



Synthesis, Characterization and Study the Biological Activities of new Schiff Base [5, 5'-(Ethane-1, 2-Diyl) Bis (4-(4-Bromobenzylideneamino)-4H-1, 2, 4-Triazole-3-Thiol)] and its Complexes with Cu (II), Cd (II), Hg (II) and Ag (I) ions

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Abstract

A series of coordination compounds of Cu(II), Cd(II), Hg(II) and Ag(I) ions with 5,5'-(ethane-1,2-diyl)bis(4-(4-bromobenzylideneamino)-4H-1,2,4-triazole-3-thio), as a ligand has been successfully prepared in alcoholic medium. The synthesized complexes were characterized quantitatively and qualitatively by using: elemental analysis CHNS, FT-IR spectroscopy, UV-visible spectroscopy, ^1H and ^{13}C NMR, atomic absorption measurements, magnetic susceptibility, thermal analysis (TG and DTG) and conductivity measurements. This ligand coordinates as a bidentate that to the metal ions through sulphur and nitrogen of (azomethine group) atoms. According to the spectral data, Cu(II)-complex has coordination of 6 with octahedral geometry while the Cd(II)-complex and Hg(II) have coordination of 4 with exhibited tetrahedral, and the Ag(I)-complex has coordination of 3 with exhibited trigonal planar. The Schiff base and its metal complexes have been screened for antimicrobial activity against four bacteria, namely: (*Staphylococcus aureus*, *Streptococcus sp.*, *Klebsilla Pneumonia*, *Escherichia coli*) and the fungi, namely (*Aspergillus flavus*).

Keywords: *Triazole complexes; Schiff base-triazole; Biological activity.*

Introduction

Triazoles are the class of heterocyclic compounds. There are two possible isomers of triazole (1, 2, 4-triazole and 1, 2, 3-triazole) depending on the position of nitrogen atom in the ring. 1, 2, 4-Triazole has the molecular formula $\text{C}_2\text{H}_3\text{N}_3$, called triazoles, which have a five-membered ring of two carbon atoms and three nitrogen atoms ofazole ring readily able to bind with a variety of enzymes and receptors in biological system via diverse non-covalent interactions, and thus display versatile biological activities.

In recent years, the chemistry of triazoles and their fused heterocyclic derivatives has received considerable attention owing to their synthetic and effective biological importance [1]. The derivatization of triazole is considered to be based on the phenomenon of bioisosterism in which replacement of oxygen of oxadiazole nucleus with nitrogen atom yields triazole analogue [2]. 1, 2, 4-Triazole derivatives are readily soluble in polar solvents and only slightly soluble in non-

polar solvents. However, the solubility in non-polar solvents can be increased by substitution on the nitrogen atom [3]. Mercaptotriazole derivatives are considered to be good coordinating ligands, because they involved both hard nitrogen and soft sulfur atoms. This ligand has donor groups that coordinate with wide range of metal ions [4-6]. The potential coordinating sites of the NS-type ligand are: sulfur of thiol group, nitrogen of the azomethine group and two nitrogen atoms at position 1 and 2 in triazole ring system [5].

The presence of (S=C) and (N=C) units allow for bidentate coordination to metal ions through thio substituted and nitrogen of the azomethine to form a stable five member ring [7], which leads to the formation of more stable complexes compared with monodentate ligands [8]. Furthermore, five or six membered chelate is by far the most common and the most stable. The synthesis of thio-triazole complexes with selected metal

ions have been reported in the literature [9]. This paper studies the synthesis and characterization of Cu(II), Cd(II) Hg(II) and Ag(I) complexes with 5,5'-(ethane-1,2-diyl)bis(4-(4-bromobenzylideneamino)-4H-1,2,4-triazole-3-thio).

Materials and methods

The following reagents, starting materials as well as solvents were purchased commercially and used without any further purification, succinic acid (BDH), hydrazine hydrate (Sucharlaw), carbon disulfide (Sucharlaw) copper (II) chloride dihydrate (BDH), mercury(II) chloride (BDH), Cadmium (II) chloride dihydrate (FLUKA) and Silver nitrate (BDH). The melting points were measured using Gallenkamp melting point apparatus.

Elemental C.H.N and S analysis were carried out on a (CE-440 elemental analyser). The infra-red spectra were recorded in the frequency range (4000-400) cm^{-1} using KBr disc for ligands and CsI disc in the frequency range (4000-200) cm^{-1} for their complexes by using (8400 S-FTIR SHIMADZU spectrophotometer).The ultraviolet-visible (U.V-Vis) spectra were recorded on (1800-UV SHIMADZU spectrophotometer in the range of (200-1100) nm. Magnetic susceptibility measurements for the synthesized complexes were obtained at room temperature using (Auto Magnetic

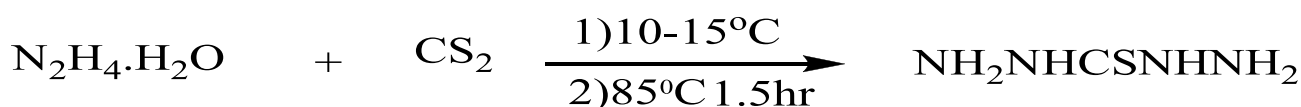
Susceptibility Balance Model Sherwood Scientific). Molar conductivity measurements were obtained using Hunts Capacitors Trade Mark British made. Thermal analyses of synthesized complexes were performed using (SHIMADZU 60-H Thermo Gravimetric Analyzer). Atomic absorption measurements were obtained by using (GBC Avanta Ver 1.33).The spectra of ^1H NMR and ^{13}C NMR were recorded on Bruker AV3400HD Spectrometer, Germany, using DMSO-*d*6 as the solvent.

Experimental

Synthesis of 5,5'-(ethane-1,2-diyl)-bis-(4-(4-bromobenzylideneamino)-4H-1,2,4-triazole-3-thio).

