



**Synthesis Characterization And Antimicrobial Activity Studies of Some Transition Metal Complexes Derived From 5-Bromo-3-Phenyl-N'-((2-Thioxo-1,2-Dihydroquinolin-3-Yl)methylene)-1H-Indole-2-Carbohydrazide**

**Vivekanand Biradar, Mahendra raj Karekal and Mruthyunjayaswamy Bennikallu Hire mathada\***

\*Department of Studies and Research in Chemistry, Gulbarga University, GULBARGA- 585106, Karnataka, **INDIA.**

Email: [bhmmswamy53@rediffmail.com](mailto:bhmmswamy53@rediffmail.com)

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**ABSTRACT**

*In this study the new Schiff base 5-bromo-3-phenyl-N'-((2-thioxo-1,2-dihydroquinolin-3-yl)methylene)-1H-indole-2-carbohydrazide and its metal complexes of Co(II), Ni(II) and Fe(III) have been synthesized. The structural features were determined on the basis of their elemental analysis, UV-Visible, magnetic susceptibility, molar conductance and characterized by IR, <sup>1</sup>H NMR, mass, powder X-ray diffraction, ESR and TGA data. All the complexes are of ligand is ML<sub>2</sub> which is 1:2 ratio of octahedral geometry. The microbial and antioxidant activity is carried out and some of the complexes have exhibited good biological activity.*

**Keywords:** Indole, quinoline, Schiff base, metal complex, biological activity.

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**INTRODUCTION**

Schiff bases derived from an amino and carbonyl compound are an important class of ligands that coordinate to metal ions via azomethine nitrogen and have been studied extensively [1]. In azomethine derivatives, the C=N linkage is essential for biological activity. Several azomethines were reported to possess remarkable antibacterial, antifungal, anticancer and diuretic activities [2]. Schiff bases have wide applications in food industry, dye industry, analytical chemistry, catalysis, fungicidal, agrochemical and other biological activities [3]. With the increasing incidence of deep mycosis, there has been increasing emphasis on the screening of new and more effective antimicrobial drugs with low toxicity. Schiff-base complexes are considered to be the most important stereochemical models in transition metal coordination chemistry due to their preparative accessibility and structural variety [4]. A considerable number of Schiff-base complexes have potential biological interest and being used as more or less successful models of biological compounds [5]. Not only they have played a seminal role in the development of modern coordination chemistry, but also found at key points in the development of inorganic biochemistry, catalysis and optical materials [6].

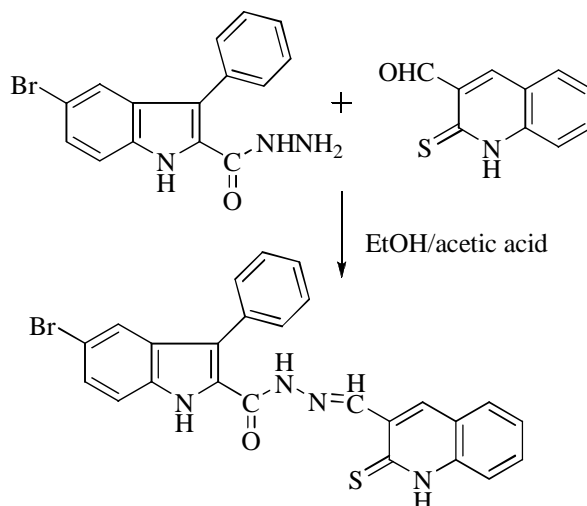
Quinoline moiety is present in many classes of Biologically active compounds. A number of them have been used clinically as antifungal, antibacterial and antiprotozoic drugs [7, 8], as well as antitubercular agents [9-11]. Some quinoline based compounds also show antineoplastic, antiasthmatic and antiplatelet activity [12-17]. Indole and its derivatives occupied a unique place in the chemistry of nitrogen heterocyclic compounds because of their wide spectrum of biological activities and are found to be significant in the development of medicinal chemistry. Amongst them, serotonin, an indole derivative is known for its vasoconstrictor properties. The imbalanced metabolism of serotonin level in cerebral tissues leads to mental disorders. Out of the several naturally occurring compounds containing indole nucleus, the plant growth hormone heteroauxine and essential amino acid tryptophan are known for their role in the growth and maintenance of life. Prompted by these observations we have synthesized some metal complexes of Schiff base formed by the condensation of 5-bromo-3-phenyl-1H-indole-2-carboxyhydrazide and 2-thioxo-1, 2-dihydroquinoline-3-carbaldehyde.

## MATERIALS AND METHODS

All the chemicals, solvents and reagents were purchased from commercially source and further purified by using standard procedure [18]. The IR spectra of compounds were recorded on Perkin-Elmer spectrum one spectrophotometer using KBr disc technique.  $^1\text{H}$  NMR spectra were recorded on Bruker Avance 400 MHz instrument in  $d_6$ -DMSO using TMS as an internal standard and mass spectra on a JEOL GC mate and Agilent 6330 ion trap mass spectrophotometer. ESR spectrum recorded on Bruker BioSpin GmbH. Melting points were determined in open glass capillary tubes. Metal chlorides, hydrazine hydrate (80%), ether,  $d_6$ -DMSO,  $\text{POCl}_3$  and DPPH were obtained from Aldrich.

