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SYNTHESIS, SPECTRAL ANALYSIS AND ANTIMICROBIAL ACTIVITY OF SOME NEW TRANSITION METAL COMPLEXES DERIVED FROM 2, 4-DIPHENOXY ACETOAMIDES

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ABSTRACT

Cu (II), Ni (II), Co (II), Fe (III), Zn (II) and Mn (II) complexes were synthesized from Schiff bases derived from 2-amino pyridine and 2, 4-diphenoxy acetoamides. The Schiff bases and complexes were characterized by elemental analysis and spectral data. The synthesized Schiff bases and their transition metal complexes have been screened for their antimicrobial activity against E.coli, S. typhi, S. aureus, B. subtilis and against various fungi like P.chrysogenum, A. niger, F. moniliformae, and A.Flavus. The complexes show enhanced activity than their corresponding ligands.

INTRODUCTION

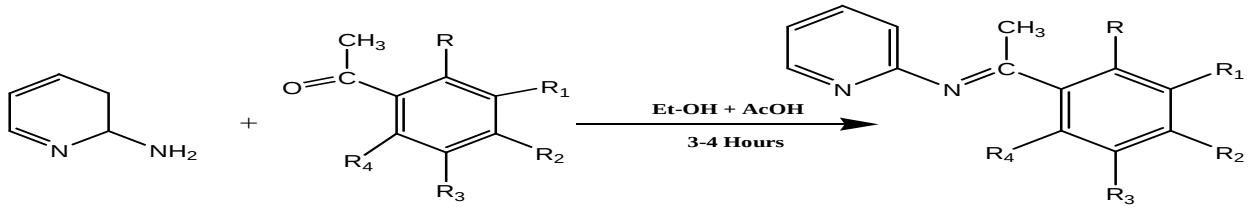
The Phenoxy acetoamides were used as starting material for the synthesis of chalcones flavones and Schiff bases etc. Schiff bases of hydroxy aldehydes and ketones were widely used in co-ordination chemistry for the preparation of metal complexes[1]. Schiff bases and their co-ordination compounds have been gained importance now-a-days as they are useful in biochemical, anti-cancer, anti-inflammatory, and antipyretic, among others. Some of them have been used as complexing agent and powerful corrosion inhibitors[2]. A Schiff base of hydroxy acetoamides and its complexes has a variety of applications in biological, clinical, analytical and pharmacological areas. Earlier work has shown that some drugs showed increased activity when administered as metal chelates rather than as organic compounds and that the co-ordinating possibility of hydroxy acetoamides has been improved by condensing with a variety of carbonyl compounds. Here in this paper we report the synthesis of Schiff bases as ligand and their metal complexes Cu(II), Ni(II), Co(II), Fe(III), Zn(II) and Mn(II). All the synthesized compounds were screened for their antimicrobial activity. Further the structures of synthesized compounds were confirmed by elemental analysis and spectral studies. The structures of the ligands are shown in scheme-1 and complexes are shown in scheme-2.

MATERIALS AND METHODS

All the melting points were determined in an open capillary tube and are uncorrected. Completion of the reaction was monitored by thin layer chromatography on pre-coated sheets of silica gel-G. All the reagents used were chemically pure and are of AR grade. Solvents were dried and distilled before use according to standard procedure. The IR spectra in KBr were recorded on shimadzu spectrophotometer and 1H NMR spectra were recorded in DMSO on AVANCE 300 MHz spectrophotometer using TMS as an internal standard. (δ ppm).

General procedure for the synthesis of ligands derived from 2-amino pyridine (scheme-1)

An equimolar mixture of 2-amino pyridine and substituted ketone (i.e.0.01mole) dissolved in ethyl alcohol and mixture was refluxed for 3-4 hours. The reaction mixture was then poured into ice cold water; solid separated was filtered washed with water,recrystallised from ethyl alcohol[3].