Preparation of Thiocarbohydrazide [10]

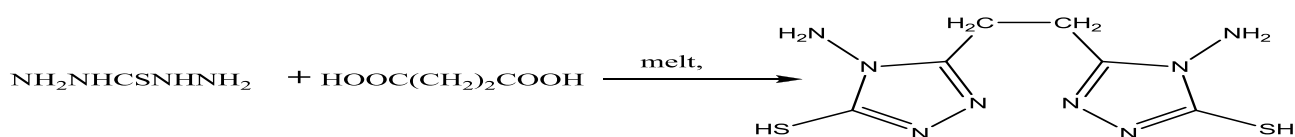
In a round bottom flask hydrazine hydrate 80% (50ml, 1.0 mol) was placed, which was equipped with thermometer, efficient agitator, and reflux condenser. The temperature was lowered to 10 °C and 0.2 mol of carbon disulfide (15.2 g, 12.1 ml) was added dropwise into the flask while maintaining the temperature below 15 °C, then the temperature was raised gradually to 85 °C for 1.5 hr. Reaction mixture was cooled to 10°C, precipitate was filtered and washed with water, m.p:(169-171)°C, Yellow solid, yield (75%), IR(cm^{-1}); 3286-3272, 3205 (NH, NH₂), (1284, 933) (CS).

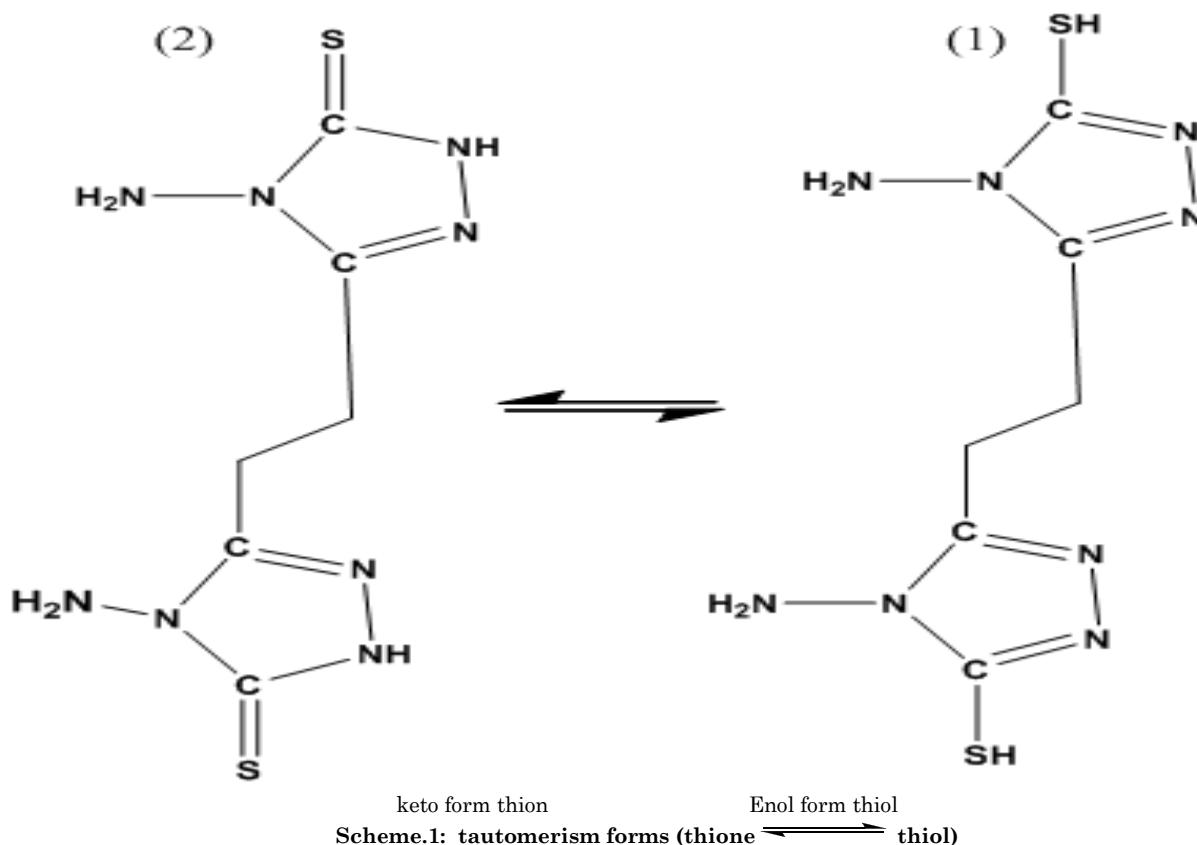


Preparation of Primary Amine 1,2-bis(4-amino-5-mercapto-1,2,4-triazole-3-yl)ethane [11].

A mixture of dicarboxylic acid (2.95g, 0.01M) and thiocarbohydrazide (5.30g, 0.02 M) contained in a at-bottomed flask was heated in an oil bath until the contents melted. The mixture was maintained at this temperature for (15-20) min. The product obtained on

cooling was treated with dilute sodium bicarbonate solution to remove the unreacted dicarboxylic acid. It was then washed with water and collected by filtration. The product was recrystallized from a mixture of DMF and water (1:1) to afford the title compounds, Off white, m.p:(238-240)°C ;yield:(66%), IR(cm^{-1}): 1616 (CN),1195 (CS),2752 (SH),663 (C-S),3264,3159 (NH₂).