**Synthesis of Schiff base:** A solution of 5-bromo-3-phenyl-1H-indole-2-carboxyhydrazide (0.330 g, 0.001 mol) and 2-thioxo-1, 2-dihydroquinoline-3-carbaldehyde (0.189 g, 0.001 mol) in ethanol (25 mL) were refluxed in presence of catalytic amount of glacial acetic acid (1-2 drops) for about 6-7 h on water bath. The reaction mixture was cooled to room temperature; the separated Schiff base was collected by filtration, washed with ethanol, dried and recrystallized from 1, 4-dioxane.

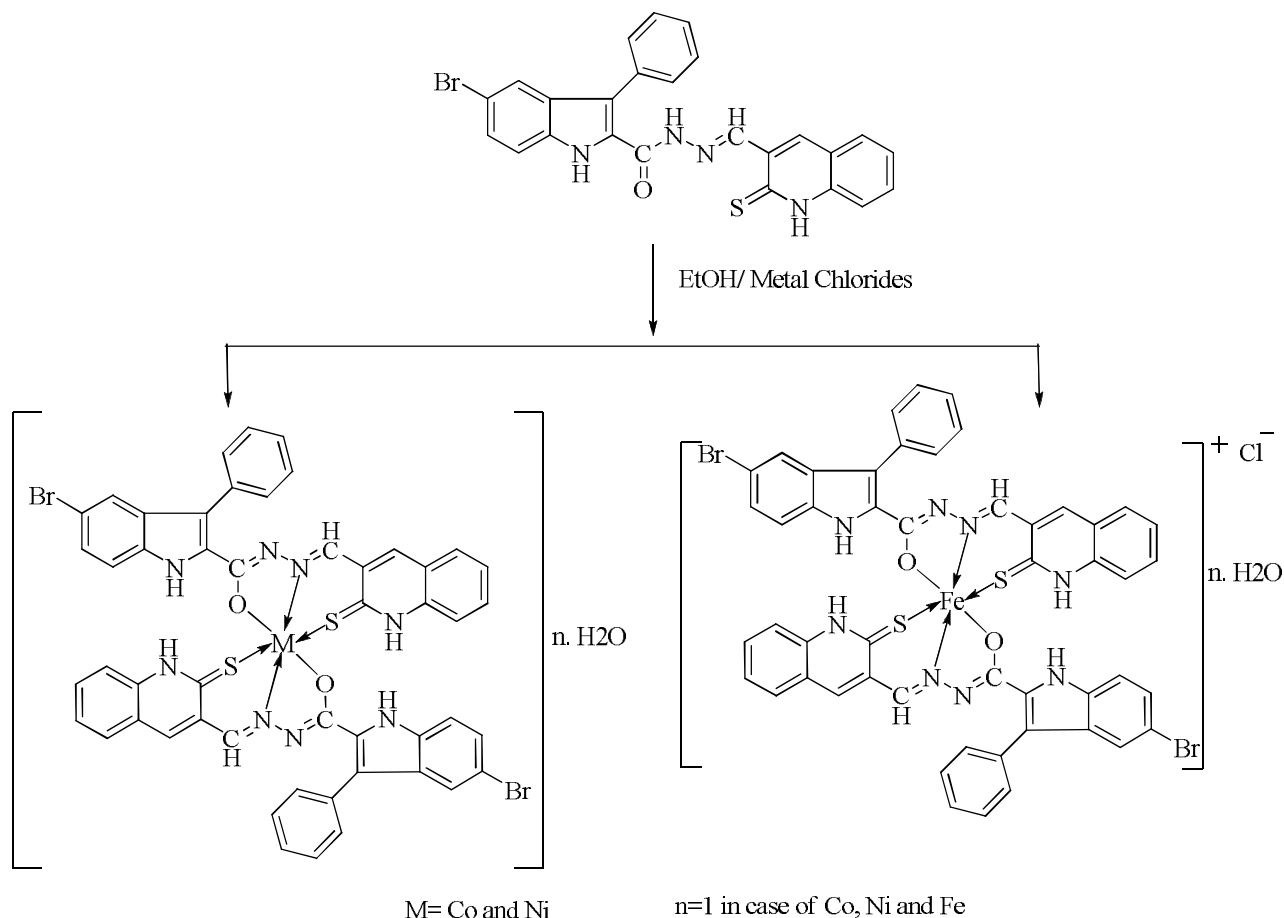
**Synthesis of Co(II), Ni(II) and Fe(III) complexes:** A Schiff base (0.500g, 0.001mole) is dissolved in hot ethanol (20 cm<sup>3</sup>). A solution of respective metal chlorides (0.001 mole) in absolute ethanol (10 cm<sup>3</sup>) was added drop wise with continuous stirring at 50 °C. The pH was maintained by adding sodium acetate. After refluxing the reaction mixture for 5 hrs. it was Poured into distilled water. The resulting solid complexes were collected by filtration, washed with sufficient quantity of distilled water, then with hot ethanol to apparent dryness and dried in a vacuum over anhydrous calcium chloride in a desiccator (yield 65-85%) (Table 1)



Scheme 1: Synthesis of Schiff base  
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Table 1: Physical, Analytical and Molar conductance data of Schiff base and its complex