R = OH R$_1$=H R$_2$ = OH R$_3$ = H R$_4$ = H

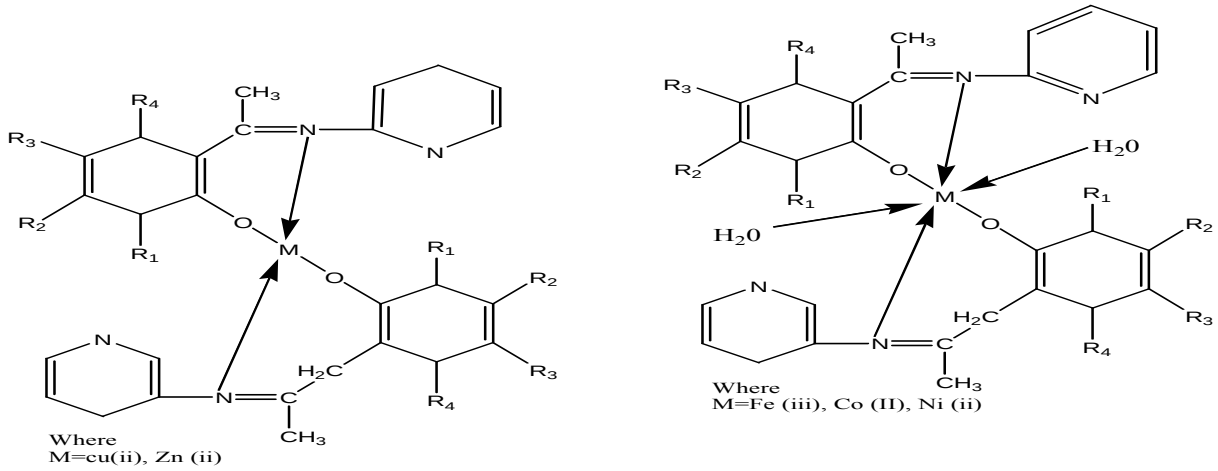
General experimental procedure for the synthesis of metal complexes (Scheme-2)

The ligand (0.02 mole) and the metal salt (0.01 mole) in 50 ml ethanol was refluxed for 2 hours. In all the cases the ligand concentration was slight excess of 1:2 metal ligand molar ratio. After refluxing the solid mass separated filtered through a sintered glass crucible (G4) and the residue was washed several times with hot methanol until the washing were free of the excess of ligand these complexes finally dried under vacuum desiccators over fused calcium chloride.

Table 1: Physical data of synthesized metal complexes

Compound Code	Molecular formula	Colour	Decomposition	Yield %
L	$C_{13}H_{12}O_2N_2$	Brown	232	80
La	$C_{26}H_{22}O_4N_4Cu$	Dark brown	258	68
Lb	$C_{26}H_{26}O_6N_4Co$	Brown	230	64
Lc	$C_{26}H_{26}O_6N_4Ni$	Orange red	268	56
Ld	$C_{26}H_{24}O_6N_4Fe$	Brown	212	72
Le	$C_{26}H_{22}O_4N_4Zn$	Lwmon Yellow	256	58
Lf	$C_{26}H_{22}O_4N_4Mn$	Brown	243	60

(Scheme-2)



Molar conductivity measurements were carried out in DMSO on an Elico digital conductometer model 180. The magnetic susceptibility measurements were made on Guoy balance at room temperature using Hg [Co (NCS) 4] as standard. IR spectra of the metal in KBr pallets in the range of 4000-350 cm-1 were recorded making use of FTIR-SCHIMADZU 8400S spectrophotometer[4]. UV visible spectra in DMF were recorded on a SCHIMADZU multipurpose recording spectrophotometer model 1601 and 1H NMR spectra were recorded in DMSO on AVANCE 300 MHz spectrophotometer using TMS as an internal standard (δ ppm).

RESULTS AND DISCUSSION

All the complexes are colored solids, soluble in polar solvents like DMF and DMSO. The elemental analysis shows 1:2 (M: L) stoichiometry for all the complexes. The analytical data given in Table 1.The metal contents in complexes were analyzed by gravimetric analysis.

All the complexes show low conductance which indicates their non electrolytic nature. The magnetic measurement studies suggest that the Cu (II), Co (II), Mn (II) and Fe (III) complexes exhibit paramagnetic behavior where as the Ni (II) and Zn (II) show diamagnetic behavior[5].

1H-NMR Spectra

1H-NMR spectra of synthesized ligand and its transition metal complexes where recorded in DMSO. The 1HNMR spectra of complexes show broad signals due to presence of metal ion and the conformation of each signal in aromatic region is difficult due to complex pattern of splitting.

IR Spectra

The FT-IR spectrum of the free ligand shows four characteristic bands at 3300 cm-1 (-OH stretch), 1538 (C=C Ar .str.), 1644 (C=N str.), 1248 (C-O, Ar-OH). Where as in the IR spectra of complexes there is one more additional absorption band appears at 445-474 cm-1 range due to M-O bond.

