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Synthesis, Characterization and Biological Activities of Cu(II), Ni(II), Zn(II), Cd(II), Sn(II), Co(II), Sb(III) and Fe(III) Complexes with Schiff base Methyl 3-[(E,E)-3-phenylprop-2-enylidene] dithiocarbazate

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Keywords : metal complexes; antimicrobial; ir spectra; uv-vis spectra.

I. INTRODUCTION

Chemistry of nitrogen-sulfur donor ligands and their complexes had been of interests for their interesting coordination chemistry and also for their profound biomedical properties. Dithiocarbazate, $NH_2NHCS_2^-$ and its substituted derivatives have been synthesized and investigated over the past few decades [1-28]. Dithiocarbazic acid and the Schiff base derived from its S-alkyl and S-benzyl esters form an interesting series of ligands and metal complexes. Researchers in this area have been continuing the synthesis of new nitrogen-sulphur donor ligands through Schiff base condensation with aldehyde and ketones. The properties of these ligands can be greatly modified through the introduction of organic substituents. The number of ligands synthesized continues to increase because of the intriguing observation that different ligands show different biological properties, although they may differ only slightly in their molecular structures [1-11, 15-22].

Transition metal complexes of these ligands are also widely studied because of their potential for therapeutic use [2-4,6-20]. For example the Schiff base of 2-benzoylpyridine with S-methyl dithiocarbazate (HBP-SMe) inhibits the growth of bacteria, E. coli and S. aureus to some extent while that with S-benzyldithiocarbazate (HBP-SBz) shows no effect at all on the two mentioned bacteria[22]. To date, no pattern has emerged to enable the activity to be predicted on the basis of structure or substituents. Reports on the bioactivities of the starting ligands, S-methyl dithiocarbazate (SMDTC) and Schiff bases have not yet been widely studied. The mode of interaction of these compounds with the cancer cells and microbes are yet to be investigated. In order to study the influence of metal ions and substituents on the structure and biological activity and as part of our continuing work on metal-Schiff base, we report here the synthesis, structure and bioactivity of complexes of a nitrogen-sulfur chelating agent derived from Cinnamaldehyde Schiff base of *S*-methyldithiocarbazate (SMDTC).

a) Related Literature

There had been immense interests in nitrogen-sulfur donor ligands of S-methyldithiocarbazates (SMDTC) due to their biomedical, electrooptical and catalytic properties. A number of Schiff bases and derived from SMDTC and their metal complexes have been reported [29-43]. For the synthesis and structure of zinc complexes of S-methyldithiocarbazates [29-30]. For the crystal structure of zinc complex of SBDTC [31]. For the synthesis and structure of other metal complex of SMDTC [32-39]. For the bioactivity of zinc complex of SMDTC Schiff base [29]. For the bioactivity of other metal complexes of SMDTC [34, 37, 40] For the non-linear optical property of metal complex of SMDTC [41]. For the metal induced cyclization of SMDTC Schiff bases [39]. For the photochemical reactivity of metal complex of SMDTC [41]. For the cinnamaldehyde Schiff base of SBDTC and Zn(II) complex [42-43].

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II. MATERIALS AND METHODS

a) *Materials*

Reagent grade chemicals were used without further purification in all the synthetic work. All solvents were purified by standard methods. Metal salt, cinnamaldehyde, other chemicals were obtained from Baker and used as received. Ethanol, Methanol, Acetone, Acetonitrile, DMSO and DMF were used as solvents purchased from Merck and Loba chemicals.

b) *Experimental*

The weighing operation was performed on a METTER TELEDO AB 204 electronic balance. Melting points of the complexes were obtained with an electrothermal melting point apparatus model No. A. Z 6512. Infrared spectra were recorded as KBr with a SHIMADZU FTIR-8101 infrared spectrophotometer, from 4000-350 cm^{-1} in the Sylhet Shahjalal University of Science and technology, Sylhet. Electrical conductivity measurements of the complexes were recorded at room temperature (25^0C) for 10^{-3} M solutions of the sample in DMSO using a type CG 857 No. 71798 SCHOTT-GERATE Gmbh, Germany, digital conductivity meter. Magnetic susceptibilities were measured at 25^0C by the Gouy method using SHERWOOD SCIENTIFIC Magnetic Susceptibility Balance. Diamagnetic corrections were estimated from Pascal's constant. The magnetic moments were calculated from the equation: $\mu_{eff} = 2.84\sqrt{(\chi_m^{corr} \times T)}$. Electronic spectra of the metal complexes were obtained in Nujol mulls using a Shimadzu UV-240 UV-Vis recording spectrometer. The biological activity of the complexes were studying microbial laboratory of Department of Pharmacy, University of Rajshahi.

c) *Synthesis of the metal complexes*

The Schiff base, [C_6H_5-CH=CH-CH=N-NH-C(S)-SCH_3], was derived from the condensation of cinnamaldehyde with S-methyldithiocarbazate was previously reported [44].Metal salt with hydrate {[$Cu(NO_3)_2$.3 H_2O] (0.241 g, 1 mmol); [$Ni(NO_3)_2$ .6 H_2O] (0.290 g, 1 mmol); [$Zn(NO_3)_2$ .6 H_2O] (0.297 g, 1 mmol); [$Cd(NO_3)_2$.4 H_2O] (0.308 g, 1 mmol); [$SnCl_2$.2 H_2O] (0.225 g, 1 mmol); [$CoCl_2$.6 H_2O] (0.238 g, 1 mmol); [$Sb(NO_3)_3$] (0.306 g ,1 mmol) and [$Fe(NO_3)_3$ .9 H_2O] (0.404 g, 1 mmol)} was dissolved in absolute ethanol (15 ml). The Schiff base (M.W 236.35) (0.472 g, 2 mmol) in hot absolute ethanol (50 ml) was added to the metal solution. The mixture was then refluxed for 30 mins and then cooled. The precipitate was filtered off and washed with hot ethanol and dried in *vacuo* over anhydrous $CaCl_2$.

$$M\,(NO_3)_2\,.n\,H_2O + 2\,C_{11}H_{12}N_2S_2 \rightarrow [M(II)(C_{11}H_{11}N_2S_2)_2]$$

$$M'(NO_3)_3\,.n\,H_2O + 2\,C_{11}H_{12}N_2S_2 \rightarrow [M'(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$$

$$M''Cl_2.nH_2O + 2\,C_{11}H_{12}N_2S_2 \rightarrow [M''(II)(C_{11}H_{11}N_2S_2)_2(H_2O)_2]$$

Where,

M = Cu(II), Ni(II), Zn(II) and Cd (II).