Mol. Formula (Mol. Wt)	M.P °C (Yield in %)	Elemental analysis (%) Calcd (Found)					Molar cond ( $\lambda_M$ ) ) $\text{ohm}^{-1}$ $\text{cm}^2 \text{mol}^{-1}$	$\mu \text{ eff}$ (B.M)	Colour
		M	C	H	N	Cl			
$\text{C}_{25}\text{H}_{17}\text{N}_4\text{OSBr}$ (500)	318 (65)	-	60 (60.16)	3.4 (3.37)	11.2 (11.11)	-	-	-	Yellow
$\text{Co}[\text{C}_{50}\text{H}_{30}\text{N}_8\text{O}_2\text{S}_2\text{Br}_2]\text{H}_2\text{O}$ (1054.93)	338 (85)	5.49 (5.59)	55.92 (55.80)	2.98 (3.00)	10.43 (10.51)	-	19	5.83	Brown
$\text{Ni}[\text{C}_{50}\text{H}_{30}\text{N}_8\text{O}_2\text{S}_2\text{Br}_2]\text{H}_2\text{O}$ (1072.69)	350 (73)	5.41 (5.48)	55.93 (55.78)	2.98 (3.00)	10.44 (10.32)	-	26	Diamagnetic	Red
$\text{Fe}[\text{C}_{50}\text{H}_{32}\text{N}_8\text{O}_2\text{S}_2\text{Br}_2]\text{Cl}\cdot\text{H}_2\text{O}$ (1108.85)	298 (78)	5.03 (5.1)	54.11 (54.05)	3.06 (2.92)	10.10 (10.22)	3.15 (3.19)	55	5.27	Brown



Scheme 2: Synthesis of metal complexes

**Antimicrobial activity:** Antimicrobial activity was carried out in MIC by the cup-plate method [19]. The *in vitro* antibacterial screening of Schiff base and its metal complexes was undertaken against *Klebsiella* and *Pseudomonas* using nutrient agar media. In brief, molten agar nutrient kept at 45 °C was poured into petri dishes and allowed to solidify. Then wells of 6 mm diameter were punched carefully using a sterile cork borer and were filled with test solution 25  $\mu\text{L}$  (1000 ppm, 500 ppm, 250 ppm, 125 ppm). The plates were incubated for 24 hrs. at 37 °C. The diameter of the zone of inhibition for all the test compounds was

measured and the results were compared with the standard drugs, Gentamycin of the same concentration as that of the test compounds under identical conditions.

The antifungal activity of the test compounds were evaluated against *A. niger* and *A. flavus* by the cup plate method cultured on seberose dextrose agar (SDA) medium adapting the procedures as described above. The plates were incubated at 37 °C for 48 hrs. The diameter of the zone of inhibition for all the test compounds were compared with standard drug fluconazole of the same concentration as that of the test compounds under identical conditions. Since all the test compounds and standard drugs were prepared in freshly distilled DMF, its zone of inhibition was found to be negligible and taken as 0 mm.

**Antioxidant activity by DPPH radical scavenging activity:** 1, 1- Diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity was measured by spectrophotometric method at 517 nm [20-22]. To a methanolic solution of DPPH (0.1 m mol) and standard compounds Vit-C were added separately in different concentrations and an equal amount of methanol (0.05 mL) was added to control. After 30 min, absorbance was measured. The percentage of free radical scavenging activity was calculated by comparing the control and test samples with the following equation.

$$\text{Percentage of free radical scavenging activity} = \frac{A_o - A_e}{A_o} \times 100$$

Where  $A_o$  corresponds to the absorbance of DPPH without sample and  $A_e$  corresponds to the absorbance of sample with complexes or ligand.  $A_o$  is the absorbance sample containing only DPPH (blank).

## RESULTS AND DISCUSSION

**IR spectra of Schiff base and its complexes:** In the IR spectrum of Schiff base showed three absorption band at 3299, 3176 and 3128  $\text{cm}^{-1}$  due to indole NH, amide NH and NH of quinoline moiety. The ligand showed peaks at 1655  $\text{cm}^{-1}$  due to carbonyl group. The bands observed at 1578 and 1179  $\text{cm}^{-1}$  are due to azomethine C=N group and C=S function of quinoline moiety respectively.

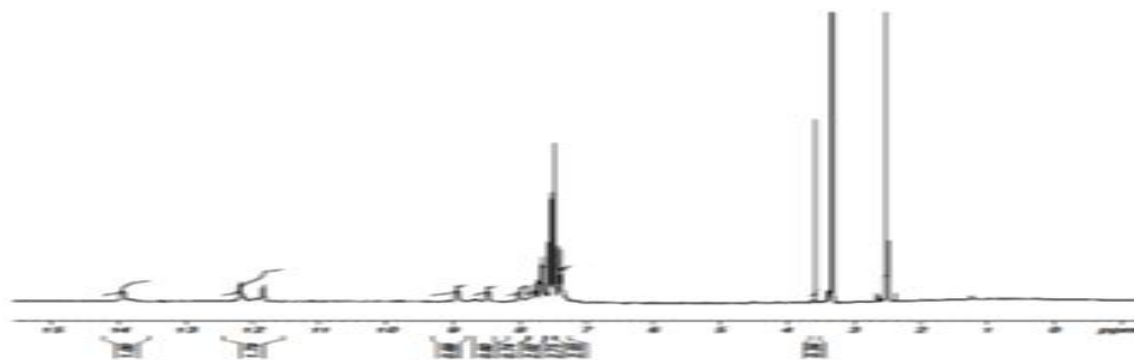
In the IR spectrum of Schiff base the band appeared at 1655  $\text{cm}^{-1}$  assigned to carbonyl group (C=O) has disappeared in its metal complexes, suggesting the involvement of carbonyl oxygen atom in coordination by the deprotonation after its enolization. All the complexes of the Schiff base under present study displayed broad band in the region 3409-3407  $\text{cm}^{-1}$  indicating the presence of lattice or coordinated water molecules. The complexes showed a peak in the region 3325-3250  $\text{cm}^{-1}$  indicating the non involvement of indole NH in complexation. The peak observed at 3128  $\text{cm}^{-1}$  in Schiff base due to quinoline NH has appeared at about the same region 3175-3125  $\text{cm}^{-1}$  in all the complexes confirming the non involvement of quinoline NH in complexation.