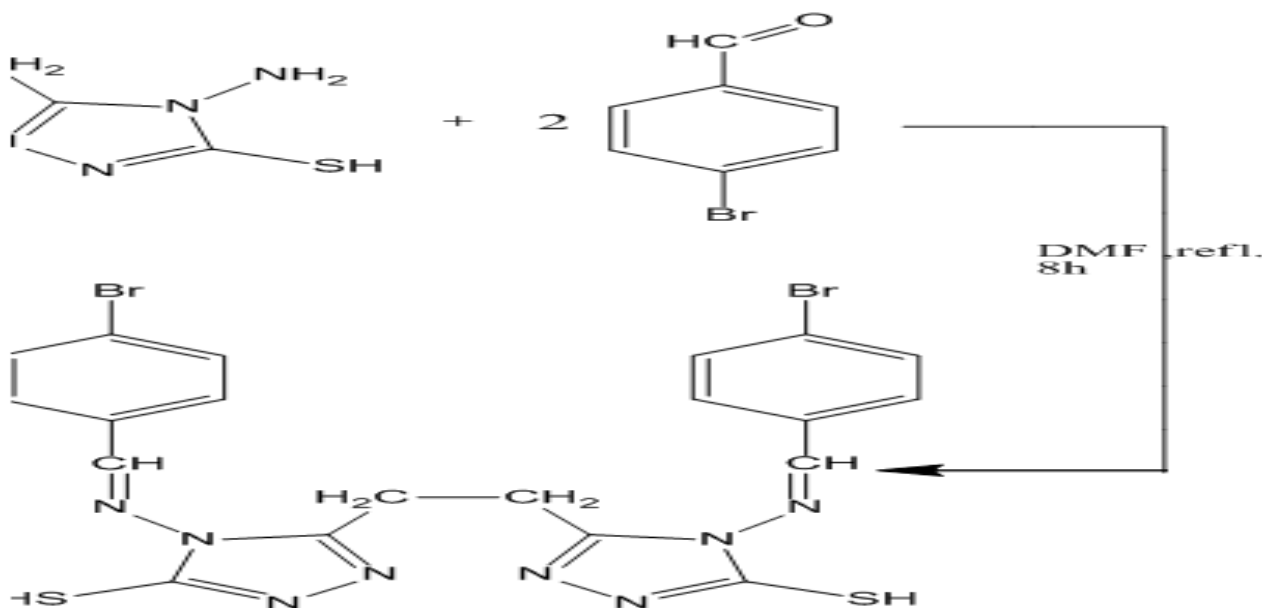




Synthesis of Schiff base from primary amine and aromatic aldehyde[12]

A mixture of 1, 2-bis (4-amine-5-mercapto-1, 2, 4-triazole-3-yl) ethane (1.70g, 0.01 mol) and (P-bromobenzaldehyde (2.44g, 0.02 mol) in DMF (20 ml) were refluxed for 8 h, cooled, and then poured into ice-cold water. The yellow precipitate was crystallized from DMF/ ethanol. (1:1), m.p:(200-203)°C, yield:(70%), IR(cm⁻¹):1589 (imine CN), 1614(trz CN), 3099, 3151(NH), 2931(H-

aliphatic), 3053(H- aromatic), 2354(SH).¹HNMR (AV3400HD, DMSO-d₆):δ6.75-7.67 (C-H romatic),9.67 (N=CH), 7.70(N-H), 13.67(S-H), 3.02-3.33(2CH₂).¹³CNMR (DMSO-d₆): δ 111-130 (C-aromatic), 166(C=N azomethine), 190(N-C=S), 21(C-C).Anal. Cal cd for C₂₀ H₁₆ N₈ S₂ Br₂ (592.33); C,40.55, H,2.72 ,N,18.92, S,10.83, Found;C,41.87, H,3.00,N,19.34,S,10.99. The ligands exhibit (thione ↔ thiol) tautomerism as given in (Scheme. 1).



Scheme.2: Synthesis of L

Synthesis of Schiff bases Complexes (C1-C4)

The hot ethanolic solution of the suitable metal salt $[M^{+2}]$ as ($CuCl_2 \cdot 2H_2O$, $CdCl_2 \cdot 2H_2O$, $HgCl_2$, $AgNO_3$) was added to the hot ethanolic solution of ligand L in a 2:1 (metal: ligand) ratio and refluxed for (2-6) hours. The mixture was stirred overnight. A colored crystalline solid precipitant was formed. The product was filtered, washed with ethanol and dried in oven.

Results and Discussion

The analytical data of the metal complexes are given in (Table 1). The data reveal the formation of complexes having 2:1 (metal ion: ligand) ratio. The data clearly indicate that, the ligand used act as neutral bidentate. The complexes are insoluble in common organic solvents but all complexes completely soluble in DMF and DMSO.

Table.1: The analytical data of the metal complexes

Complexes (Formula weight) Molecular weight	Analytical Data %Found (Calculated)						Metal content	Chloride content
	Color	C	H	N	S			
C1 $[Cu_2LCl_4 \cdot (H_2O)_4]$ (933.31)	green	26.20 (25.74)	2.60 (2.59)	12.29 (12.01)	7.30 (6.86)	14.40 (13.62)	15.38 (15.22)	
C2 $[Cd_2LCl_4 \cdot 4H_2O]$ (1030.93)	Yellowish-green	25.70 (25.05)	1.95 (1.68)	11.81 (11.68)	6.87 (6.69)	23.62 (23.44)	14.20 (14.79)	
C3 $[Hg_2LCl_4]$ (1135.33)	yellow	21.69 (21.16)	1.60 (1.42)	10.40 (9.87)	6.00 (5.65)	-	12.78 (12.51)	
C4 $[Ag_2L(NO_3)_2]$ (932.07)	Light yellow	26.10 (25.77)	1.92 (1.72)	15.02 (15.03)	7.20 (6.88)	-	-	

Molar Conductance

Molar conductance values of 10^{-3} M DMF solutions, their values fall in the range (46.73-10.70) $\text{Ohm}^{-1}\text{cm}^2 \text{mol}^{-1}$ for all the complexes indicating non electrolytic nature of these complexes [13].

Infrared Spectra

The existence of the thioamide bands in the IR spectra of the free ligand and its complexes indicate that they exist as thione tautomer in the solid state, show (Fig.1)-(Fig.4) which are in agreement with the previous work on the family of triazole.

