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Structural and Biological Studies on Transition Metal Complexes of 4-Aminoantipyrine Derivative

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Novel tetradentate Cu(II), Ni(II), Co(II), VO(II) and Zn(II) Schiff base complexes have been synthesized from salicylidene-4-iminoantipyrine and tyrosine. The synthesized Schiff base complexes was characterized by powder X-ray diffraction studies (XRD), scanning electron microscopy (SEM), FT-IR, ESR, ^{1}H NMR, ^{13}C NMR, UV-vis, molar conductance and magnetic susceptibility measurements. The general formula of complexes was confirmed as [ML] type [M = Cu(II), Co(II), Zn(II), Ni(II) and VO(II); L = $C_{27}H_{24}N_4O_4$]. Magnetic susceptibility, IR and UV-vis, spectral data showed that all the complexes have square planar geometry except vanadyl complex which suggests square pyramidal geometry. Lower molar conductance values proved that all the chelates were non-electrolytic nature. The X-band ESR spectra of [CuL] and [VOL] complexes in DMSO solution suggest that the complexes were predominant covalent character. Powder XRD and SEM image pattern evidenced that all the compounds were crystalline in nature and their size ranges from 100-40 nm. Calf thymus DNA binding potential of [CuL] and [VOL] complexes shows that the binding occurs through intercalation mode with low binding constant. The analgesic, CNS, antiulcer and antimicrobial activities of the investigated compounds report reveals that the chelates were significant effect than free Schiff base.

Keywords: 4-Aminoantipyrine, Schiff base complex, Biological screening studies.

INTRODUCTION

During the past few decades, there has been a great deal of interest in synthesis and characterization of pyrazolone derivative transition metal complexes owing to their significance as catalysts in many reactions such as carboxylation, hydroformylation, reduction, epoxidation and hydrolysis. Among the various pyrazolone derivatives, 4-aminoantipyrine is more important due to its coordinating tendency which has been further enhanced by condensing it with various aldehydes/amines. Transition metal complexes of 4-aminoantipyrine and its derivatives have great consequences in a biological, pharmacological, clinical and analytical area [1-5]. Amino acids are a special class of compounds and exist in various living systems. Amino acids also react with 4-aminoantipyrine derivatives and improve its chelating ability. Tyrosine is one of the important amino acids when they present in the metal complexes leads it to improve the pharmacological activities due to its fascinating coordination behaviour with metal ions [6-11]. Schiff base itself has assorted pharmacological activities which have been further enhanced by chelating it with the metal ion. In recent years, several research articles have been published on transition metal complexes derived from 4-aminoantipyrine derivatives with aza or aza-oxo donor atoms [12-14]. A literature investigation reveals that no work has been done on the condensation of salicylidene-4-iminoantipyrine with tyrosine. Hence, in this paper, we reported the synthesis, structural and biological studies of some transition metal complexes derived from salicylidene-4-iminoantipyrine and tyrosine. We also describe the redox behaviour and DNA binding abilities of complexes.

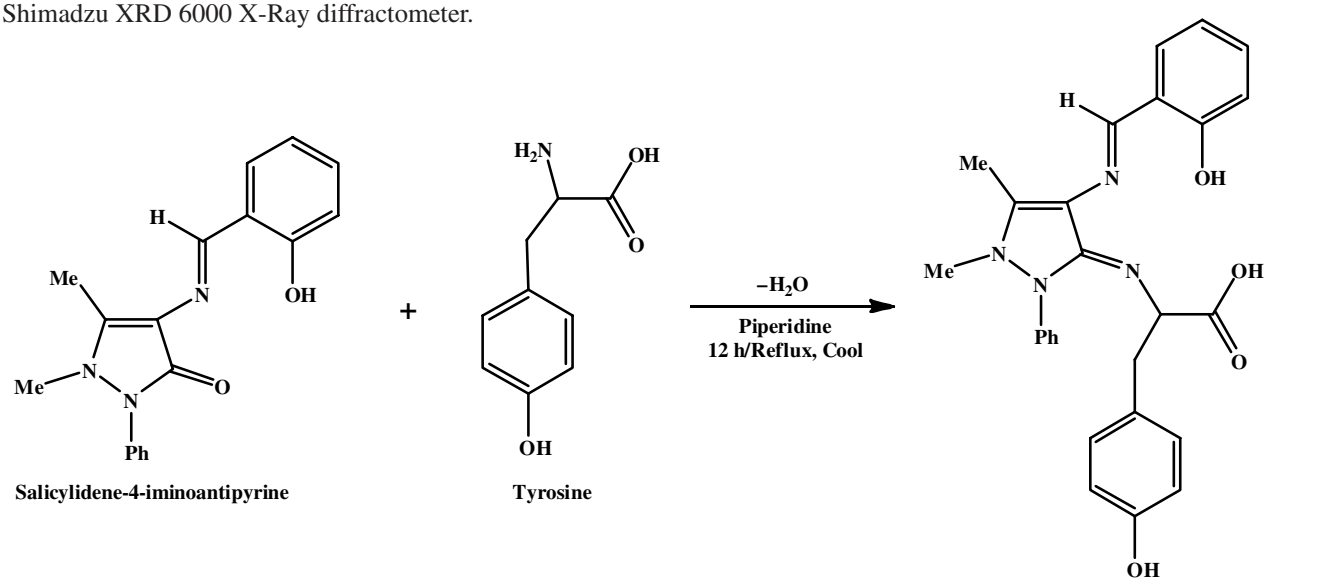
EXPERIMENTAL

Chemicals used in this work (Solvents, salicylaldehyde, tyrosine, 4-aminoantipyrine and $CuCl_2$/$NiCl_2$/$CoCl_2$/$ZnCl_2$/$VOCl_2$) were procured from Merck and used as such. Carbon, hydrogen and nitrogen analysis were done at sophisticated analytical instrumentation facility, IIT, Mumbai by the help of thermal finger-flash CA, 112 series. Electronic spectra of the samples were recorded by using Shimadzu UV-1700 model spectrophotometer and IR spectra of the samples were recorded