The disappearance of a band at 3176  $\text{cm}^{-1}$  in all the complexes due to amide NH and appearance of a new band in the region 1602-1595  $\text{cm}^{-1}$  due to -C=N=N=C- function further confirms the enolization of O=CNH attached to 2-position of indole during complexation and its deprotonation during complexation. Absorption band at 1578  $\text{cm}^{-1}$  in case of Schiff base due to C=N of azomethine function has been shifted towards the lower frequency side 1576-1549  $\text{cm}^{-1}$  in all the complexes indicates the metal ions have coordinated to azomethine nitrogen. A band at 1179  $\text{cm}^{-1}$  due to C=S in case of Schiff base has shifted to lower frequency 1173-1142  $\text{cm}^{-1}$  in case of all the complexes indicating the coordination of metal ions with sulfur of C=S function. The bands of weak intensity in the region 558-532  $\text{cm}^{-1}$  in case of all the complexes of the Schiff base are assigned M-O vibrations and the bands in the region 450-429  $\text{cm}^{-1}$  to M-N vibrations. The weak intensity band at 350  $\text{cm}^{-1}$  due to M-Cl vibration only in case of Fe(III) complex. Table 2.

Table 2: IR data of Schiff base and its complexes

Comp d.	Indole NH	Amide NH	Quinoline NH	H <sub>2</sub> O	C=O	C=S	C=N	>C=N-N=C< Azine	M-O	M-N	M-Cl
Schiff base	3299	3176	3128	-	1655	1179	1578	-	-	-	-
Co(II)	3250	-	3125	3409	-	1173	1576	1602	532	433	-
Ni(II)	3275	-	3152	3408	-	1157	1554	1595	542	429	-
Fe(III)	3325	-	3175	3407	-	1142	1549	1599	558	450	350

**<sup>1</sup>H NMR spectrum of Schiff base:** The <sup>1</sup>H NMR spectrum of Schiff base in *d*<sub>6</sub>-DMSO at room temperature, showed signal at, δ13.9 (s, 1H, CSNH), δ12.17 (s, 1H, indole NH), δ11.8 (s, 1H, CONH), δ8.93 (s, 1H, HC=N) and δ7.39-8.0 (m, 13H, ArH) due to protons of quinoline NH, Indole NH, amide NH, azomethine CH and aromatic protons respectively.

Figure 1: <sup>1</sup>H NMR spectrum of ligand

**Mass spectrum of Schiff base:** The mass spectrum of Schiff base showed the molecular ion peak at  $M^+ + 1 = 500, 502$  (3.1%, 3%) which is equivalent to its molecular weight. This on loss of NCS radical gave a fragment ion peak at  $m/z$  442, 444 (2%, 2%). The molecular ion simultaneous loss  $C_6H_5$ , Br, NCS and NHCO radicals gave a fragment ion  $m/z$  243 (70%) and from the same molecular ion peak due to loss of  $C_9H_6NS$  species, bromide radical, carbon monoxide and Nitrogen molecule gave a fragment ion peak at  $m/z$  205 (100%) which is also a base peak.  $M^+ + 1$  ion on simultaneous expulsion of bromide radical, phenyl radical, two hydrogen molecule and two hydrogen radical gave a fragment ion peak recorded at  $m/z$  338 (12.5%).