Table.2: IR-spectral data of L-complexes (C1-C4)

Group	Assignment (cm^{-1})			
	C1	C2	C3	C4
$\nu(\text{N-H})$ stretch (asym, sym)	3168,3305	3207,3371	3328,3200	3205,3326
$\nu(\text{C=N})$ imine	1585	1587	1583	1585
$\nu(\text{C=S})$	1166	1166	1164	1166
$\nu(\text{C=N})$ trz	1610	1612	1612	1610
(C-H) Ar	3097	3068	3055	3045
M-N	541	543	530	541
M-S	460	459	474	447
M-Cl	356	366	349	(M-O)=368

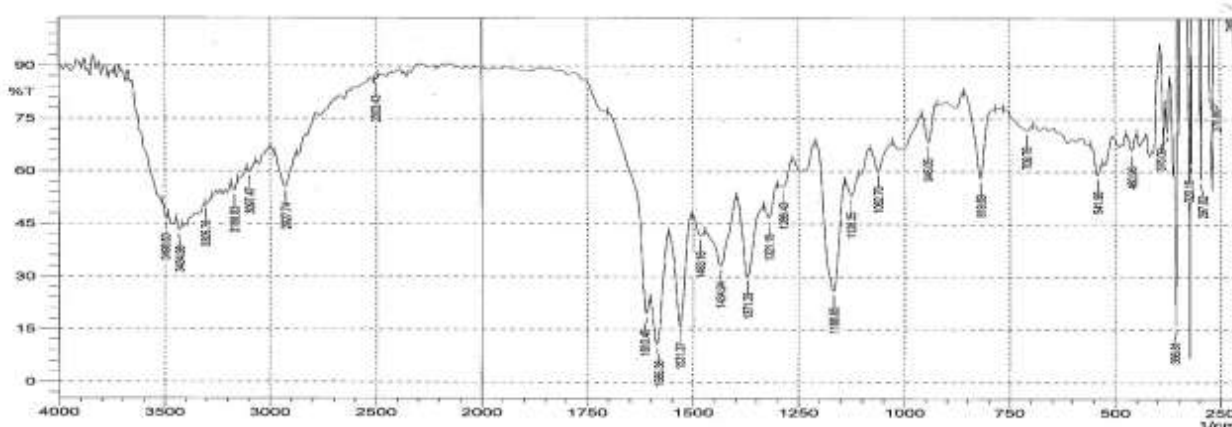


Fig.1: IR spectrum of C1

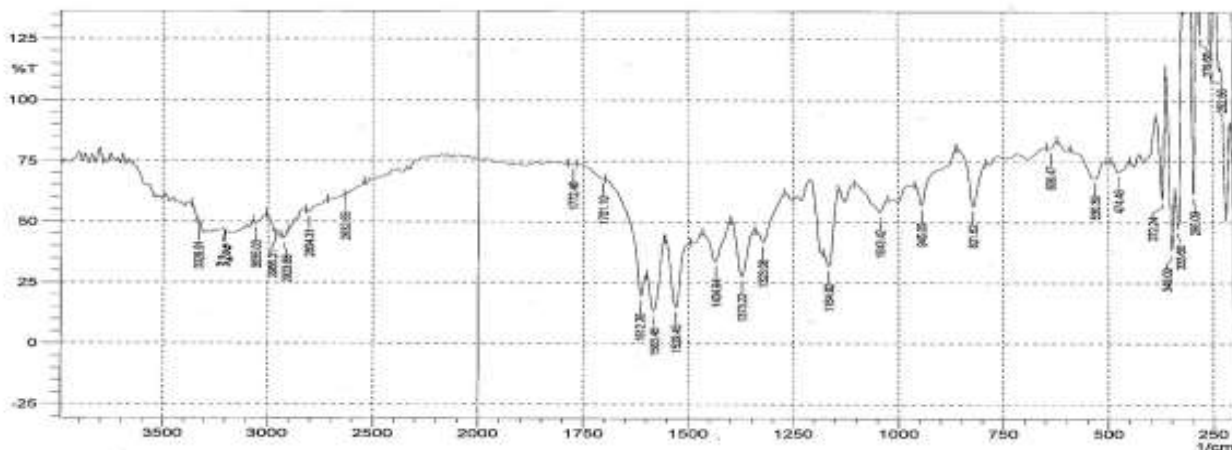


Fig.2: IR spectrum of C3

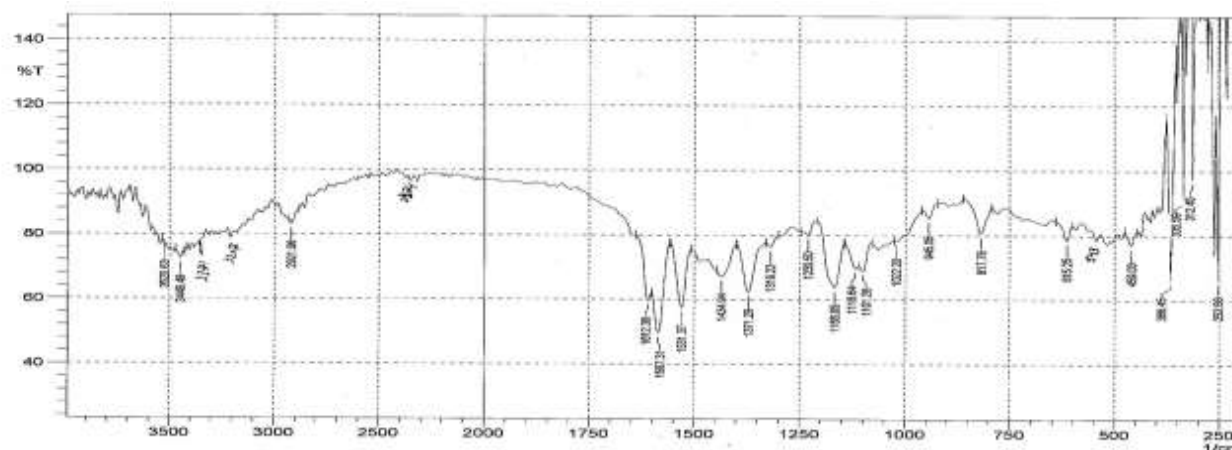


Fig.3: IR spectrum of C2

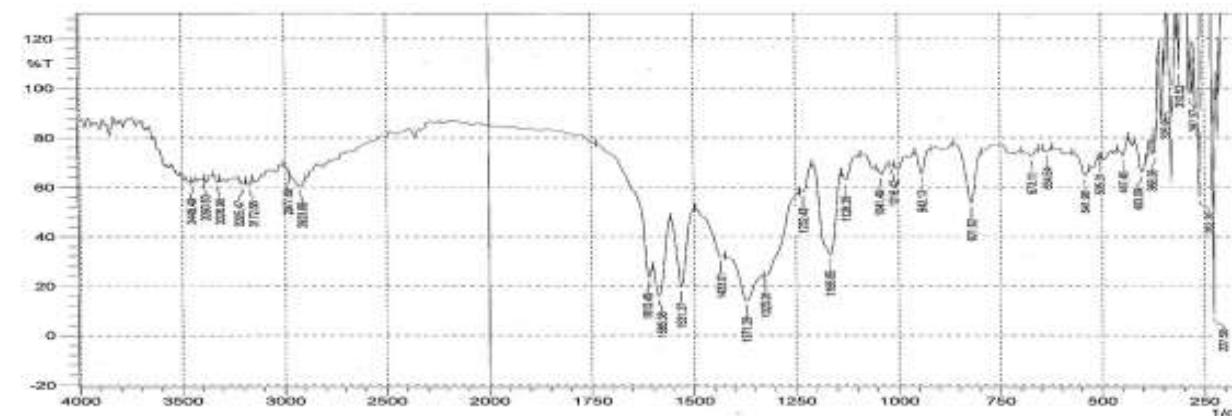


Fig.4: IR spectrum of C4

Electronic Spectra and Magnetic Studies

The electronic spectra of the ligand and its complexes have been recorded as DMF solutions in the wavelength range (200-1100) nm. The electronic spectrum of the ligand L is exhibited a high intensity bands appeared as a singlet or doublet due to intra-ligand transitions, the band which appeared at (265) nm is assigned to ($\pi-\pi^*$) transition of the conjugated system. A lower intensity band appeared in the near U.V. region at (337) nm was assigned to ($n-\pi^*$) transition, which are shown in Fig.(5).

The complexes (C1-C4) of this ligand were showed the following :

Electronic Spectrum of Copper (II) Complex (C1)