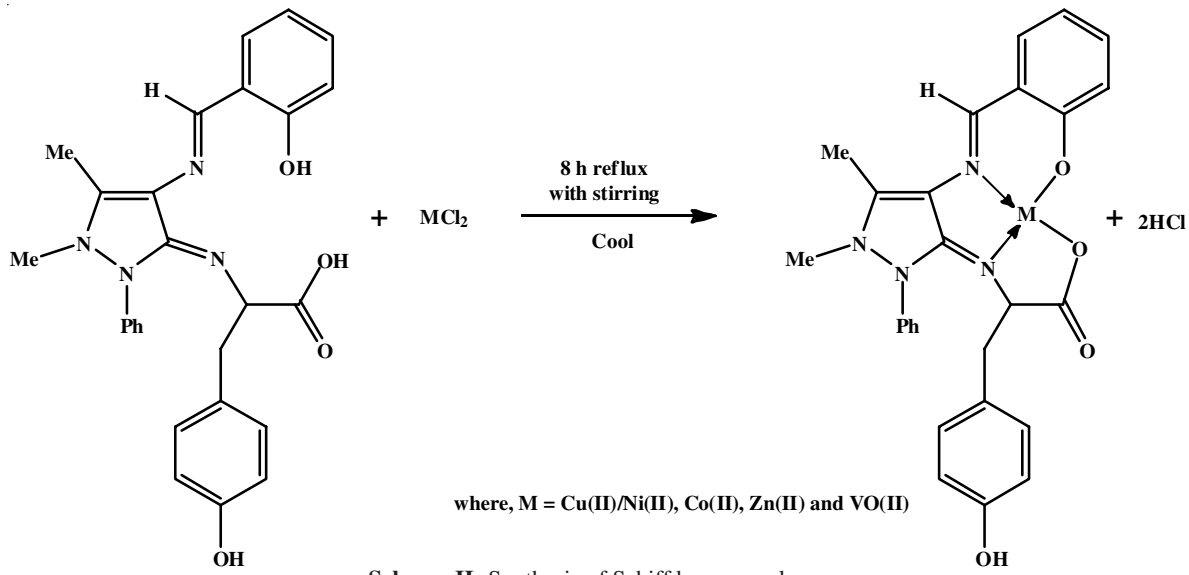
on the FT-IR Shimadzu model 8400s in KBr pellets. The molar conductance of the samples was measured in acetonitrile solution at room temperature using a 305 model systronic conductivity bridge with a dip type cell. Proton nuclear magnetic resonance spectra (300 MHz) of the ligand and its zinc complex were recorded in DMSO-d_6 solution on a Bruker Advance DRX 300 FT NMR spectrometer using TMS as an internal standard at Madurai Kamaraj University, Madurai. ^{13}C NMR spectra of the ligand and its zinc complex were recorded in the DMSO-d_6 solution (Brucker 400 MHz NMR) at Gandhigram rural institute, Dindigul. The X-band ESR spectra of the copper and vanadyl complex in the DMSO solution were recorded at 300 K and 77 K in sophisticated analytical instrumentation facility, IIT, Mumbai. The surface morphology of the synthesized Schiff base and its complexes was analyzed using Scanning Electron Microscopy technique (JEOL JSM 6390). Powder XRD patterns of Schiff base, [CuL], [NiL] and [ZnL] were recorded on a Shimadzu XRD 6000 X-Ray diffractometer.

Synthesis of Schiff base: An ethanolic solution of (50 mL) salicylidene-4-iminoantipyrine (3.07 g, 0.01 mol) and tyrosine (1.81 g, 0.01 mol) was boiled under reflux on a water bath for 8 h in the presence of two drops of piperidine. The resultant solutions had been filtered and concentrated to 10 mL. Then the mixture was stirred with 5 mL of petroleum ether (40-60 °C range) solution. The yellow solid product obtained was amassed by filtration, recrystallized from ethanol, dried and preserved in a desiccator. The synthesis of the Schiff base was specified in **Scheme-I**.

Synthesis of complexes: To the ethanol solution of metal(II) salts ($CuCl_2$/$NiCl_2$/$CoCl_2$/$ZnCl_2$/$VOCl_2$) (0.05 mol) and Schiff base (0.05 mol) was added and refluxed with stirring for 8 h in a water bath. Then, the solution were concentrated to one third on a water bath and cooled. The complex precipitated out was filtered, washed and recrystallized in hot methanol. The path route is given in **Scheme-II**.