M' = Sb(III) and Fe(III).

M" = Sn(II) and Co(II).

$C_{11}H_{12}N_2S_2$ = Cinnamaldehyde Schiff base of SMDTC

III. RESULT AND DISCUSSION

a) *Physical Properties and Molar Conductance*

Physical properties of the complexes were given in Table-1. The analytical data were in good agreement with the proposed empirical formula of the present complexes.

Table 1 : Analytical data and physical properties of the complexes

Complexes	F.W.	Colour	Melting point (°C)	Molar conductance (ohm^{-1} cm^2 mol^{-1})	Elementary analysis, found/(Calc)%				
					C	H	N	S	M
SMDTC	122.13	White	81	2.30					
[$C_{11}H_{12}N_2S_2$]	236.35	Orange	170	2.10	55.76 (55.90)	5.05 (5.12)	11.67 (11.85)	27.00 (27.13)	-
[Cu(II)($C_{11}H_{11}N_2S_2)_2$]	534.21	Greenish brown	188	3.25	49.44 (49.46)	4.22 (4.15)	10.36 (10.49)	23.79 (24.01)	11.40 (11.89)

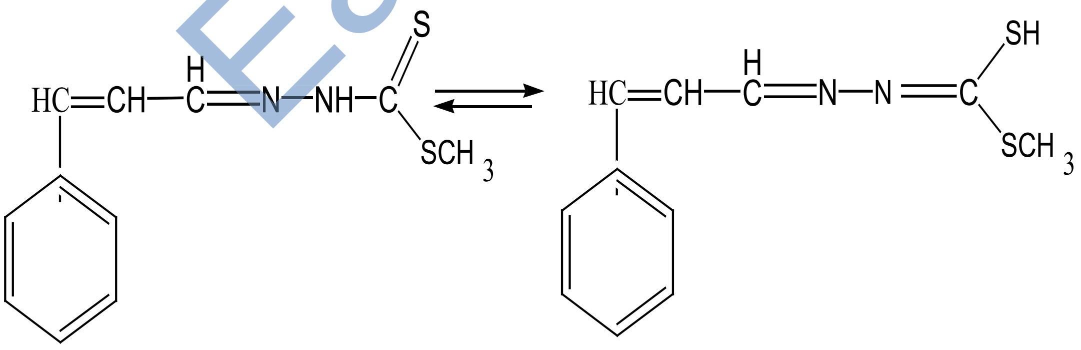
[Ni(II)($C_{11}H_{11}N_2S_2)_2$]	529.35	Golden brown	268	1.90	49.60 (49.91)	4.11 (4.19)	10.78 (10.58)	23.88 (24.23)	10.78 (11.09)
[Zn(II)($C_{11}H_{11}N_2S_2)_2$]	536.05	Light yellow	205	3.10	49.35 (49.29)	4.07 (4.14)	10.32 (10.45)	24.00 (23.93)	11.80 (12.20)
[Cd(II)($C_{11}H_{11}N_2S_2)_2$]	583.07	Yellow	208	2.15	45.20 (45.32)	3.65 (3.80)	9.52 (9.61)	21.63 (21.99)	19.15 (19.28)
[Sn(II)($C_{11}H_{11}N_2S_2)_2(H_2O)]_2$]	625.37	Reddish yellow	210	2.05	42.00 (42.25)	4.00 (4.19)	9.00 (8.96)	20.33 (20.51)	18.56 (18.98)
[Co(II)($C_{11}H_{11}N_2S_2)_2(H_2O)]_2$]	565.61	Reddish black	220	2.50	47.00 (46.72)	4.56 (4.63)	9.56 (9.91)	22.56 (22.68)	10.22 (10.41)
[Sb(III)($C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)$]	672.42	Cream	190	2.35	39.47 (39.30)	3.80 (3.60)	10.78 (10.90)	18.87 (19.07)	17.67 (18.11)
[Fe(III)($C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)$]	606.61	Black	198	2.56	43.38 (43.56)	3.80 (3.99)	11.33 (11.54)	21.00 (21.14)	8.86 (9.21)

The conductance values of the prepared complexes were illustrated in Table-1. The conductance values of the complexes reveal that these were non electrolyte in nature [45].

b) IR Studies

SMDTC showed all the characteristic bands as reported in the literature [46]. The IR spectrum of SMDTC (Table-.2) showed strong intensity bands at 3365 cm^{-1} and 3220 cm^{-1} which were assigned to the asymmetric *v*(N-H) and symmetric *v(N-H)* modes of the NH_2 group, respectively. The *v(C=S)* band for SMDTC appeared at 1064 cm^{-1}.

The IR spectrum (Table:2) of the Schiff base showed strong bands at 3210 cm^{-1}. This was attributed to the secondary amine *v(N-H)* mode of the free ligands. The thione groups are relatively unstable in the monomeric form and tend to turn to the more stable thiolo forms by enethiolization in solution (Fig.1.1). The absence of *v(S-H)* absorbance at approximately 2570 cm^{-1} indicates that in the solid state, the bases exist primarily in the thione form. The disappearance of *v*(N-H) bands their spectra of the metal complexes suggests deprotonation and consequent co-ordination through the thiolate anions. The Schiff base also showed strong bands at ≈1580 cm^{-1}. These are assigned to the *v(C=N)* modes for the free ligand. In the metal complexes, this stretching band shifted to lower frequencies, due to the lowering of the C=N bond order as a result of the metal–nitrogen bond formation. The Schiff base also showed *v(C=S)* modes at 1055 cm^{-1}. The *v(C=S)* mode observed in the free ligand disappeared in the complexes, thus supporting the above contention of thiolate bonding with metal ions. Consequently the *v(C-S)* mode was observed in the spectra of the complexes supporting thiolate bindings.