The electronic spectrum of Cu(II) complex, exhibited absorption band at (436) nm assignable to $^2E_g \rightarrow ^2T_{2g}$ (d-d) transition [14], and at (333) nm assignable to (C.T.) as shown in Fig.(6) [14]. The Cu(II) complex showed magnetic moment (1.98) B.M. corresponds to one unpaired electron [15] .

Electronic Spectra of Cd(II),Hg (II) and Ag(I)- Complexes (C2 -C4)

The electronic spectra of these complexes were showed no d-d transitions because the d-orbitals are filled (d^{10}). The U.V.-visible spectra of these complexes were appeared in (452,333) nm for C2,(458,334,265)nm for C3 and (451,409,332,305) nm for C4 due to

charge transfer (C.T) from (M→L)[16]. Some changes in the bands position of these complexes were appeared compared to that of free ligand as listed in Table.(2).All the complexes(C2-C4) are diamagnetic , Thus, the tetrahedral geometry was suggested for complexes (C2, C3) [17] and trigonal planar for the complex C4 [18].

Table 2: Electronic spectral data, suggested geometry and molar conductivities

Compound	Assignments	Wavelength , λ (nm)	Suggested Geometry	μ_{eff} B.M
L1	$n \rightarrow \pi^*$ $\pi \rightarrow \pi^*$	337 265	-	-
C1	${}^2E_g \rightarrow {}^2T_{2g}$ C.T.(L-M)	436 333	Distorted octahedral	1.98 Paramagnetic
C2	C.T.(M→L)	452, 333	Tetrahedral	0 Diamagnetic
C3	C.T.(M→L)	458, 334,265	Tetrahedral	0 Diamagnetic
C4	C.T.(M→L)	451,409,332, 305	Trigonal planar	0 Diamagnetic

