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Research Article

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Characterization and antimicrobial screening of Cr(III), Mn(III), Fe(III), VO(IV), Zr(IV) and UO_2(VI) with Schiff base having N_2O_2 donor group

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ABSTRACT

The new synthesized Schiff base have been condensing by 2-hydroxy-5-chloro acetophenone with ethylene diamine. The metal complexes were obtained as a result of interaction of Schiff base ligand and metal ions Cr (III), Mn (III), Fe (III), VO (IV), Zr (IV) and UO_2 (VI). The complexes have been characterized on the basis of elemental analysis, infrared, molar conductance and magnetic Susceptibilities. The IR spectra revealed that the complexes coordinated through azomethine nitrogen and methoxy oxygen of the ligands. Further conclusive evidence of the coordination of the Schiff bases with the metal ions was shown by the appearance of new bands due to ν(M-N) and ν(M-O) in the metal complexes. The metal complexes have been examined against the growth of bacteria to assess their antimicrobial potential.

Keywords: Schiff base, Spectra, Molar conductance, Antimicrobial

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INTRODUCTION

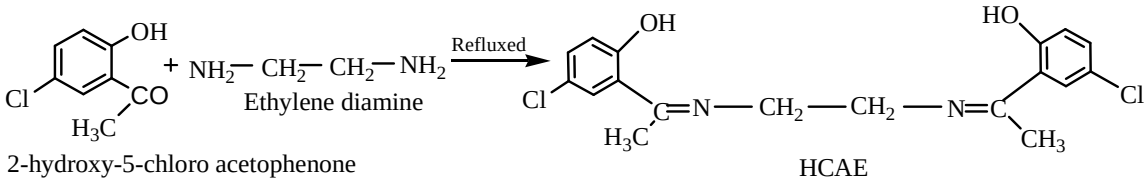
Schiff bases are an important class of compounds widely used in medicinal and pharmaceutical field. Schiff base complexes have an important and popular area of research due to their simple synthesis, versality and diverse range of applications (Taylor and Relinski, 2004; Yamada, 1999). The Schiff bases play a significant role in the area of coordination chemistry. The Schiff base prepared by using variety of aldehydes and amines possessed antitubercular, antitumer, 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. It is significance to design and synthesize highly fluorescent organic compound due to their fascinating functions as fluorescence sensors and biomarkers [1-6]. Antimicrobial screening and biological great significance of Schiff base metal complexes research[7,8] Schiff bases and their complexes have a variety of applications in biological clinical and analytical fields[9-11]. Recently there has been a considerable interest in the chemistry of hydrazine and hydrazone compounds because of their potential pharmacological applications[12].

This paper discusses the molar conductance, magnetic Susceptibilities and antimicrobial screening for Schiff base complexes of Cr(III), Mn(III), Fe(III), VO(IV), Zr(IV) and UO_2(VI).

EXPERIMENTAL SECTION

All the chemical were of A.R. grade and used as received ethylene diamine and 2-hydroxy-5-chloro acetophenone (HCA) was prepared by known methods[13]. The solvents were purified by standard methods[14].

Synthesis of 2-Hydroxy-5-chloroacetophenone-N,N'-ethylenediimine (HCAE):
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 3-4 h. The colour product was filtered off and recrystallised. Yield 90%. M. P. 260^0C



2-hydroxy-5-chloro acetophenone HCAE

Preparation of complexes:
All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCAT (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 : 40-45%

Table 1. Analytical data and molar conductance of the compounds

Compounds	Colour	Mol.wt.	Analysis % Found (calc.)					μ_{eff} B.M.	Λ_M (Ω^{-1} cm^2 mol^{-1})
			M	C	H	N	Cl		
$C_{18}H_{18}N_2O_2Cl_2$	Yellow	364.1	--	58.83 (59.19)	4.85 (4.97)	7.17 (7.67)	19.27 (19.41)	--	--
[CrL(H_2O)Cl] $2H_2O$	Yellow	503.6	8.66 (11.89)	42.28 (42.89)	3.88 (4.36)	4.98 (5.55)	18.77 (19.14)	3.56	19.2
[MnL(OAc)] $2H_2O$	Brown	512.0	9.82 (10.72)	45.88 (46.87)	4.73 (4.88)	4.58 (5.46)	--	5.8	10.8
[FeL(H_2O)Cl] H_2O	Green	489.5	10.68 (11.39)	42.23 (44.12)	4.42 (4.49)	5.12 (5.72)	20.62 (21.75)	6.0	14.8
[VOL]	Green	429.1	10.45 (11.86)	49.62 (50.33)	4.11 (4.19)	5.89 (6.52)	--	1.70	12.5
[ZrL($OH)_2$] $2H_2O$	Yellow	523.3	16.79 (17.18)	40.78 (41.27)	3.97 (4.20)	4.88 (5.35)	--	Dia	26.9
[UO_2L]	Orange	632.2	36.92 (37.64)	33.52 (34.16)	2.18 (2.53)	3.85 (4.42)	--	Dia	19.6