(a) (b)

Figure 1.1 : Tautomeric forms (a) Thione form (b) Thiolo form

The C=N stretching vibration in the free NS Schiff base appeared at ≈1580 cm^{-1}, which upon complexation, shifted towards lower frequency regions, at ≈1530 cm^{-1} (Table:2). This lowering of C=N stretching mode on complexation supported coordination through nitrogen atom. The mode of the free Schiff base appeared at 1055 cm^{-1}. This band also disappeared in the IR spectra of the metal complexes giving evidence of coordination through the thilate anion. The Schiff base coordinated to the metal through the thiolate sulphur and the β-nitrogen as evident from the IR spectrum showing bands at ≈384 cm^{-1} and ≈491 cm^{-1}, corresponding to *v*(M-S) and *v*(M-N) stretching modes, respectively.

In case of complexes $[Sn(II)(C_{11}H_{11}N_2S_2)_2(H_2O)_2]$ and $[Co(C_{11}H_{11}N_2S_2)_{2.}(H_2O)_2]$, the IR band at 3250-3300 cm^{-1} was indicated of the presence of coordinated water molecule.

IR spectra for the complexes $[Sb(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$ and $[Fe(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$ display bands at about 1480 and 1255 cm^{-1} suggesting the presence of ionic nitrate group [47]. The IR band at 3250-3300 cm^{-1} was indicated of the presence of coordinated water molecule.

Table 2 : Important infrared spectral bands of the ligands and metal complexes

Compounds	ν (NH_2) cm^{-1}	ν (N-H) cm^{-1}	ν (C=S) cm^{-1}	ν (C=N) cm^{-1}	ν (C-S) cm^{-1}	ν (M-S) cm^{-1}	ν (M-N) cm^{-1}	ν (OH) cm^{-1}	ν (ON) cm^{-1}
SMDTC	3365, 3220	3200	1064	-	-	-	-	-	-
$[C_{11}H_{12}N_2S_2]$	-	3110	1055	1580	-	-	-	-	-
$[Cu(II)(C_{11}H_{11}N_2S_2)_2]$	-	-	-	1535	771	384	490	-	-
$[Ni(II)(C_{11}H_{11}N_2S_2)_2]$	-	-	-	1545	765	390	503	-	-
$[Zn(II)(C_{11}H_{11}N_2S_2)_2]$	-	-	-	1520	750	375	495	-	-
$[Cd(II)(C_{11}H_{11}N_2S_2)_2]$	-	-	-	1530	760	385	480	-	-
$[Sn(II)(C_{11}H_{11}N_2S_2)_2]$	-	-	-	1550	768	410	485	-	-
$[Co(II)(C_{11}H_{11}N_2S_2)_2(H_2O)]_2]$	-	-	-	1540	758	365	501	3300-3250	-
$[Sb(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$	-	-	-	1565	765	389	510	3210-3150	1480, 1255
$[Fe(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$	-	-	-	1525	780	395	482	3325-3210	1475, 1260

c) *Magnetic moment and electronic spectra*

The magnetic susceptibility measurement (Table-3) showed that the complex Cu(II) was paramagnetic. The greenish brown paramagnetic copper complex gave a magnetic moment of 1.93 B.M corresponding to one unpaired electron. The UV-vis spectrum of the complex showed d-d bands at 582 nm and 410 nm, arising from the $^2B_{1g} \rightarrow {}^2B_{2g}$ and $^2B_{1g} \rightarrow {}^2E_g$ transitions, respectively, characteristic of a square planer stereochemistry [48]. The intence band at 308 nm was presumably caused by charge transfer.

The magnetic susceptibility measurement (Table-3) showed that the complex $[Ni(II)(C_{11}H_{11}N_2S_2)_2]$ was diamagnetic. For the electronic spectra, the diamagnetic nature of complex indicated a d-d band at ca. 440-560 nm and 600 – 800 nm. A square-planar Ni(II) configuration gives rise to three bands corresponding to $^1A_1g \rightarrow {}^1A_2g$, $^1A_1g \rightarrow {}^1B_1g$ and $^1A_1g \rightarrow {}^1Eg$ transitions, , but in some cases these bands were too weak or were overshadowed by other stronger absorptions in the same region[49].

The absorption bands of the Zn(II) and Cd(II) complex exhibited charge transfer M_L at 355nm and 350nm. This is because of the electronic configuration and the diamagnetic of these complexes which confirmed the absence of any d-d electronic transition [50-51]. The Zn(II)complex was distorted tetrahedral in geometry whereas Cd(II) tetrahedral.

The UV-VIS spectrum of the complex, Sb(III) and Sn (II) band at 305 nm and 302nm, arising from charge transfer transition. The magnetic susceptibility measurement showed that the complexes were diamagnetic in nature. The complexes were octahedral in geometry.

The cobalt complex Co(II) had room-temperature magnetic moments of about 3.94 B.M (Table-3) indicative of octahedral geometry. The electronic spectra of these complexes showed three bands 390, 430 and 560 nm (Table-3). This bands were assigned to the transition, $^4T_{1g} \rightarrow {}^4T_{2g}(v_1)$, $^4T_{1g} \rightarrow {}^4A_{2g}(v_2)$, $^4T_{1g} \rightarrow {}^4T_{2g}(F)(v_3)$ of octrahedral Co(II).