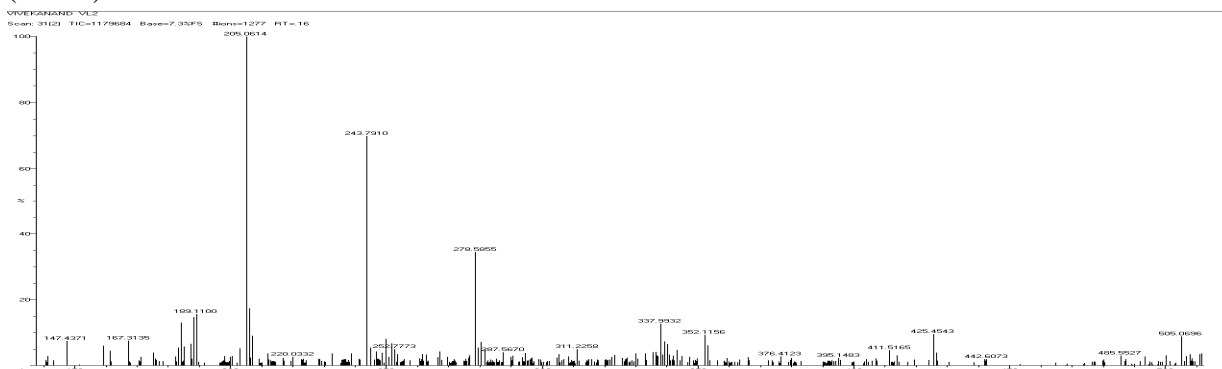
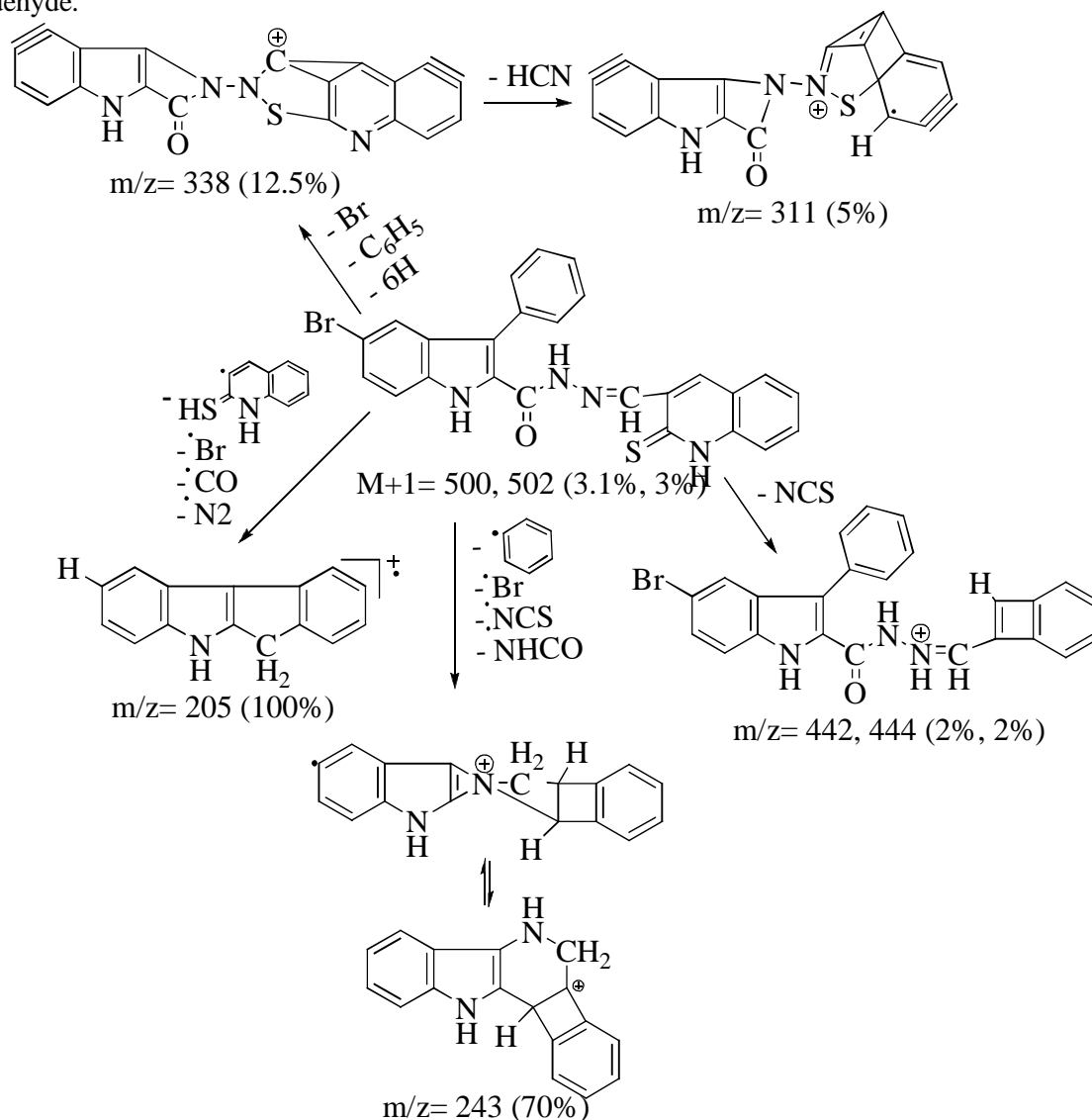


Figure 2: Mass spectrum of ligand

Which on elimination of HCN molecule gave a another fragment ion recorded at  $m/z$  311(5%) The fragmentation pattern is depicted in Scheme-3. The above fragmentation pattern is in consistency with its structure. The IR,  $^1\text{H}$ NMR and mass spectral data of Schiff base confirms its formation by the reaction between 5-bromo-3-phenyl-1*H*-indole-2-carboxyhydrazide and 2-thioxo-1, 2-dihydroquinoline-3-carbaldehyde.



**Scheme 3:** Mass fragmentation pattern of ligand

**Electronic spectra of Co(II), Ni(II), and Fe(III) complexes of the Schiff base:** UV- Visible spectra were recorded on Analytik gena-Specord 50 Spectrophotometer using DMF as solvent. Electronic spectral data of the Co(II), Ni(II) and Fe(III) complexes of the Schiff base are given in Table 3.