Scheme-I: Synthesis of Schiff base



Scheme-II: Synthesis of Schiff base complexes

DNA binding studies: The interaction of DNA with [CuL] and [VOL] complexes were studied at pH = 7.2 (using Tris-HCl/NaCl as a buffer) by measuring the concentration of calf-thymus DNA (260 nm) using UV-vis, spectrophotometer. The stock solutions of the complexes were prepared by using MeCN as a solvent. During the experiment concentration of complexes was kept constant and absorbance of CT-DNA was measured after each addition [15,16].

Biological activities: Schiff base and its complexes were evaluated to test against the growth of human pathogenic bacteria species like as *Escherichia coli, Salmonella typhi, Staphylococcus aureus, Klebsiella pneumonia* and *Bacillus subtilis* and fungi species *Rhizoctonia bataicola, Candida albicans, Aspergillus niger, Aspergillus flavus* and *Rhizopus stolonifer* by disc diffusion method using nutrient agar and potato dextrose agar for antibacterial and antifungal studies, respectively. The stock solutions (10^{-3} mol L^{-1}) were prepared by using acetonitrile and consecutively diluted for determining the minimum inhibitory concentration values [17-19]. The concentration at which an inhibition zone formed was noted as minimum inhibitory concentration (MIC) values. Analgesic activities of the Schiff base and its chelates were studied by the Tail Immersion method using albino rats in an oral path through mouth and diclofenac as control [20,21]. CNS activity of compounds was recorded using actophotometer with the help of albino mice using caffeine and chlorpromazine as a reference and standard, respectively [22-25]. The antiulcer activity of compounds was conveyed by pylorus ligation method in albino rats (140-170 g of body weight). Ulcer list, gastric juice volume, pH, free acidity and total acidity were established [26].

RESULTS AND DISCUSSION

The analytical information of Schiff base and its metal complexes (Table-1) established were an excellent agreement with calculated values which indicates that the complexes have the general formula [ML], where M = Cu(II), Co(II), Ni(II), Zn(II) and VO(II); L= $C_{27}H_{24}N_4O_4$. At room temperature, magnetic susceptibilities of the complexes were consistent with the square planar geometry around the central metal ion. The lower conductivity values of the chelates support the non-electrolytic nature of the complexes.

Mass spectra: The molecular ion peak for the ligand (482 *m/z*) and [CuL] complex (546 *m/z*) shows their composition as $C_{28}H_{26}O_4N_4$ and [$CuC_{28}H_{24}O_4N_4$], respectively. It confirms the stoichiometry of metal complexes as being of [ML] type.

Powder X-ray diffraction: The X-ray diffractogram of H_2L, [CuL], [NiL] and [ZnL] complexes were recorded in the range 0-80° at wavelength 1.54 Å. The diffraction outline of all the complexes differs extensively from the ligand. The typical crystallite size of the complexes was predicted from XRD patterns using the Debye-Scherrer equation [27,28]. X-Ray diffraction pattern of Schiff base (Fig. 1a) manifests the peaks at 13.9792°, 15.653°, 21.83°, 29.9044°, 30.9403°, 40.3797°, 43.3889° and 64.8845° proposed that it is highly crystalline.

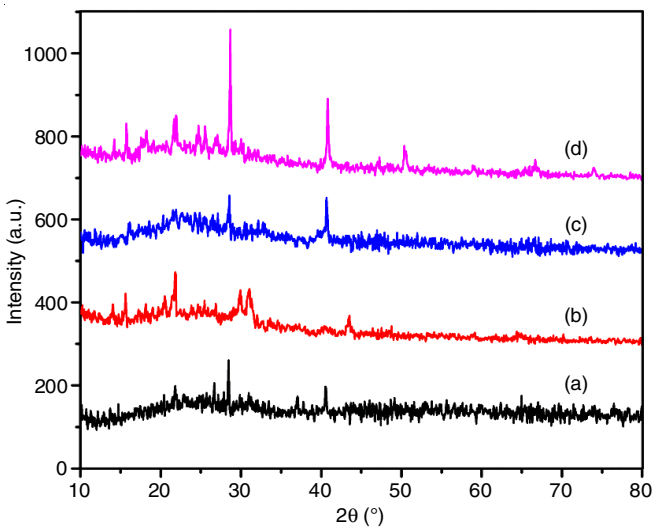


Fig. 1. Powder XRD of (a) Schiff base, (b) [CuL], (c) [NiL] & (d) [ZnL] complexes

The 100% intensity peak of [H_2L] was observed at 21.83°. Powder XRD pattern of [CuL] complex (Fig. 1b) is observed at the range of 26.6866°, 28.4621° and 40.5788°. [NiL] (Fig. 1c) complex peaks experienced at 15.0514°, 21.9645°, 28.5759°, 32.9329° and 40.6995° ranges. [ZnL] (Fig. 1d) complex shows it diffraction peaks at various ranges like 15.749°, 18.0105°, 21.9477°, 24.779°, 25.5869°, 26.9829°, 28.6803°, 40.8259°, 50.5756°, 66.7575° & 73.9988° were observed. The 100% intensity peak appears in the range of 28.4621°, 28.5759° and 28.6803° for [CuL], [NiL] and [ZnL] complexes, respectively [29]. Average crystalline size of Schiff base, [CuL], [NiL] and [ZnL] complexes is 82, 56, 55 and 42 nm, respectively which insists that reduction in size of the ligand due to chelation [30].