The electronic spectrum of the Fe(III) Complex , showed bands at 744 nm, that may be assigned to $^6A_{1g} \rightarrow {}^4T_{1g}(G)$; indicating distorted octahedral geometry around Fe(III) ion. [52- 53] The magnetic moment of this complex was found to be 5.8 B.M. and fall within the range observed for octahedral Fe(III) complexes[54].

Table 3 : The electronic absorption spectral bands(nm) and magnetic moment(B.M) for the complexes

Complexes	λ_{max}(nm)	Band Assignment	μ_{eff} (B.M.)	Geometry
[Cu(II)($C_{11}H_{11}N_2S_2)_2$]	308 410 582	Charge transfer ${}^2B_{1g}\rightarrow {}^2A_{1g}$ ${}^2B_{1g}\rightarrow {}^2E_{1g}$	1.93	Square Planar
[Ni(II)($C_{11}H_{11}N_2S_2)_2$]	465 555 634	Chargetransfer ${}^1A_{1g}\rightarrow {}^1A_{2g}$, ${}^1A_{1g}\rightarrow {}^1B_{1g}$	Dia	Square planar
[Zn(II)($C_{11}H_{11}N_2S_2)_2$]	355	Chargr transfer	Dia	Distorted Tetrahedral
[Cd(II)($C_{11}H_{11}N_2S_2)_2$]	350	Charge transfer	Dia	Tetrahedral
[Sn(II)($C_{11}H_{11}N_2S_2)_2(H_2O)]_2$]	302	Charge transfer	Dia	Octrahedral
[Co(II)($C_{11}H_{11}N_2S_2)_2(H_2O)]_2$]	390, 430, 560	${}^4T_{1g}\rightarrow {}^4T_{2g}$, ${}^4T_{1g}\rightarrow {}^4A_{2g}$, ${}^4T_{1g}\rightarrow {}^4T_{2g}$(F)	3.94	Octahedral
[Sb(III)($C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)$]	305	Charge transfer	Dia	Octahedral
[Fe(III)($C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)$]	734	${}^6A_{1g}\rightarrow {}^4T_{1g}$(G);	5.8	Octahedral

d) Provable Structure

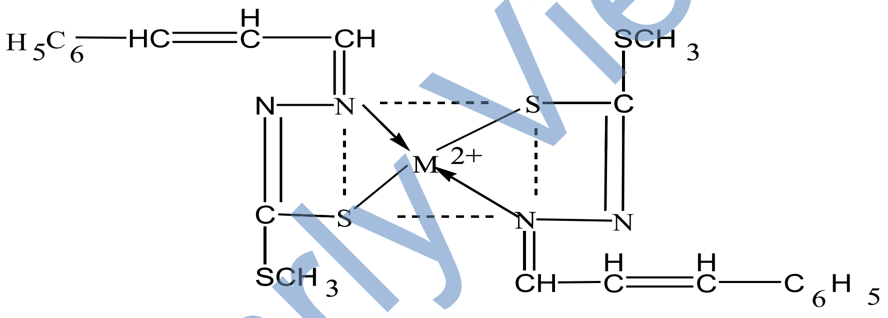


Figure 1.2 : Square planner structure of the complexes

Where, M^{2+} = Cu(II) and Ni(II)

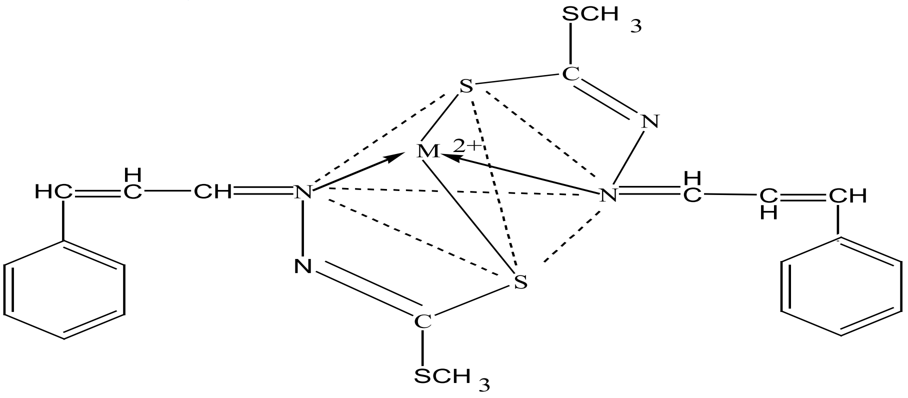


Figure 1.3 : Tetrahedral structure of the complexes

Where, M^{2+}= Zn(II) and Cd(II).

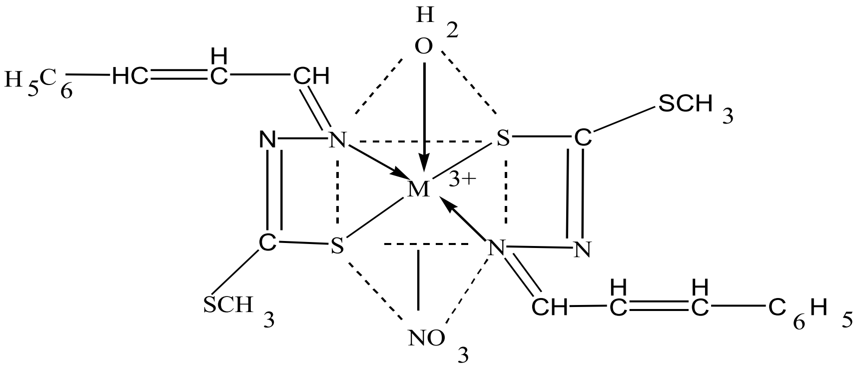


Figure 1.4 : Octahedral structure of the complexes

Where, M^{3+} = Sb(III) and Fe(III).

