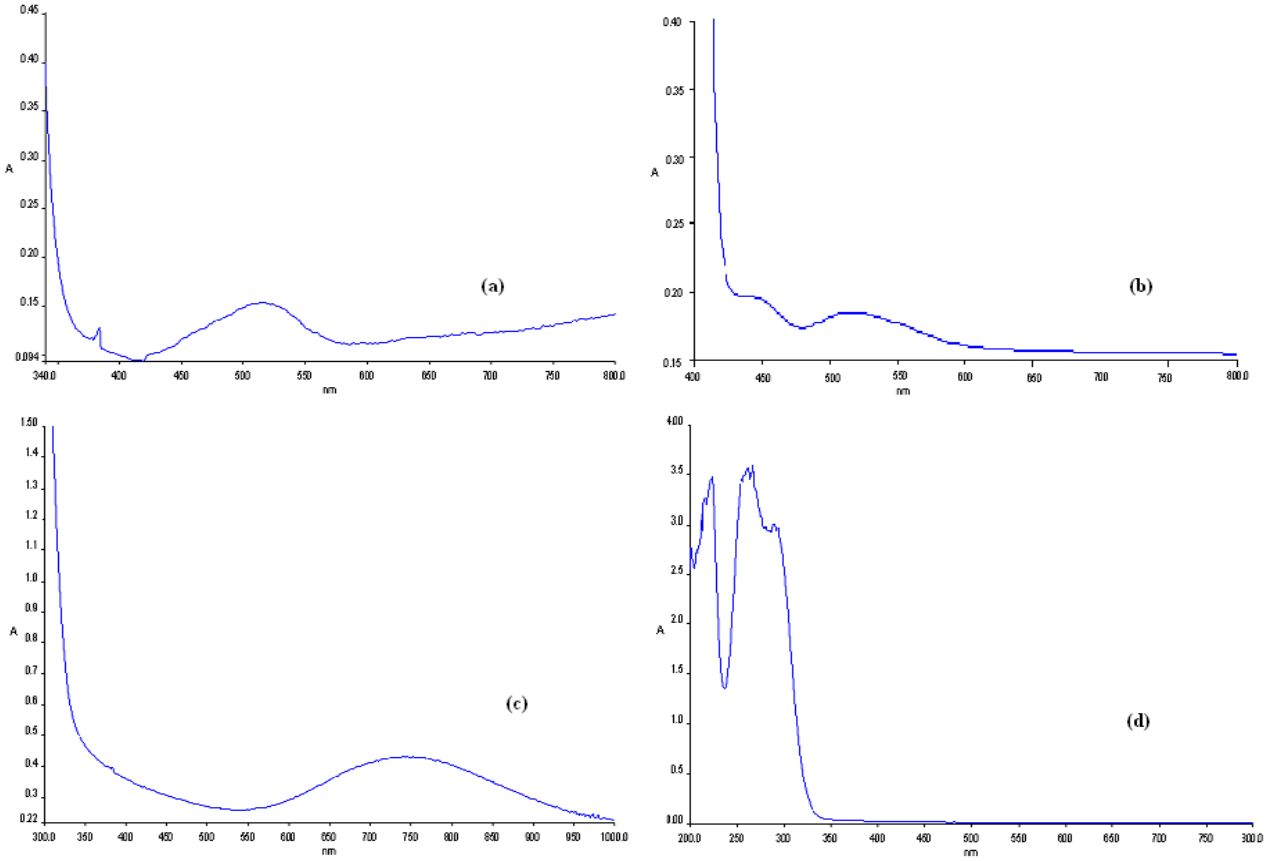

Fig.1.Electronic spectrum of Schiff base complexes: (a) CoAB; (b) NiAB; (c) CuAB and (d) ZnAB complexes

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