Morphological analysis: The SEM analysis of the Schiff base and its metal chelates have been established in Fig. 2. The SEM image of Schiff base (Fig. 2a) shows flower-like

TABLE-1
PHYSICAL AND ANALYTICAL DATA OF THE SYNTHESIZED SCHIFF BASE AND ITS COMPLEXES

Compounds	Colour	m.p./ Decom. (°C)	Yield (%)	Elemental analysis (%): Found (calcd.)				Molar conductance $\Lambda_m \times 10^{-3}$	μ_{eff} (B.M.)
				M	C	H	N		
H_2L	Red	192	82	–	68.87 (68.92)	5.43 (5.56)	11.82 (11.91)	–	–
[CuL]	Dark green	248	65	11.75 (11.94)	60.73 (60.95)	4.38 (4.55)	10.12 (10.53)	10.12	1.78
[CoL]	Pale pink	304	71	11.32 (11.17)	61.34 (61.48)	4.53 (4.59)	10.54 (10.58)	14.92	2.96
[NiL]	Pale green	320	68	11.09 (11.13)	61.45 (61.51)	4.89 (4.58)	10.58 (10.63)	2.65	-
[ZnL]	Yellow	300	83	12.19 (12.25)	60.32 (60.74)	4.48 (4.53)	10.45 (10.49)	13.58	-
[VOL]	Dark brown	310	64	9.36 (9.51)	60.48 (60.57)	4.61 (4.52)	10.33 (10.46)	9.47	1.86