FTIR-Spectrum of Schiff base and metal complexes

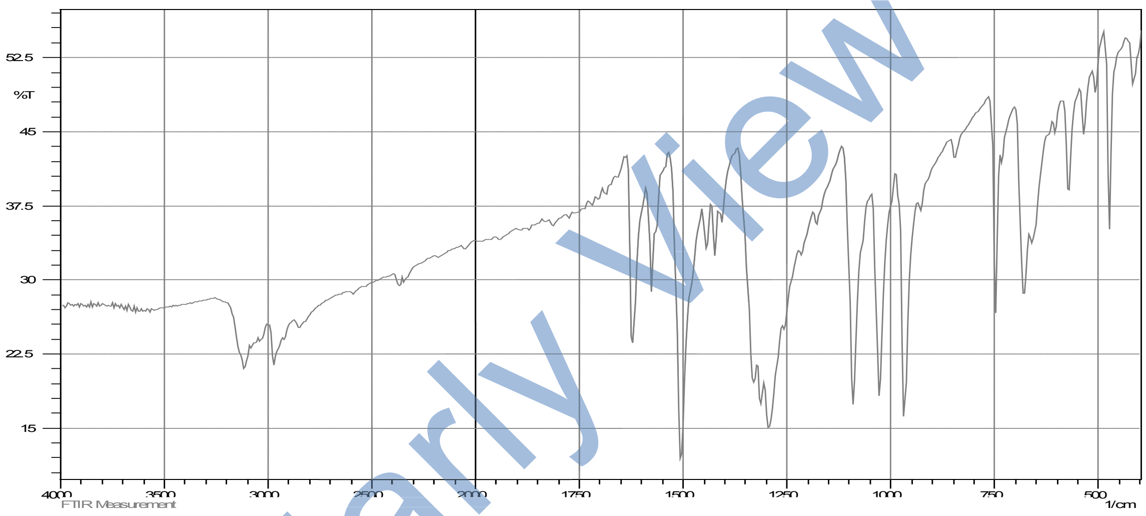


Figure 2.1 : FTIR spectrum of the cinnamaldehyde Schiff base of SMDTC($C_{11}H_{12}N_2S_2$)

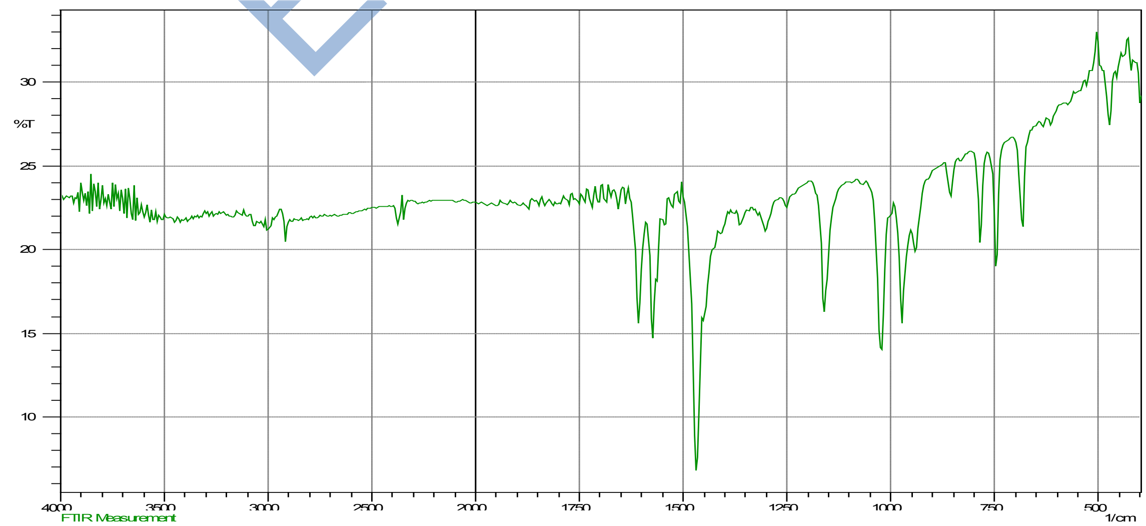


Figure 2.2 : FTIR spectrum of the complex [Cu(II)($C_{11}H_{11}N_2S_2)_2$]

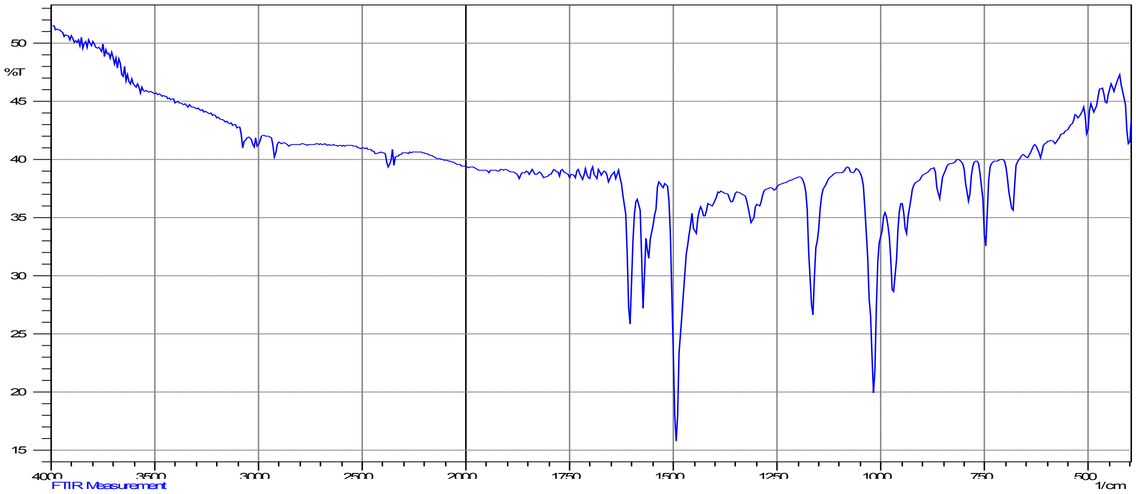


Figure 2.3 : FTIR spectrum of the complex [Ni(II)($C_{11}H_{11}N_2S_2)_2$]