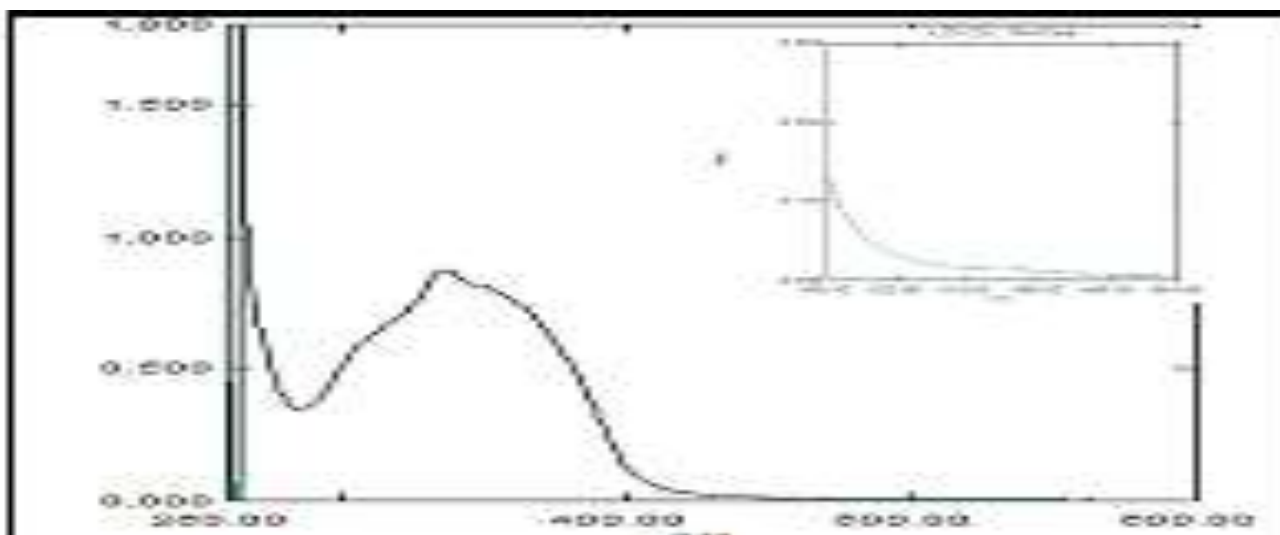


Fig.5: Electronic spectrum of L

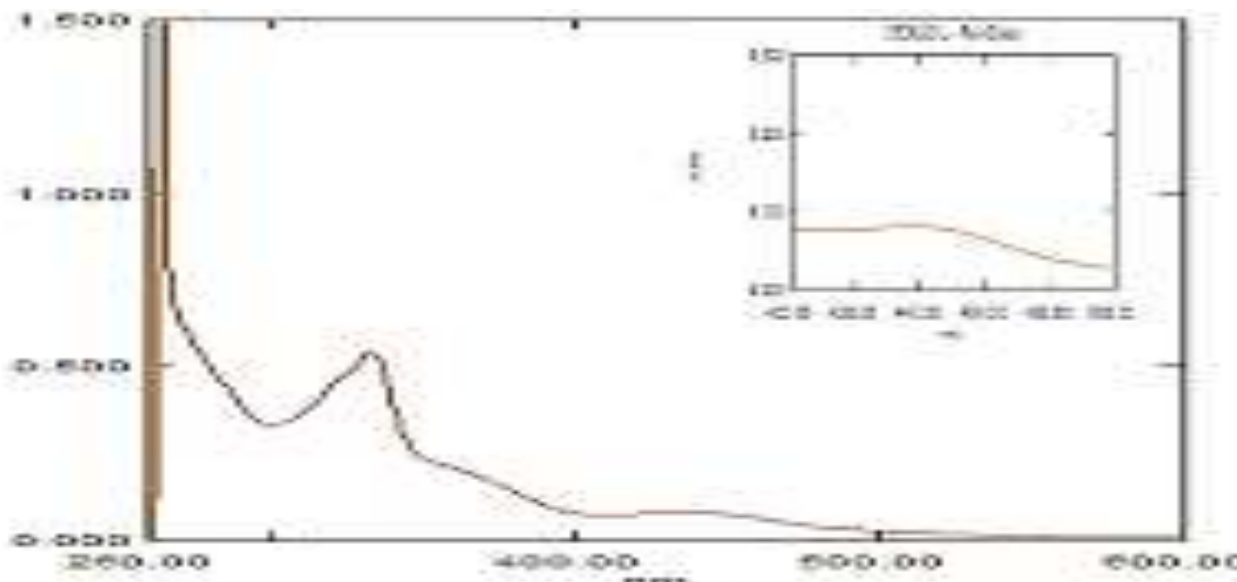


Fig.6: Electronic spectrum of C1

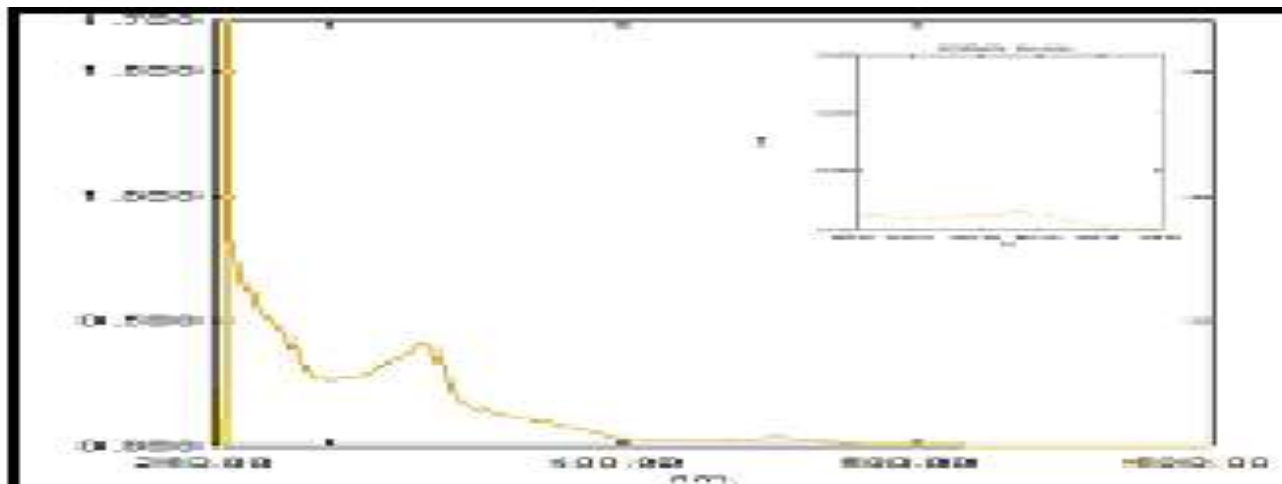


Fig.7: Electronic spectrum of C2

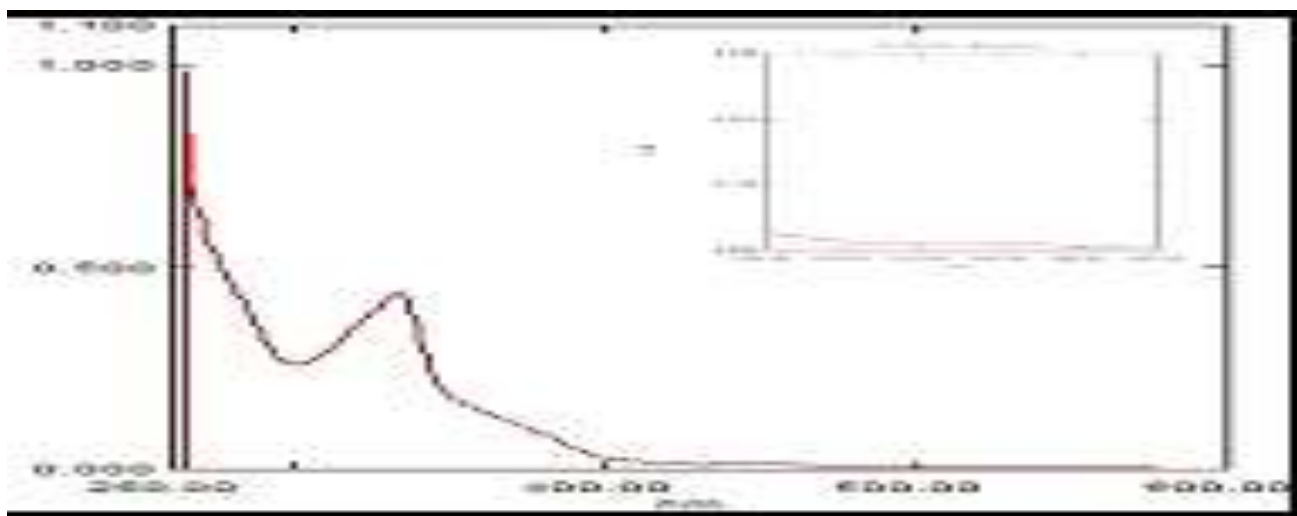


Fig.8: Electronic spectrum of C3

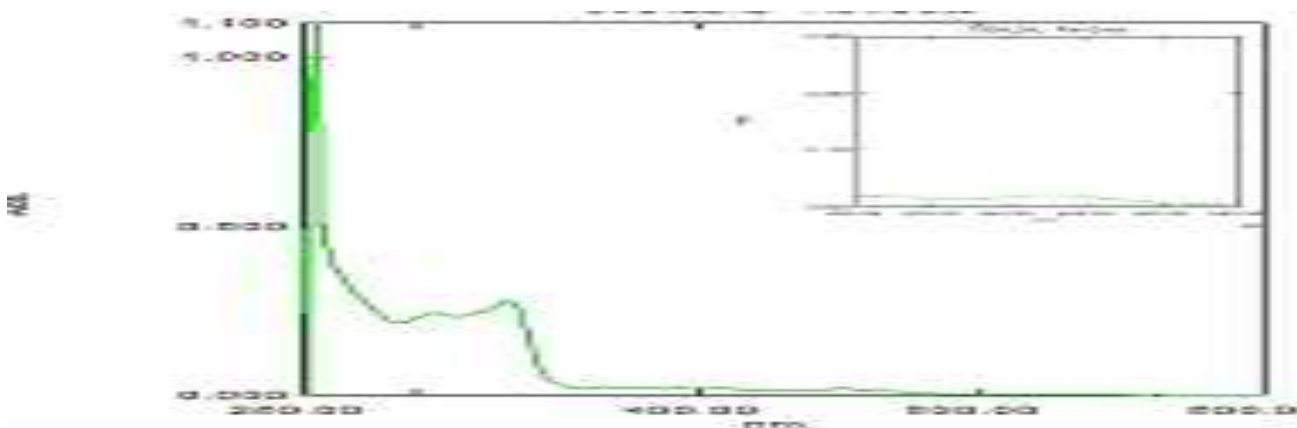


Fig.9: Electronic spectrum of C4

Thermal Analyses (TG and DTG)

Thermal decomposition of metal complexes (C1-C4) follows TG and DTG techniques under nitrogen inert gas with heating range (50-600) °C and heating rate 10 °C/min. The following results were obtained and explained according to analytical suggestions mentioned in the literature [19, 20].

- As a common behavior, at low temperatures some TG and DTG curves of the synthesized complexes mentioned above

are shown the stage of mass-loss of water hydration molecules and solvent molecules (ethanol). The initial weight losses was determined from TG curves of the studied complexes in good agreement with the calculated values [20].

- The final stage of the thermal decomposition of some complexes gave metal sulfides as a final residue depending on the type of metal ion and the affinity between the metal ion and the ligand [21].