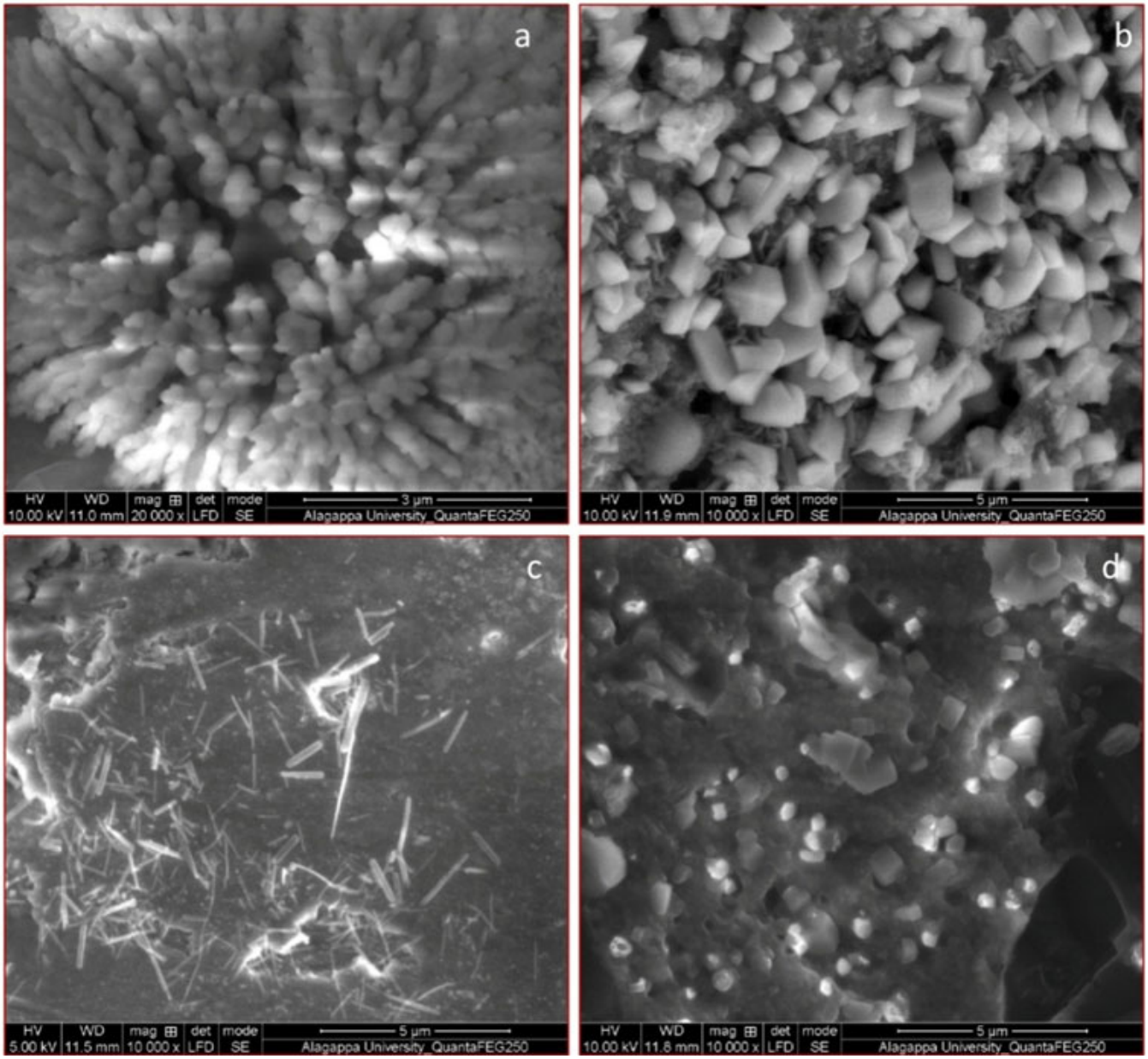


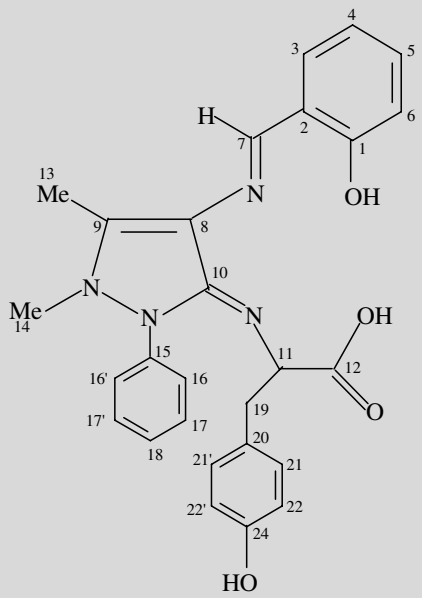
Fig. 2. SEM images for (a) Schiff base, (b) [CuL], (c) [NiL] & (d) [ZnL] complexes

morphology and [CuL] (Fig. 2b) shows irregular rectangular shape while [NiL] (Fig. 2c) complex exhibits sharp-edged needle-like morphology and [ZnL] (Fig. 2d) complex displays cubic-like shape [31,32]. The grain size of Schiff base and its [CuL], [NiL], [ZnL] chelates exhibit 100, 80, 55 and 60 nm, respectively. Due to the chelation, grain size of the metal chelates was shrinked. This analysis concluded that the interaction of ligand with metal gives crystallinity shape and porosity to metal chelates. These results are also coinciding with XRD data [33,34].

^{1}H NMR and ^{13}C NMR: The ^{1}H NMR spectra of the Schiff base and its zinc complexes were recorded in DMSO-d_6 solution. The ^{1}H NMR spectrum of H_2L in DMSO-d_6 shows the following signals: C_6H_5 as multiplet at 6.4-7.6 ppm, =C-CH_3 at 2.7 ppm, -N-CH_3 at 3.2 to 3.4 ppm, -CH_2 group at 3.6 ppm, -CH- group and phenolic -OH group of tyrosine moiety at 5.1 & 11.3 ppm, respectively and azomethine proton of salicylaldehyde moiety at 5.4 ppm. The ^{1}H NMR spectrum of the Schiff base shows two peaks at 9.77 ppm and 8.72 ppm which are attributable to the phenolic -OH group of salicylaldehyde and -COOH group of tyrosine moiety, respectively. Absence of these two peaks in the [ZnL] complex favours the loss of phenolic -OH and -COOH protons due to coordination of ligand with a zinc ion. All other peaks appear downfield shift in the ^{1}H NMR spectrum of [ZnL] complex due to deshielding of electrons around the metal ion which authenticate the complexation of the azomethine group [35].

The decoupled ^{13}C NMR spectra of Schiff base and its [ZnL] complex in DMSO-d_6 solution were recorded and assigned data is summarized in Table-2. In the spectrum of [ZnL] complex, carbon attached to imine, phenolic-OH and carboxylic acid group signals are deshielded when compared to free ligand

TABLE-2
^{13}C NMR SPECTRAL DATA OF SCHIFF BASE AND ITS [ZnL] COMPLEX IN DMSO-d_6 SOLUTION

Structure	Position of C – atom	H_2L	[ZnL] complex
	C1	153	152.6
	C2	136	135.8
	C3	128	127.4
	C4	121	120
	C5	127	126.4
	C6	116	115.4
	C7	20	19
	C8	139	138
	C9	118	117.9
	C10	137	136.7
	C11	42	41
	C12	49	46
	C13	18	17.4
	C14	41	39
	C15	139.6	139
	C16 & C16'	123	122.8
	C17 & C17'	128.4	128.1
	C18	126.2	125.8
	C19	129	128
	C20	135	134.6
	C21 & C21'	130	129
	C22	129.2	128.2
	C23	129	127
	C24	136	134

suggesting the coordination of azomethine nitrogen atoms, deprotonation of phenolic and carboxylic -OH group with the metal ion. All other peaks illustrate slight down-field shifts when compared to Schiff base [36].

IR spectra: The IR spectrum of the ligand exposed that a fused strong band at 3400-3000 cm^{-1} region is allotted for intra ligand hydrogen bonding of phenolic group of salicylaldehyde with –COOH group of tyrosine moiety. These bands were disappeared in the spectra of all the chelates designated that deprotonation of these groups due to coordination with the metal ion. All the complexes show a new strong peak at 3450 to 3350 cm^{-1} region insists that the existence of phenolic -OH group of tyrosine moiety which is not involved in chelation. Ligand also shows two different -C=N bands in the region 1640-1620 cm^{-1} which is shifted to lower frequencies in the spectra of all complexes (1625-1615 cm^{-1}) indicating the involvement of azomethine nitrogen atom in coordination with metal ion [37]. The appearance of medium new bands at 550 and 480 cm^{-1}region in all the chelates are attributed to M-N and M-O bonds, respectively which supports the proposed coordination sites. Besides the other bands, the vanadyl complex exhibits its characteristic V=O peak at 946 cm^{-1} region [38].