**Co(II) complex:** The electronic spectra of Co(II) complex recorded in DMSO solution display three bands at  $10319\text{ cm}^{-1}$ ,  $15268\text{ cm}^{-1}$  and  $19753\text{ cm}^{-1}$ . These band may be assigned to the transitions  $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{T}_{2g}(\text{F})$  ( $\nu_1$ ),  $^4\text{T}_{1g} \rightarrow ^4\text{A}_{2g}$  ( $\nu_2$ ) and  $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{T}_{1g}(\text{P})$  ( $\nu_3$ ), respectively. The position of these bands suggest an octahedral environment around the Co(II) ion. Chandra *et al* [23] have reported three bands corresponding to  $\nu_1$ ,  $\nu_2$  and  $\nu_3$  transition around  $9000\text{ cm}^{-1}$ ,  $14500\text{ cm}^{-1}$ ,  $20620\text{ cm}^{-1}$  respectively for octahedral Co(II) complex.

**Ni(II) complex:** Figgis [24] has reported bands in the region  $\sim 10000$ ,  $\sim 12000$  and  $\sim 25000 \text{ cm}^{-1}$  due to  ${}^3A_{2g}(F) \rightarrow {}^3T_{1g}(P) (\nu_3)$ ,  ${}^3A_{2g}(F) \rightarrow {}^3T_{1g}(F) (\nu_2)$  and  ${}^3A_{2g}(F) \rightarrow {}^3T_{2g}(F) (\nu_1)$  for the transitions mentioned above which are characteristics of octahedral geometry [25]. The electronic spectrum of Ni(II) complex of the Schiff base under present investigation exhibited three bands in the region  $10618 \text{ cm}^{-1}$ ,  $16785 \text{ cm}^{-1}$  and  $25912 \text{ cm}^{-1}$  which are assigned to  ${}^3A_{2g}(F) \rightarrow {}^3T_{2g}(F) (\nu_1)$ ,  ${}^3A_{2g}(F) \rightarrow {}^3T_{1g}(F) (\nu_2)$  and  ${}^3A_{2g}(F) \rightarrow {}^3T_{1g}(P) (\nu_3)$  transition. All these observations favor the octahedral geometry for Ni(II) complex of the present study.

**Fe(III) complex:** The electronic spectrum of Fe(III) complex displayed three bands at  $16870 \text{ cm}^{-1} (\nu_1)$ ,  $20402 \text{ cm}^{-1} (\nu_2)$ ,  $25815 \text{ cm}^{-1} (\nu_3)$ , which may be assigned to  ${}^6A_{1g} \rightarrow {}^4T_{1g}$ ,  ${}^6A_{1g} \rightarrow {}^4T_{2g}$ , and  ${}^6A_{1g} \rightarrow {}^4T_{1g}$ ,  ${}^4E_g$  transitions, respectively typical of an octahedral geometry. These observed values for Fe(III) complex in its visible spectrum are in agreement with the literature values [26] and there by proved octahedral geometry for the Fe(III) complex of the ligand HL.

**Magnetic susceptibility data:** The various Co(II) complexes is in the range 4.70-5.20 BM is for octahedral complexes. In the present investigation the observed magnetic moment value for Co(II) complex is 5.83 BM indicates octahedral geometry for the Co(II) complex [27]. For Ni(II) complex at room temperature shows diamagnetic behavior. For Fe(III) complexes the observed magnetic moment value is 5.27 BM respectively which corresponds to high spin octahedral complex which is in agreement with literature value [23] Table 1.

**Molar Conductance:** The molar conductance of the complexes was measured in DMF at  $10^{-3}M$  concentration. Measured conductance values of these complexes are too low to account for their electrolytic behavior except Fe(III) complex given in Table 1.

**ESR spectrum of Fe(III) complex of ligand HL:** The ESR spectrum of Fe(III) complex was recorded on Bruker BioSpin GmbH at room temperature, on the x-band at 9.429 GHz under the magnetic field strength 3500G. In order to obtain more information about the environment of Fe(III) complex, the X- band ESR spectrum of the polycrystalline Fe(III) complex has been recorded at room temperature. The value of  $g_{\perp}$  and  $g_{\parallel}$  were calculated and presented in the Table-3. The observed ESR spectrum is characteristics of octahedral geometry with rhombic distortion. The 'g' value averaged to overall distortion where calculated using the relation  $G = (g_{\parallel} - 2) / (g_{\perp} - 2)$  which measures the exchange interaction between iron centers in a polycrystalline solid has been calculated. According to Hathaway [28], if the  $G > 4$ , the exchange interaction is negligible, while a value of  $G < 4$  indicates a considerable exchange interaction between metal ions in the solid complex. In the present case,  $G = 4.33$  indicates that there is no exchange interaction in the Fe(III) complex of ligand HL. The observed  $g_{\parallel} = 2.52$ ,  $g_{\perp} = 2.12$  and  $g_{av} = 2.25$  values (Table 3) of the Fe(III) complex under the present study followed the same trend  $g_{\parallel} > g_{\perp} > 2.003$  which suggest the presence of unpaired electron is localized in the  $d_{x^2-y^2}$  orbital giving octahedral geometry [29]. The observed  $G = 4.33$  for the complexes under present study evidenced the monomeric nature of the complexes [30].