Table 3: Thermogravimetric analytical data (TG and DTG) for decomposition of ligand (L) and its complexes (C1-C4)

compound	Molecular formula M.Wt	step	Temp. range of the decomposition (C°)	Suggested Formula of loss	Mass loss%	
					Cal.	found
L	C ₂₀ H ₁₆ N ₈ S ₂ Br ₂ (592.33)	1	120-311	C ₆ H ₄ Br, CHN ₂ S C ₂ H ₄ , C ₆ H ₄ Br, C ₅ H ₃ N ₆ S	38.66	38.86
		2	311-535		61.28	61.88
C1	[Cu ₂ L1Cl ₄ .(H ₂ O) ₄] (933.31)	1	50-254	4H ₂ O, 2Cl C ₆ H ₄ Br, 2Cl, C ₂ H ₄ , C ₆ N ₇ H ₄ S Cu ₂ S, C ₆ H ₄ BrN	15.32	15.88
		2	254-380		49.28	49.25
		3	>600		35.25	35.40
C2	[Cd ₂ L1Cl ₄].4H ₂ O (1030.93)	1	100-280	4H ₂ O, CN 4Cl, C ₂ H ₆ N C ₂ N ₂ H, C ₆ H ₄ Br, C ₂ N ₄ H, C ₆ H ₄ Br, 2CdS	9.50	9.53
		2	280-400		18.04	18.29
		3	400-510		20.27	19.71
		4	>600		52.08	52.47
C3	[Hg ₂ L1Cl ₄] (1135.33)	1	98-351	4Cl, C ₆ H ₄ Br, C ₂ H ₄ , C ₆ N ₈ H ₄ S ₂ C ₆ H ₄ Br 2Hg	50.55	50.19
		2	371-470		13.74	14.21
		3	>600		35.24	35.60
C4	[Ag ₂ L1(NO ₃) ₂] (932.07)	1	98-312	C ₆ H ₄ Br, CHN, C ₂ N ₃ SH C ₂ H ₄ , C ₆ H ₄ Br C ₃ H ₂ N ₅ O ₆ , Ag ₂ S	30.25	30.26
		2	312-594		19.74	19.90
		3	>600		50.01	49.95