Electronic absorption spectra: UV-vis, spectra of investigated compounds was recorded in MeCN solution at 300 K (Table-3) insists that the complexes were square planar geometry except [VOL] complex which exists in square pyramidal geometry due to the presence of axial oxygen atom [39-41].

Electron paramagnetic resonance spectra: The X-band ESR spectra of [CuL] and [VOL] complexes in DMSO solution at a concentration of *ca.* 0.1 M have been recorded at 300 and 77 K (Fig. 3).

TABLE-3
ELECTRONIC ABSORPTION SPECTRAL DATA OF SCHIFF BASE AND ITS COMPLEXES IN MeCN SOLUTION AT 300 K

Compound	Absorption region (cm^{-1})	Band assignment	Geometry
H_2L	236	INCT	
	296	INCT	-
[CuL]	250	INCT	
	298	INCT	Square-planar
	415	$^2B_1g \rightarrow {}^2A_1g$	
	810		
[NiL]	260	INCT	
	285	INCT	
	318	$^1A_1g \rightarrow {}^1A_2g$	Square-planar
	710	$^1A_1g \rightarrow {}^1B_1g$	
[CoL]	235	INCT	
	289	INCT	
	621	$^1A_1g \rightarrow {}^1B_1g$	Square-planar
[VOL]	246	INCT	
	286	INCT	
	390	$^1B_2 \rightarrow {}^2A_1$	Square-pyramidal
	780	$^1B_2 \rightarrow {}^2E$	

INCT = Intra ligand charge transfer band

The observed ESR parameters of [CuL] complex clear that $A_{\parallel}(196 \times 10^{-4}\ cm^{-1}) > A_{\perp}(87 \times 10^{-4}\ cm^{-1})$ and $g_{\parallel}(2.35) > g_{\perp}(2.07) > 2$ it has square planar geometry and axially symmetric. It is supported that the unpaired electron is predominantly found in $d_{x^2-y^2}$ orbital, which is also confirmed by exchange interaction parameter (G = 5). The observed in-plane σ-bonding ($\alpha^2 = 0.83$), in-plane π-bonding ($\beta^2 = 1.01$) and out-of-plane π-bonding ($\gamma^2 = 0.95$) indicates that the complex have partial covalent character and in-plane σ-bonding is predominant. The ESR spectra of [VOL] complex at 300 and 77 K in DMSO solution were used

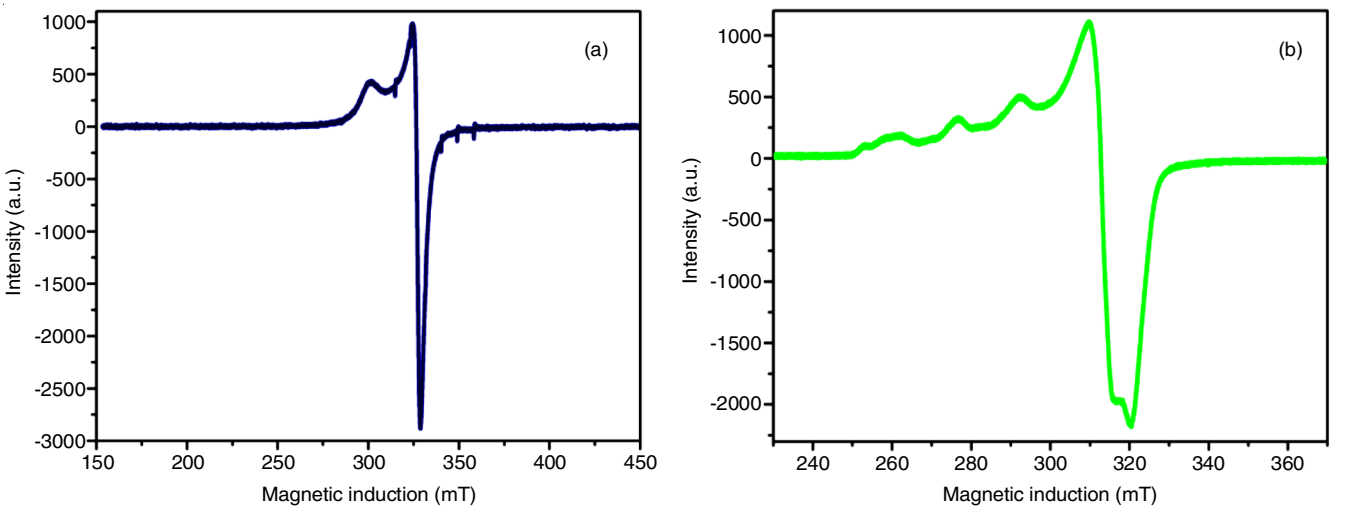


Fig. 3. ESR spectra of [CuL] complex at 300 K and 77 K in DMSO solution

to calculate the spin Hamiltonian parameters [$A_{\parallel}$(178 × 10^{-4} cm^{-1}) > $A_{\perp}$ (79 × 10^{-4} cm^{-1}) and $g_{\parallel}$ (1.99) > $g_{\perp}$ (1.94)] which indicate that the complex is square pyramidal geometry. The determined α^2 (0.86) value indicates that in-plane σ-bonding is covalent while β^2 (0.97) and γ^2 (1.12) are completely ionic [42].