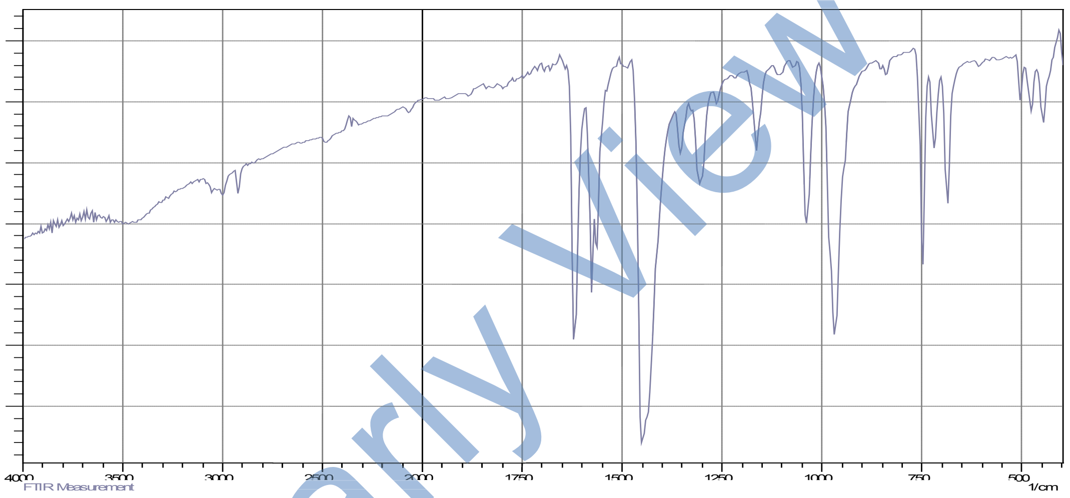


Figure 2.4 : FTIR spectrum of the complex [Zn(II)($C_{11}H_{11}N_2S_2)_2$]

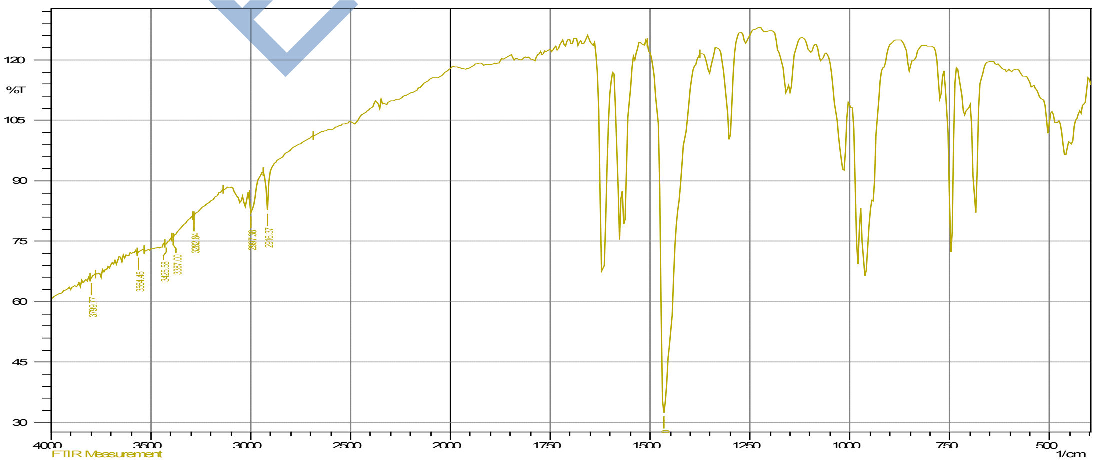


Figure 2.5 : FTIR spectrum of the complex [Cd(II)($C_{11}H_{11}N_2S_2)_2$]

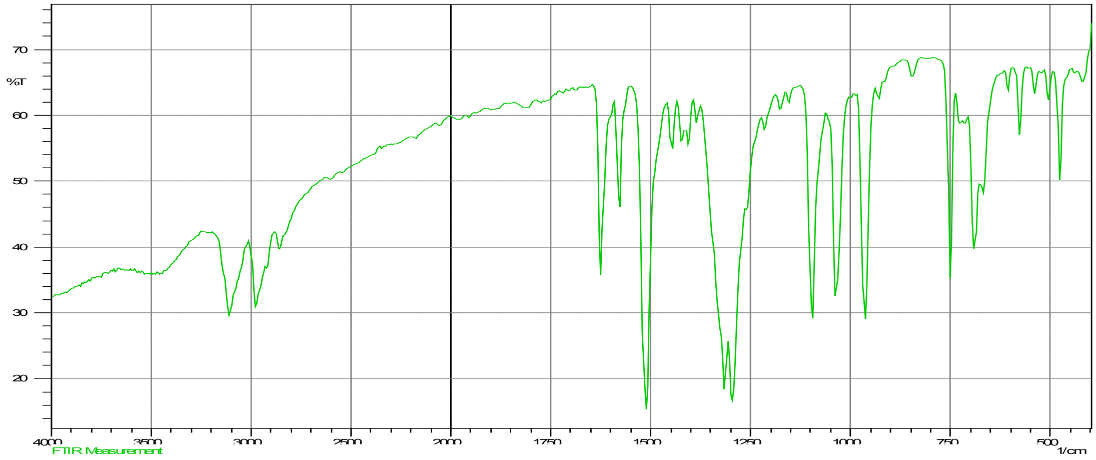


Figure 2.6 : FTIR spectrum of the complex [Sb(III)($C_{11}H_{11}N_2S_2$)$_2$(NO_3)(H_2O)]