**Table 3:** Electronic and ESR spectral data

Compound	Electronic spectral data (in $\text{cm}^{-1}$ )			E. S. R data			
	$\nu_1$	$\nu_2$	$\nu_3$	$g_{\perp}$	$g_{\parallel}$	$g_{av}$	G
Co(II)	10319	15268	19753	-	-	-	-
Ni(II)	10618	16785	25912	-	-	-	-
Fe(III)	16870	20402	25815	2.12	2.52	2.2	4.33

**Powder X-ray diffraction (XRD) studies:** The compounds were soluble in polar organic solvents (DMSO & DMF). We did not obtain crystal suitable for single crystal studies. In order to test the degree of crystallinity of the synthesized complexes, we obtained the powder XRD pattern of Co(II) complex.

The powder XRD data of Co(II) complex have been depicted in Table 4. The Co(II) complex showed twenty reflections in the range 1.5-80° (2θ), arising the diffractions of X-ray by the planes of complex. All important peaks have been indexed and observed values of inter-planar distance (d) have been compared with the calculated ones. The unit cell calculations were performed for cubic system and the (h<sup>2</sup>+ k<sup>2</sup>+ l<sup>2</sup>) values were determined. The presence of forbidden numbers (7) indicates that the Co(II) complex has either hexagonal or tetragonal symmetry. The experimental values are in good agreements with (h<sup>2</sup>+ k<sup>2</sup>+ l<sup>2</sup>) values of primitive type cubic cell with lattice parameter equal to a = b = c = 8.37 Å table 4.

**Table 4:** Powder X-ray data of Co(II) complex of Schiff base

Peak	2θ	θ	Sinθ	Sin <sup>2</sup> θ	h k l	d		h <sup>2</sup> + k <sup>2</sup> + l <sup>2</sup>	a in Å
						Calc.	Obser.		
1	10.56	5.28	0.092	0.008	1 0 0	8.36	8.37	1	8.37
2	11.62	5.81	0.101	0.010	1 0 0	7.62	7.60	1.21	8.37
3	14.36	7.18	0.124	0.015	1 1 0	6.20	6.16	1.82	8.31
4	19.56	9.78	0.169	0.028	1 1 1	4.55	4.53	3.39	8.34
5	19.83	9.91	0.172	0.029	1 1 1	4.47	4.47	3.51	8.38
6	20.53	10.26	0.178	0.031	2 0 0	4.32	4.32	3.76	8.38
7	20.96	10.48	0.181	0.032	2 0 0	4.25	4.23	3.89	8.35
8	23.30	11.65	0.201	0.040	2 1 0	3.83	3.81	4.80	8.35
9	23.63	11.81	0.204	0.041	2 1 0	3.77	3.76	4.95	8.36
10	23.90	11.95	0.207	0.042	2 1 0	3.71	3.72	5.09	8.39
11	24.40	12.20	0.211	0.044	2 1 0	3.64	3.64	5.29	8.38
12	25.71	12.85	0.222	0.049	2 1 1	3.46	3.46	5.85	8.37
13	26.84	13.42	0.232	0.053	2 1 1	3.31	3.31	6.40	8.39
14	27.87	13.93	0.240	0.057	---	3.20	3.19	6.85	8.37
15	28.07	14.03	0.242	0.058	---	3.18	3.17	6.96	8.37
16	29.58	14.79	0.255	0.065	2 2 0	3.01	3.01	7.73	8.38
17	31.60	15.80	0.272	0.073	2 2 1	2.83	2.82	8.79	8.38
18	33.03	16.57	0.285	0.081	3 1 0	2.70	2.70	9.66	8.42
19	33.23	16.61	0.285	0.081	3 1 0	2.70	2.69	9.66	8.37
20	35.47	17.73	0.304	0.092	3 1 1	2.53	2.52	11.0	8.38

**Thermal studies:** From TG curve, information related to the thermal stabilities, composition of the initial sample, intermediate compounds that formed and the final residue could be obtained. The TGA study on [C<sub>50</sub>H<sub>34</sub>N<sub>8</sub>O<sub>3</sub>S<sub>2</sub>Br<sub>2</sub>Cl]Fe were carried out in the temperature range 50 °C to 1000 °C. The decomposition studies of the Fe(III) complex, [C<sub>50</sub>H<sub>34</sub>N<sub>8</sub>O<sub>3</sub>S<sub>2</sub>Br<sub>2</sub>Cl]Fe has been carried out. In the thermogram of the [C<sub>50</sub>H<sub>34</sub>N<sub>8</sub>O<sub>3</sub>S<sub>2</sub>Br<sub>2</sub>Cl]Fe, the first stage of the decomposition represents the weight loss of H<sub>2</sub>O and Cl atom at 280 °C, with weight loss of 5%. The theoretical weight loss for this decomposition was 4.77% agreeing with observed value of 5%. The complex underwent further degradation and gave break at 300 °C with a weight loss of 8.12%, which corresponds to the decomposition of the 4H and Br species. The complex underwent further degradation with practical weight loss 2.5% is in accordance with theoretical weight loss of 2.67% at 325 °C which corresponds to the decomposition of CN species. The resultant complex underwent further degradation with practical weight loss 60% is in accordance with the theoretical weight loss of 61.32% which corresponds to the decomposition of 2C<sub>6</sub>H<sub>5</sub>, Br, 2C<sub>9</sub>H<sub>5</sub>NS and CN species. Thereafter compound showed a gradual decomposition up to 1000 °C and onwards. The weight of residue



corresponds to iron oxide. The thermal decomposition of  $[C_{50}H_{34}N_8O_3S_2Br_2Cl]Fe$  with probable assignments are given in Table 5.