DNA binding studies: Electronic absorption spectra of [CuL] and [VOL] complexes in the non-existence and existence of CT-DNA are shown in Fig. 4. The observed spectra showed that the strong binding of [CuL] and [VOL] complexes with DNA [43] due to the interaction of aromatic chromophore and azomethine group present in the moiety of Schiff base with base pairs of DNA. An increase in concentration of DNA (0-50 mM) increases the optical density of chelate at 260-370 and 280-375 nm regions, respectively. The binding constant (K_b) values of complexes due to interaction are [CuL] = 6.4 × 10^5 with Δλ = 8 nm and [VOL] = 2 × 10^5 with Δλ = 3 nm explains that the binding occurs through intercalation mode [44]. Lower binding constants of both complexes are due to the presence of methyl, phenyl and pyridine moieties in complexes.

Analgesic activity: Analgesic activity of Schiff base and its metal chelates *via* tail immersion method [45] in rats were sustained out and the values have been given in Table-4. It shows that Schiff base have lower reaction time while its complexes exhibit moderate analgesic activity and reaction time increases with increase in time. Among the synthesized complexes [CoL] showed excellent analgesic activity.

CNS activity: The CNS activity of Schiff base and its complexes were studied with the help of albino rats and shown in Table-5. Metal chelates possess enhanced CNS activity than free Schiff base. [CoL] complex has more CNS depressant activity when compared to all other complexes [46].

Antiulcer activity: The antiulcer activity of Schiff base and its complexes in albino rats were summarized in Table-6. Using ranitidine (10 mg/kg of bodyweight) as Standard. Data were expressed as Mean ± SEM, statistical analysis executed by one way ANOVA [47]. It showed that the chelates have high ability than Schiff base. Maximum antiulcer activity was observed in [ZnL] complex.

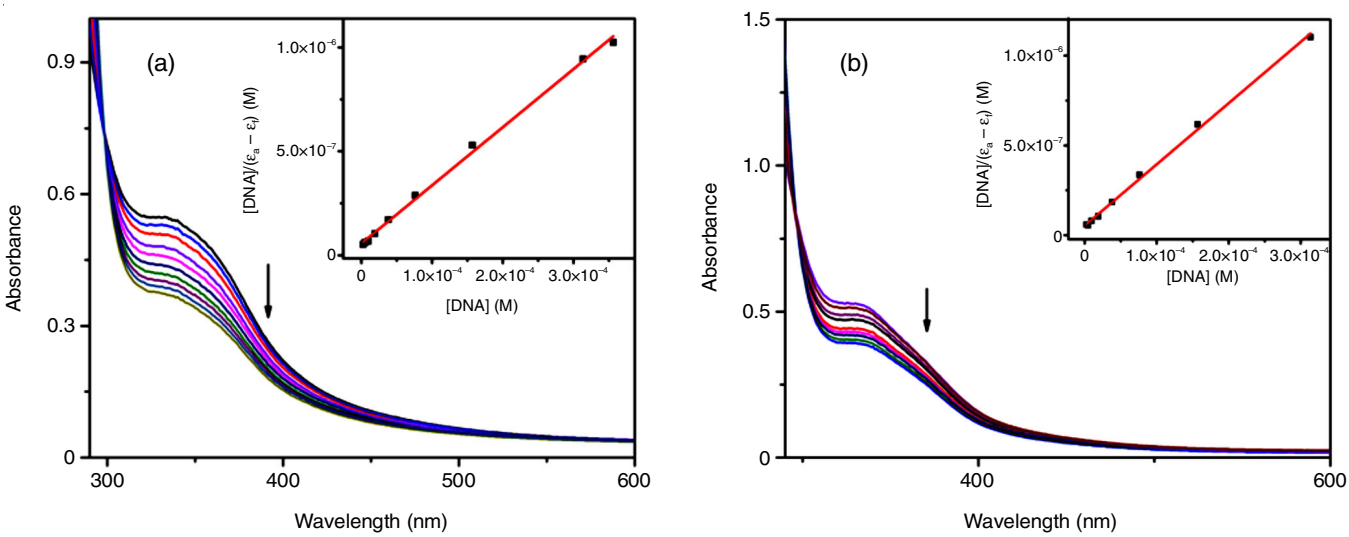


Fig. 4. Absorption spectra of [CuL] (a) and [VOL] (b) complexes in Tris-HCl/NaCl buffer in absence and presence of a different concentration of CT-DNA (0-50 mM) at 300 K

TABLE-4
ANALGESIC ACTIVITY OF SCHIFF BASE AND ITS COMPLEXES IN MECN SOLUTION

Compound	Dosage (mg/kg)	Mean time (s) ± SEM			
		0.5 h	1 h	2 h	3 h
Control	Saline	2 ± 0.8165	1.75 ± 0.9574	1.5 ± 0.5774	2.25 ± 0.4787
Diclofenac	10	10.5 ± 1.291	12 ± 1.4142	12.5 ± 0.5774	12 ± 0.4082
H_2L	250	2.5 ± 0.5774	1.291 ± 2.2174	2.75 ± 1.5	4.5 ± 1.1902
[CuL]	250	8.25 ± 0.9574	10 ± 0.8165	11.25 ± 0.9574	11 ± 0.7071
[NiL]	250	6.5 ± 1.291	7 ± 1.1547	6.5 ± 1	6.25 ± 0.25
[CoL]	250	13.75 ± 1.2583	13.5 ± 1.7321	14 ± 2.708	15.25 ± 1.6008
[ZnL]	250	10.5 ± 4.5092	8.5 ± 0.5774	8.25 ± 0.9574	8.25 ± 0.5
[VOL]	250	9 ± 0.8165	11 ± 2.708	12.75 ± 1.5	13.25 ± 1.8875