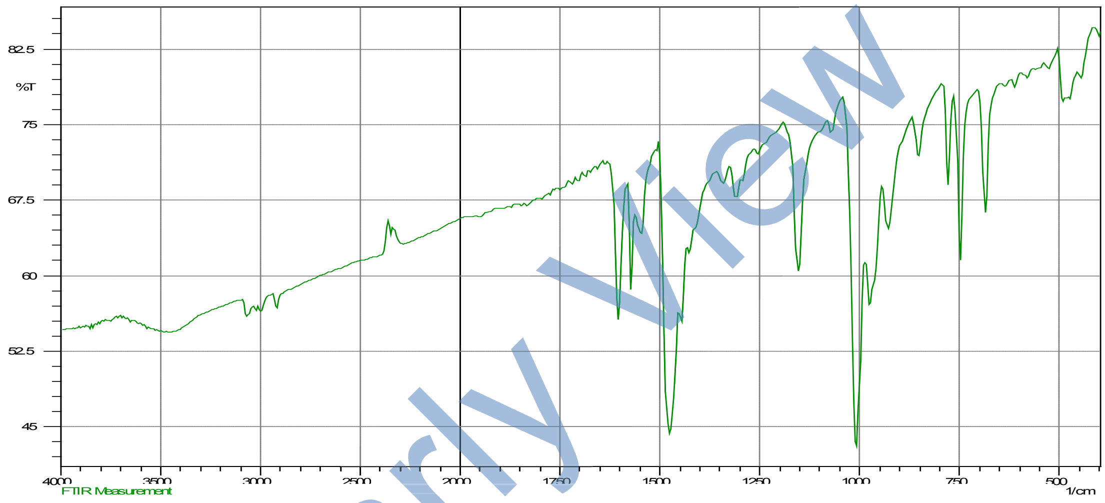
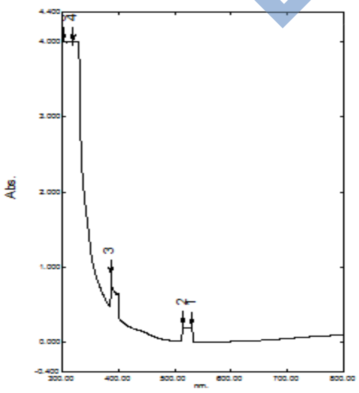


Figure 2.7 : FTIR spectrum of the complex [Fe(III)($C_{11}H_{11}N_2S_2$)$_2$(NO_3)(H_2O)]

UV-Vis Spectrum of metal complexes



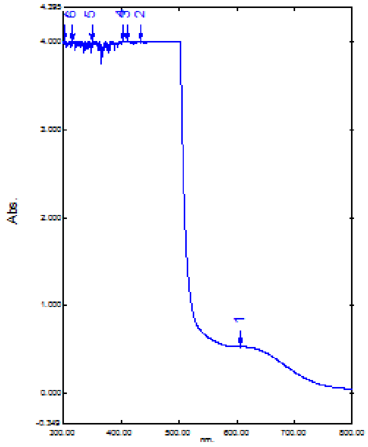


Figure 3.1 : UV-visible spectrum of the complex [Cu(II)($C_{11}H_{11}N_2S_2$)$_2$]

Figure 3.2 : UV-visible spectrum of the complex [Ni(II)($C_{11}H_{11}N_2S_2$)$_2$]

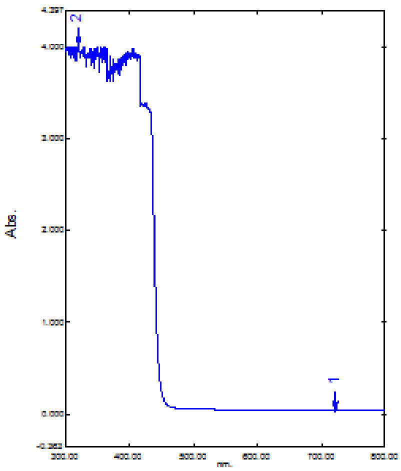


Figure 3.3 : UV-visible spectrum of the complex $[Zn(II)(C_{11}H_{11}N_2S_2)_2]$

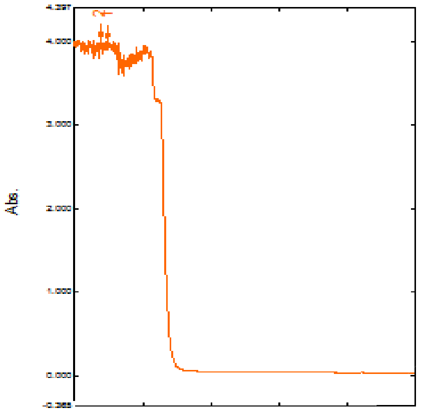


Figure 3.4 : UV-visible spectrum of the complex $[Cd(II)(C_{11}H_{11}N_2S_2)_2]$

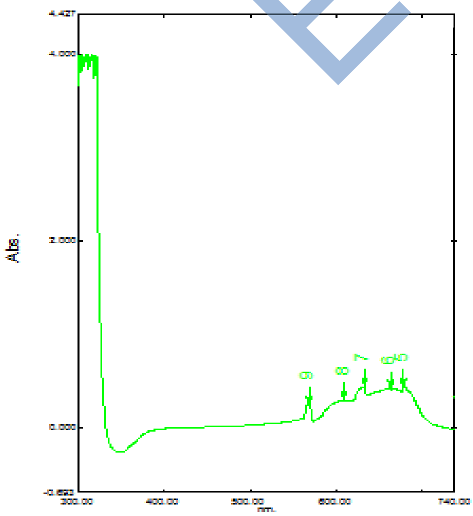


Figure 3.5 : UV-visible spectrum of the complex $[Fe(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$