The complexes are soluble in DMSO and DMF but insoluble in water and common organic solvents. The metal chloride content of complexes were analyzed by standard methods[11].

The ^{1}H NMR spectra of ligand was recorded and obtained from RSIC Chandigarh. IR spectra of the compounds were recorded on Perkin Elmer 842 spectrophotometer in the region 400-4000cm^{-1}, Carbon, Hydrogen and Nitrogen analysis were carried out at RSIC, Punjab University, Chandigarh. 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 thermogravimetric analysis were performed on laboratory set up apparatus in air atmosphere at 10^0C min^{-1} heating rate. The molecular weights of the complexes were determined by Rast method.

RESULTS AND DISCUSSION

The Schiff base ligand HCAE and its complexes have been characterized on the basis of ^{1}H 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 coordinating solvents like DMF and DMSO. The molar conductance values in DMF (10^{-3} M) solution at room temperature (Table 1) shows all the complexes are non electrolytes[11].

The ^{1}H NMR spectra of ligand HCAE shows signals: δ12.87 (1H, s, phenolic OH); 9.15 (1H, s, phenyl); 7.66 and 7.31(2H, m, phenyl), 3.49(4H, s, CH_2–CH_2); 2.41 ppm (3H, s, methyl)[15-24]

Table 2. IR spectra of ligand and metal complexes

Compound	ν(O–H) hydrogen bonded	ν(C=N) imine	ν(C–O) Phenolic	ν(M–O)	ν(M–N)
$C_{18}H_{18}N_2O_2Cl_2$	2910	1628	1470	--	--
[CrL(H_2O)Cl] $2H_2O$	--	1605	1445	575	462
[MnL(OAc)] $2H_2O$	--	1596	1456	584	494
[FeL(H_2O)Cl] H_2O	--	1608	1465	534	421
[VOL]	--	1607	1458	526	484
[ZrL($OH)_2$] $2H_2O$	--	1609	1448	568	462
[UO_2L]	--	1595	1456	564	472

Antimicrobial activity:
Antimicrobial Screening assay depends upon a comparison of the inhibition of growth of microorganism by measuring the concentration of the sample to be examined with the known concentration of standard antibiotic. For the antimicrobial analysis the agar diffusion method has been employed. In this study the ligand and their metal complexe were tested for their effect on certain human pathogenic bacteria such as Gram-positive.

The ligand HCAE and its complexes [25-36] are found to show considerable bacteriocidal activity against *E. coli, A. aerogenes, S. aureus* and *B. subtilis* and are almost inactive against *B. megatherium, P. vulgaris* and *P. fluorescen.* The ligand inhibits the growth of *S. aureus* more than all its complexes. The results reveals that the sensitivity of the ligand HCAE and its complexes is shows in (Table 3).

Table 3. Antimicrobial 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)
HCAE	S_8	R	S_{16}	S_{13}	R	R	R
Cr- HCAE	S_{12}	R	S_{11}	S_{14}	R	S_{12}	R
Mn- HCAE	S_{13}	R	S_{15}	S_6	R	S_8	S_9
Fe- HCAE	R	S_9	S_{14}	R	R	S_{12}	R
VO- HCAE	S_{10}	R	S_{13}	S_4	R	S_{15}	S_9
Zr- HCAE	S_{13}	R	S_{14}	R	R	S_9	R
UO_2- HCAE	R	R	S_{14}	S_{11}	R	S_{11}	S_8

CONCLUSION

A new ligand and complexes using ethylene diamine Schiff's base ligand has been synthesized and characterized by spectral and analytical data. The results revealed that the ligands and their complexes show considerable antimicrobial 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 antimicrobial activities.

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