TABLE-5
CNS ACTIVITY OF SCHIFF BASE AND ITS COMPLEXES IN MECN SOLUTION

Treatment	Dose (mg/kg)	Locomotor activity (score in 10 min)		Change in activity (%)
		Before treatment	After treatment	
Caffeine	3	89.5 ± 3.1091	32 ± 2.1602	64.2
Chlorpromazine	3	93.25 ± 2.2174	24.5 ± 4.0415	73.7
H_2L	250	74 ± 2.582	24.75 ± 2.2174	66.5
[CuL]	250	83.75 ± 2.7538	25.5 ± 2.0817	69.5
[NiL]	250	84.75 ± 2.2174	27 ± 6.0553	71.1
[CoL]	250	96 ± 2.1602	26.5 ± 2.3805	72.4
[ZnL]	250	57.25 ± 1.7078	27.75 ± 1.893	51.5
[VOL]	250	77 ± 2.8284	32 ± 2.1602	58.4

TABLE-6
ANTIULCER ACTIVITY OF SCHIFF BASE AND ITS COMPLEXES AT 250 mg/kg (P.O) THE RESULT IS SIGNIFICANT AT $p < 0.01$

Group	Volume of gastric juice	pH	Acidity (mEq/L)		Ulcer score
			Free	Total	
Control	6.75 ± 0.4655	7.3 ± 0.1826	167.25 ± 2.3629	186.5 ± 5.8023	1.875 ± 0.8539
Ranitidine	4.175 ± 0.0957	5.125 ± 0.1893	52.5 ± 3.1091	65.5 ± 3.4157	0.125 ± 0.25
H_2L	4.65 ± 0.3416	5.525 ± 0.3304	64.25 ± 3.7749	66.5 ± 4.2032	1 ± 0.4082
[CuL]	4.9 ± 0.4546	5.4 ± 0.2449	67 ± 4.2426	70 ± 3.1623	0.875 ± 0.25
[NiL]	6.9 ± 0.4243	7.325 ± 0.2217	169.5 ± 3.6968	196.75 ± 2.2174	2 ± 0.7071
[CoL]	4.825 ± 0.2217	5.2 ± 0.1826	50.5 ± 4.0415	64.5 ± 2.0817	0.25 ± 0.2887
[ZnL]	5.6 ± 0.1826	6.675 ± 0.1258	104.5 ± 5.4467	118 ± 2.1602	1.875 ± 0.8539
[VOL]	4.85 ± 0.1291	5.625 ± 0.1708	69.75 ± 2.2174	88 ± 2.582	0.875 ± 0.4787
Oneway ANOVA	45.4495	75.3466	692.8345	1045.1114	6.7703
DF	(7, 24)	(7, 24)	(7, 24)	(7, 24)	(7, 24)
P	= 0	= 0	< .00001	< .00001	< .00001

Antimicrobial activity: The minimum inhibitory concentration (MIC) values of the investigated compounds are summarized in (Tables 7 and 8). A lower MIC value of chelates indicates that chelates have higher antimicrobial activity than the free ligand due to greater polarization of metal ion [48,49].

Conclusion

Neutral Cu(II), Ni(II), Co(II), VO(II) and Zn(II) Schiff base complexes were synthesized and characterized by using Powder XRD, SEM, elemental analysis, magnetic susceptibility, molar conductivity measurements, FAB-Mass, ^{1}H NMR,

TABLE-7
ANTIBACTERIAL ACTIVITY DATA OF SCHIFF BASE AND ITS COMPLEXES IN MECN SOLUTION

Compound	Minimum inhibitory concentration (mg/L)				
	Escherichia coli	*Salmonella typhi*	*Staphylococcus aureus*	*Klebsiella pneumonia*	*Bacillus subtilis*
H_2L	70	70	60	90	100
[CuL]	60	55	55	70	90
[NiL]	65	65	70	80	85
[CoL]	60	70	55	75	80
[ZnL]	55	50	50	70	65
[VOL]	50	40	45	65	70
Levofloxacin	45	50	40	70	75

^{13}C NMR, UV-vis, IR and ESR spectral techniques. As per mass spectra, the stoichiometry of metal chelates is [ML] type. Non-eletrolytic natures of complexes were confirmed from their lower conductance data. Powder XRD measurements of Schiff base and its chelates persist that all the compounds are crystalline nature. The SEM image exhibits that the compounds are nano sized in nature. The ^{1}H NMR spectra of the Schiff base and its zinc complex in DMSO-d_6 show the loss of the –OH and –COOH proton due to complexation. UV-vis and IR spectral data show square planar geometry of metal chelates except for [VOL] complex which has square pyramidal geometry. ESR spectra of [CuL] and [VOL] complexes in DMSO solution indicated that in-plane σ-bonding is more significant than in-plane π-bonding. DNA binding studies of complexes with calf-thymus DNA suggested that the interaction occurs *via* intercalation mode. The analgesic, CNS, antiulcer and antimicrobial activity of compounds experienced an enhanced activity than Schiff base. [ZnL] complex have superior biological activities than all other metal chelates.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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