e) *Microbial activity of the complexes*

i. *Microbial Activity*

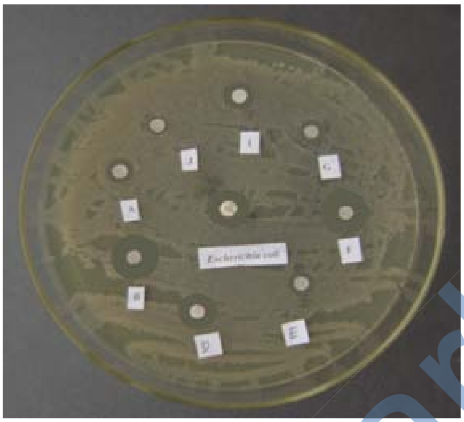
The antibacterial activities of ligand and its metal complexes were studied by usual cup-plate agar diffusion method. The bacterial species used in the screening were *Shegilla sonnei, Escherichia coli,* (gram negative), *Bacillus subtilis* (gram-positive). Stock cultures of the test bacterial species were maintained on Nutrient Agar media by sub culturing on petri dishes. The media were prepared by adding the components as per manufacturer's instructions and sterilized in the autoclave at 121°C temperature and 15 lbs pressure for 15 minutes and then cooled to 45-60°C. 20 mL of each medium was poured in a Petri dish and allowed to solidify. After solidification, Petri plates with media were spread with 1.0 mL of bacterial suspension, which is prepared in sterile distilled water. The wells were bored with cork borer and the agar plugs were removed. 100 µl of the compound reconstituted in $CHCl_3$ (Choloform) in concentrations of 1.0 mg/mL was added to the agar wells. The plates were incubated at 37°C for 24 hours and then the plates were observed for the growth inhibition zones. The presence of clear zones around the wells indicated that the compound is active. The diameter of the zone of inhibition was calculated in millimeters. The well diameter was deducted from the zone diameter to get the actual zone of the inhibition diameter and the values have been tabulated. Results of bactericidal screening show that the chelation tends to make the ligand act as more powerful and potent bactericidal agents, thus killing more of the bacteria than the ligand (Table 4).

Table 4 : Antibacterial activity of the complexes with standard Kanamycin

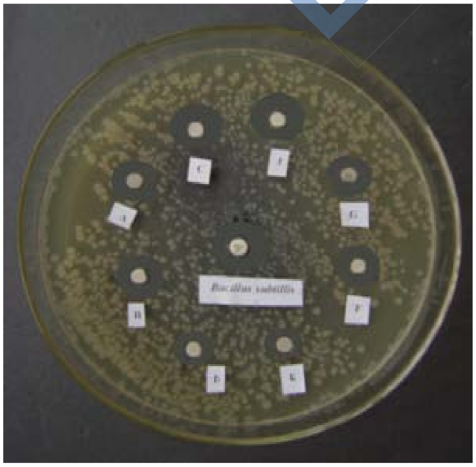
Complexes Symbol	Compounds	Zone of inhibition, diameter in mm		
		For *Escherichia coli*	For *Shigella sonnei*	For *Bacillus subtilis*
A	$[Zn(C_{11}H_{11}N_2S_2)_2]$	9	10	8
B	$[Ni(C_{11}H_{11}N_2S_2)_2]$	25	24	38
C	$[Cd(C_{11}H_{11}N_2S_2)_2]$	26	25	40
D	$[Cu(C_{11}H_{11}N_2S_2)_2]$	23	18	19
E	$[Sn(C_{11}H_{11}N_2S_2)_2(H_2O)_2]$	13	14	22
F	$[Co((C_{11}H_{11}N_2S_2)_2(H_2O)_2]$	13	10	16
G	$[Sb(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$	16	13	15
I	$[Fe(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O]$	10	15	14
R	Schiff base $C_{11}H_{12}N_2S_2$	20	19	17
	Kanamycin disc	20	20	22

Assay results refer to concentration of 100 mg/ml of samples in $CHCl_3$. Inhibition diameter > 20mm-strongly active.

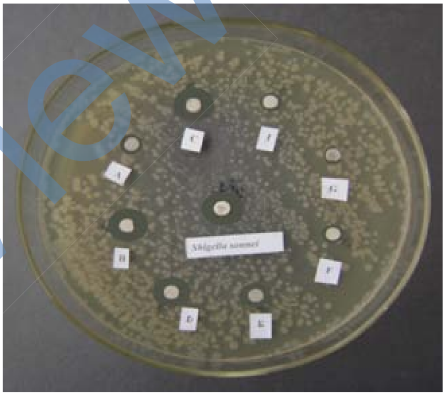
Photographic Representation



B.1. Photographic representation of zone of Inhibition of complexes A,B,C,D,E,F,G and I against *BaCillus subtilis*



B.2 : Photographic representation of zone of Inhibition of complexes A,B,C,D,E,F,G and I against Escherichia coli



B.3 : Photographic representation of zone of inhibition of complexes A, B, C, D, E, F, G and I against *Shigella sonnei*

IV. CONCLUSION

All the above observations indicated that the complexes $[Cu(II)(C_{11}H_{11}N_2S_2)_2]$ and $[Ni(II)(C_{11}H_{11}N_2S_2)_2]$ had square planar structure with two ligands satisfying the four steriochemical sites, where the complexes $[Zn(II)(C_{11}H_{11}N_2S_2)_2]$ and $[Cd(II)(C_{11}H_{11}N_2S_2)_2]$ were distorted tetrahedral and tetrahedral respectively. The complexes $[Sn(II)(C_{11}H_{11}N_2S_2)_2(H_2O)_2]$, $[Co(II)(C_{11}H_{11}N_2S_2)_2(H_2O)_2]$, $[Sb(II)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$ and $[Fe(III)(C_{11}H_{11}N_2S_2)_2(NO_3)(H_2O)]$ were octahedral in geometry. The antibacterial activities of the complexes have been studied against three pathogenic bacteria two gram-negative (*Escherichia coli* and *Shegilla sonnei*] and one gram-positive (*Bacillus subtilis*). In particular, Complex $[Ni(C_{11}H_{11}N_2S_2)_2]$ and $[Cd(C_{11}H_{11}N_2S_2)_2]$ were found to be the most effective compounds against the bacteria *Escherichia coli*. Complex $[Cd(C_{11}H_{11}N_2S_2)_2]$ was also the most active compound against *Shighella* *sonnei* where the Schiff-base was selective against the bacteria mentioned. The values have been compared with an antibacterial standard, *Kanamycin*.

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