**Table 5:** Thermal decomposition of Fe(III) complex of Schiff base

Complex	Stage	Peak temp TG(°C)	Loss of mass (in %)		Probable assignments
			Practical	Theoretical	
Fe(III)	I	280	5	4.77	$[C_{50}H_{34}N_8O_3S_2Br_2Cl]Fe$ ↓ -Cl -H <sub>2</sub> O
	II	300	8.12	7.95	$[C_{50}H_{32}N_8O_2S_2Br_2]Fe$ ↓ -4H -Br
	III	325	2.5	2.67	$[C_{50}H_{28}N_8O_2S_2Br]Fe$ ↓ -CN
	IV	350	60	61.32	$[C_{49}H_{28}N_7O_2S_2Br]Fe$ ↓ -2C <sub>6</sub> H <sub>5</sub> -Br -2C <sub>9</sub> H <sub>5</sub> NS -CN ↓ Fe <sub>2</sub> O <sub>3</sub>

## APPLICATIONS

### Biological Activities:

**Antimicrobial activity:** The in vitro evaluation of antimicrobial activity of the Schiff base and its complexes under the present study was carried out. The prepared Schiff base and its metal complexes were tested against some bacteria and fungi by cup plate method to provide the minimum inhibitory concentration (MIC) for each compound. MIC is the lowest concentration of solution to inhibit the growth of the test organism against the bacterial species *Klebsiella* and *Pseudomonas* and fungal species *A. niger* and *A. flavus*. Minimum inhibitory concentrations (MICs) were detected by the serial dilution method. All the compounds at minimum concentration of 125 ppm were studied, the compound Ni(II) complex exhibit high activity, Co(II) complex showed moderate activity and Fe(III) complex and Schiff base exhibit less activity towards the *Klebsiella* and *Pseudomonas*, compare to the standard drug gentamycin.

The antifungal activity of ligand and its complexes was studied at the same concentration as that of the test compounds. Schiff base and Ni(II) complex showed good activity, Fe(III) complex showed moderate activity and Co(II) complex exhibited less activity towards *A. niger* and *A. flavus* compare to the standard drug fluconazole.

**Antioxidant activity:** The antioxidant free radical activity of Schiff base and its metal complexes was carried out by DPPH was analyzed at 25-100 µg in DMF solution at 30 min. against the standard drug vitamin-C. The Co(II) and Ni(II) complexes showed good activity than Fe(III) complex compare to standard. The percentage of free radical scavenging activity of test compounds and Schiff base in the form of graphical representation is as shown in Figure 3.

**Table 6:** MIC (125ppm) of compound against bacteria and fungi

Compound	Antibacterial activity Zone of Inhibition in mm		Antifungal activity Zone of Inhibition in mm	
	<i>Klebsiella</i>	<i>Pseudomonas</i>	<i>A. Niger</i>	<i>A. Flavus</i>
Schiff base	16	14	18	17
Co(II)	20	19	16	18
Ni(II)	22	21	19	21
Fe(III)	17	18	17	18
Gentamycin	25	24	-	-
Fluconazole	-	-	22	24

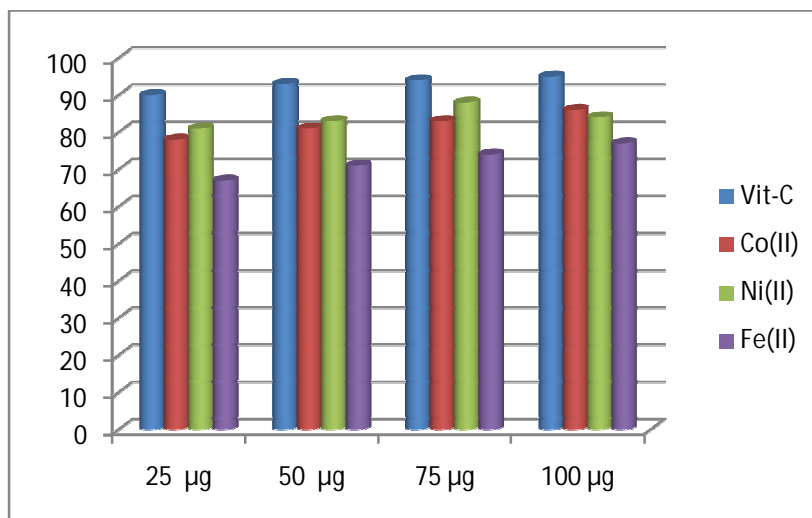


Figure 3: Antioxidant activity of Schiff base and its metal complexes

### CONCLUSIONS

The Schiff base and its complexes have been characterized by IR,  $^1\text{H}$  NMR, mass, TGA, ESR and Powder XRD data which concludes that the Co(II), Ni(II) and Fe(III) complexes are of the type  $\text{ML}_2$  - stoichiometry with octahedral geometry. The prepared complexes are colored, amorphous in nature and stable in air. Some of these complexes have exhibited good antimicrobial and antioxidant activities.

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