Thermal Analysis

The thermogram of Ni(II), Fe(III) Co(II) complexes confirms the presence two moles of coordinated water molecules where as there is absence of coordination of water molecule in Zn(II) and Cu(II) complexes. Hence from TGA it is clear that the complex under study contains two moles of coordinated water molecules which are coordinated to central metal ion.

Magnetic moment

The μeff. Values at room temperature for Cu (II) complexes are in the range of 1.76-1.88 B.M. usually observed for square planar geometry. Ni (II) and Co (II) complexes have magnetic moment values in the range of 2.84-3.24 and 4.28-4.94 B.M. respectively. Whereas completely filled ‘d’sub- shell the Zn ion complex is diamagnetic in nature.

Electron spin resonance study

From the ESR spectra the values have been calculated by Kneubehls methods.The observed g-values point to the presence of the unpaired electron in the dx2-y2 orbital with characteristic of square planar of elongated tetragonal geometry. The g11 obtain obtained for the Cu (II) complexes is less than 2.3 indicating covalent character of the metal-ligand bond.

Antimicrobial activity

The antibacterial activity of the compounds was determined by agar diffusion method against various bacteria like E.coli, S. typhi, S. aureus, and B. subtilis at various concentrations such as 20, 50 and 100 µg /ml. The zone of inhibition was measured in mm and DMSO was used as solvent. Sterile nutrient agar was seeded with test organism and layered in sterile petri plate. After solidification, agar cups were borered with cork borer 0.1 ml of the compound solution was added to the cup with the help of micropipettes, one cup in the plates was filled with solvent. Standard penicillin (10v/ml) was used as reference drug. The plates were kept at low temperature (4°C) for 20 minutes to allow diffusion of the compound. Then the plates were incubated at 37 °C for 24 hr. After proper incubation the plates were observed for zone of no growth (zone of inhibition of growth) around the cup. Similarly the same compounds were screened for the antifungal activity against different organisms like P.chrysogenum, A. niger, F. moniliformae, and A. Flavus by using poison plate method. The compound was mixed with sterile potato dextrose agar medium so as to get final concentration 2%. It was then poured in sterile petri plate and allowed to solidify. Spots of test organisms were placed on the agar surface. A plate without compound was prepared for control. The plates were incubated at room temperature for 48 hr. After proper incubation plates were observed for growth of the test organisms. The growth indicates that the compound is not antifungal while inhibition of growth of test organism indicates antifungal activity. The antifungal activities of the compounds were compared with standard griseofulvin.

Table-2: Antimicrobial activity of synthesized compounds.

Product	Bacterial strain				Fungal strain			
	Ec	St	Sa	Bs	An	Pc	Fm	An
L_1	13	12	23	17	-ve	-ve	-ve	-ve
(L_1.Cu.H_2o)	09	17	12	22	+ve	+ve	+ve	-ve
L_1.Ni(H2O)2	11	08	26	21	+ve	+ve	RG	+ve
L_1Co(H2o)2	13	--	28	16	+ve	RG	-ve	-ve
L_{1Mn}	16	--		24	+ve	+ve	-ve	-ve
$L_1Fe(H_2O)_2$	06	08	17	16	-ve	RG	-ve	+ve
(L_1Zn)	--	14	23	11	RG	+ve	-ve	+ve
Penicillin	18	20	32	28	-ve	-ve	-ve	-ve
Griseofulvin	NA	NA	NA	NA	-ve	-ve	-ve	-ve

Ec-E.coli, St-S.typhi, Sa- S.aureus, Bs-B.subtilis; An-A.niger, Pc-P.chrysogenum, Fm-F.moneliformae, Ca-C.albicans; -ve: No growth of fungi,+ve: Growth of fungi, RG-Reduced growth, NA-Not Applicable, Zone of inhibition was measured in mm.

The result of antimicrobial data of the ligand and complex shows that the complexes of the schiff bases shows enhanced activity than their corresponding ligand.

CONCLUSION

From the result and the discussion and analytical data it is confirmed 1:2 stoichiometry and the electronic spectral data suggest that the Co (II), Ni (II), Fe (II) complexes have octahedral geometry where as Cu (II), Zn (II) and Mn (II) complexes have square planar geometry. The antimicrobial study show that the complexes of the corresponding Schiff bases show enhanced activity than their corresponding ligand.

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