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Antimicrobial Studies of Co(II), Ni(II), Cu(II), Cr(III), Mn(III), Fe(III), VO(IV), Zr(IV) and UO₂(VI) with tetradentate Schiff base

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ABSTRACT

The newly synthesized tetradentate Schiff base have been prepared by condensing ethylene diamine with 2-hydroxy-5-chloro acetophenone. The metal complexes were obtained as a result of interaction of Schiff base ligand and metal ions Co(II), Ni(II), Cu(II), Cr(III), Mn (III), Fe(III) VO(IV), Zr(IV) and UO₂(VI). The complexes have been characterized on the basis of elemental analysis, infrared, molar conductance, magnetic susceptibilities and electronic spectra. The metal complexes have been examined against the growth of bacteria to assess their antimicrobial potential.

Keywords: Tetradentate Schiff base, Antimicrobial studies

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CONTENTS

1. Introduction	130
2. Experimental.	131
3. Results and Discussion.	131
4. Conclusion	132
5. References	132

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1. Introduction

Schiff base complexes have an important and popular area of research due to their simple synthesis, versatility 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 International Journal of Chemistry and Pharmaceutical Sciences

possessed antitubercular, antitumor and 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 [1-12]. This paper discusses thermal decomposition, antimicrobial activities and the

accompanying compensation effect for Schiff base complexes of Co (II), Ni (II), Cu (II), Cr (III), Mn(III), Fe(III) VO(IV), Zr(IV) and UO₂(VI).

2. Experimental

In all research the chemicals 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-chloro acetophenone-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 4-5 h. The colour product was filtered off and recrystallised. Yield 80%. M. P. 275°C.

Preparation of complexes:

All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCAE (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. 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]. Yield: 55-60%.

3. Results and Discussion

The Schiff base ligand HCAE and its complexes have been characterized on the basis of ¹H NMR, IR spectral data, elemental analysis, molar conductance, magnetic susceptibility measurements and thermo gravimetric analysis data. 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 electrolytes¹¹ The ¹H NMR spectra of ligand HCAE shows signals at: 15.57 (1H, s, phenolic OH); 8.03(1H, s, phenyl); 7.57 and 7.41 (2H, m, phenyl), 3.23(4H,s, CH₂CH₂); 2.41 ppm (3H, s, methyl)[15-24].

Antimicrobial activity:

The ligand HCAE and its complexes [25-33] 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 reveal that the sensitivity of the ligand HCAE and its complexes is shows in table 3.

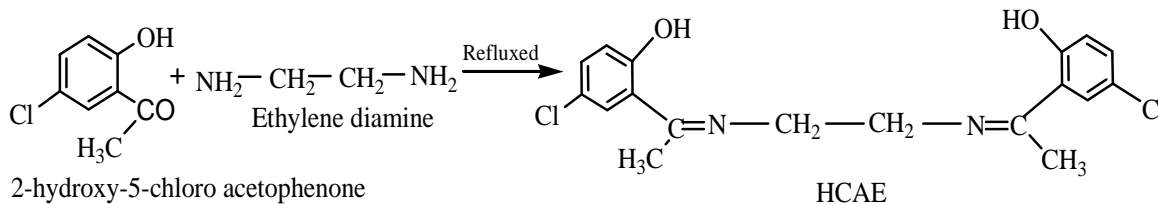


Table 1: Analytical data and molar conductance of the compounds

Compounds	Colour	Mol.wt	Analysis % Found (calc.)					μ_{eff} B.M.	$[\Lambda]_{\text{M}}$ (⁻¹ cm ² mol ⁻¹)
			M	C	H	N	Cl		
C ₁₈ H ₁₈ N ₂ O ₂ Cl ₂	Yellow	367.0	--	46.84 (46.53)	3.83 (3.93)	6.17 (6.27)	--	--	--
[CoL(H ₂ O) ₂] H ₂ O	Brown	478.1	10.42 (10.45)	38.22 (38.45)	3.72 (3.89)	4.72 (4.85)	--	4.02	5.8
[NiL] H ₂ O	Black	370.7	11.12 (11.18)	40.32 (40.57)	3.44 (3.65)	5.18 (5.28)	--	Dia	6.6
[CuL(H ₂ O) ₂] 2H ₂ O	Brown	500.5	10.65 (10.88)	36.71 (36.87)	3.85 (4.01)	4.60 (4.71)	--	2.12	16.8
[CrL(H ₂ O)Cl] 2H ₂ O	Yellow	506.5	8.67 (8.78)	36.42 (36.50)	3.62 (3.70)	4.53 (4.70)	5.71 (5.92)	3.56	20.6
[MnL(OAc)] 2H ₂ O	Brown	514.9	9.05 (9.15)	39.88 (39.98)	3.65 (3.82)	4.52 (4.63)	--	5.26	14.7
[FeL(H ₂ O)Cl] H ₂ O	Green	482.4	9.11 (9.23)	37.23 (37.39)	3.35 (3.49)	4.71 (4.81)	6.01 (6.08)	5.5	15.7
[VOL]	Green	432.0	9.21	41.22	3.06	5.18	--	1.28	13.6

			(9.53)	(41.43)	(3.09)	(5.38)			
[ZrL(OH) ₂] 2H ₂ O	Yellow	526.2	14.32 (14.57)	35.18 (35.23)	3.40 (3.52)	4.32 (4.52)	--	Dia	24.7
[UO ₂ L]	Orange	635.1	32.57 (32.68)	29.52 (29.62)	2.01 (2.20)	3.73 (3.81)	--	Dia	21.5

Table 2: IR spectra of ligand and metal complexes

Compound	(O-H) hydrogen bonded	(C=N) imine	(C=O) Phenolic	(M=O)	(M=N)
C ₁₈ H ₁₈ N ₂ O ₂ Cl ₂	2900	1613	1482	--	--
[CoL(H ₂ O) ₂] H ₂ O	--	1588	1442	521	456
[NiL] H ₂ O	--	1584	1461	512	496
[CuL(H ₂ O) ₂] 2H ₂ O	--	1593	1443	593	492
[CrL(H ₂ O)Cl] 2H ₂ O	--	1598	1432	572	462
[MnL(OAc)] 2H ₂ O	--	1592	1443	583	493
[FeL(H ₂ O)Cl] H ₂ O	--	1600	1462	532	427
[VOL]	--	1600	1452	524	485
[ZrL(OH) ₂] 2H ₂ O	--	1602	1441	566	464
[UO ₂ L]	--	1595	1422	562	473

Table 3: Antibacterial activity of ligands HCAE and their complexes

Ligand and its complexes	<i>B. subtilis</i> (mm)	<i>P. vulgaris</i> (mm)	<i>S. aureus</i> (mm)	<i>E. coli</i> (mm)	<i>P. fluorescen</i> (mm)	<i>A. aerogenes</i> (mm)	<i>B. megatherium</i> (mm)
HCAE	S ₈	R	S ₁₆	S ₁₃	R	R	R
Co- HCAE	S ₁₄	R	S ₁₂	R	S ₁₄	R	S ₁₀
Ni- HCAE	S ₉	R	S ₇	R	S ₁₆	R	R
Cu- HCAE	R	S ₁₄	R	S ₁₀	R	S ₁₀	S ₁₁
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

S – Sensitive, R - Resistant

4. Conclusion

The newly synthesized ligand and their complexes using ethylene diamine Schiff's base ligand has 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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