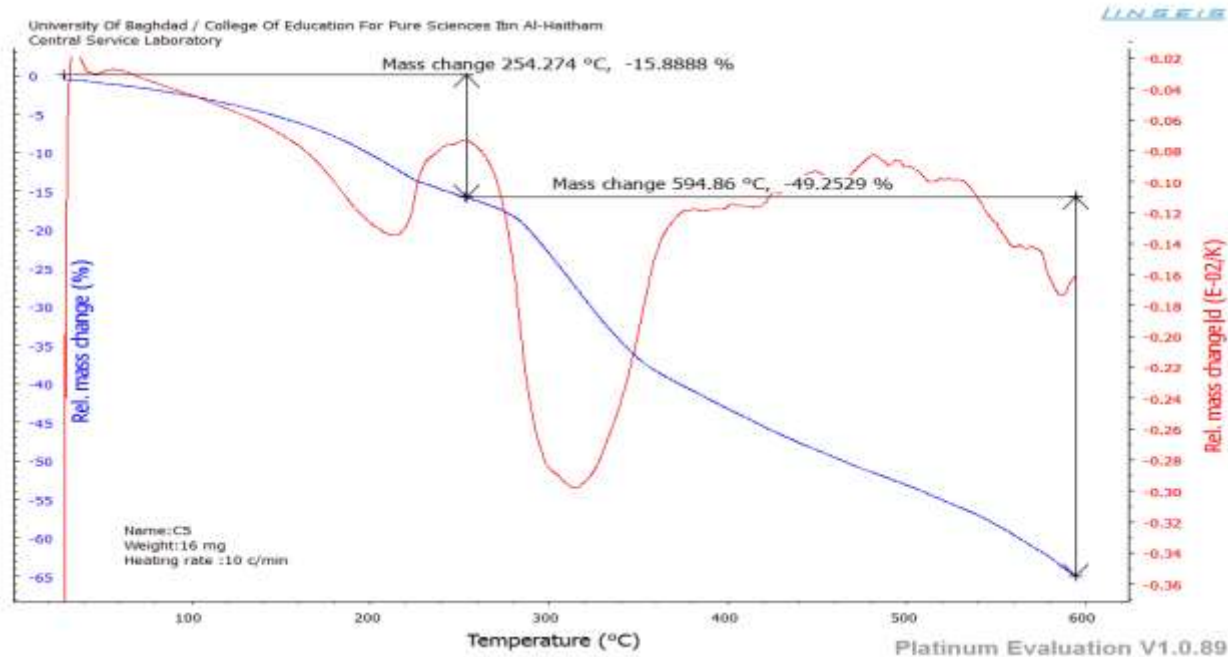


Fig.10: Thermograph of C1

NMR Spectra of L and its metal complexes with metal ions (Cu²⁺, Cd²⁺, Hg²⁺, and Ag¹⁺)

The ¹HNMR and ¹³CNMR chemical shifts (ppm) for the above mentioned compounds are described in the following sections :-

¹HNMR and ¹³CNMR Spectra of L and its complexes (C1-C4)

The ¹HNMR Spectrum for L

The ¹HNMR spectrum of L in DMSO-d₆ is shown in (Fig.11) signal assignments are

given in (Table.4). Chemical shifts of N=CH Proton of azomethine exhibited a peak at δ = (9.67) ppm [22]. Chemical shifts of aromatic and triazole ring protons appeared at δ = (6.75-7.67) ppm [23, 24], and δ = (9.41) ppm [24] respectively.

The spectrum exhibited sharp peak at low field at δ = (13.67) ppm which signed to S-H proton of thiole and thion [5, 25]. Chemical shifts of N-H proton appeared at δ = (7.70) ppm [22] [23], while the proton of (4H, 2CH₂) appeared at δ = (3.02-3.33) ppm [26].

Table.4: ¹HNMR spectral data of L

Assignments	Chemical shifts (ppm)
δC-H aromatic	6.75-7.67
δN=CH	9.67
δN-H	7.70
δS-H	13.67
δCH ₂	3.02-3.33

¹³CNMR Spectrum of the ligand L

The ¹³CNMR spectrum of the ligand L in DMSO-d₆ is shown in (Fig.12) and signal assignments of chemical shifts are described in (Table .5). The spectrum of L is characterized by the presence of (N=C) of

azomethine group which appeared as a signal at δ=(153) ppm [22]. Chemical shift of (C-aromatic ring) appeared at δ =111-130 ppm[27]. The spectrum appearance at low fields at δ = 166 ppm which was assigned to C=S of thion, while chemical shifts of (C-C) appeared at δ =(21) ppm [5].

Table.5: ¹³CNMR spectral data of L

Assignments	Chemical shifts (ppm)
δC- aromatic	111-130
δN=C azomethime	153
δN-C=S/ C-S	166
δC-C	21

¹HNMR Spectra of L-complexes (C1-C4)

The ¹HNMR spectra of L-complexes (C1-C4) in DMSO-d₆, signal assignments of chemical shifts are described in (Table.6). Chemical shifts of the (N=CH) proton of azomethine exhibited peaks at range δ=(9.65-9.67) ppm [22, 28]. Chemical shifts of aromatic proton

for (C1-C4) appeared at δ = (6.61-7.18), (6.75-7.68), (6.70-7.76) and (6.78-7.69) ppm respectively [24, 29], while the chemical shifts of triazole ring proton appeared at δ = (7.65, 9.40, 8.88, and 7.68) respectively [30], the chemical shifts of the (CH₂) proton exhibited peaks at range δ =(3.02-4.04)ppm [29].

Table.6: ¹HNMR spectral data in ppm of complexes (C1-C4)

Assignments	C1	C2	C3	C4
δN=CH	9.65	9.67	9.67	9.67
δC-aromatic	6.61-7.18	6.75-7.68	6.70-7.76	6.78-7.69
δTriazole ring	7.65	9.40	8.88	7.68
δCH ₂ proton	3.02-3.99	3.13-4.00	3.05-3.23	3.05-4.04

¹³CNMR Spectra of L-complexes (C1-C4)

The ¹³CNMR spectra of these complexes are shown in Figure (3) and chemical shifts with their signal assignment are described in Table (3). In addition to the peak related to which appeared at range δ =(155-166)

ppm assigned to azomethine [22], the complexes exhibited chemical shifts assigned to aromatic carbon ring at range δ=(111-132)ppm [24]. The spectrum appearance of peaks at lower fields at δ =(190) ppm was assigned to (C=S) of thion [22, 25], while (C-C) appeared at δ =(21-29) ppm [27], [5].

Table.7: ¹³CNMR spectral data in ppm of complexes (C1-C4).

Assignments	C1	C2	C3	C4
C- aromatic	111-132	111-132	111-131	111-131
N=C azomethine	155	165	166	163
N-C=S	190	190	190	190
C-C	29	21	20	29

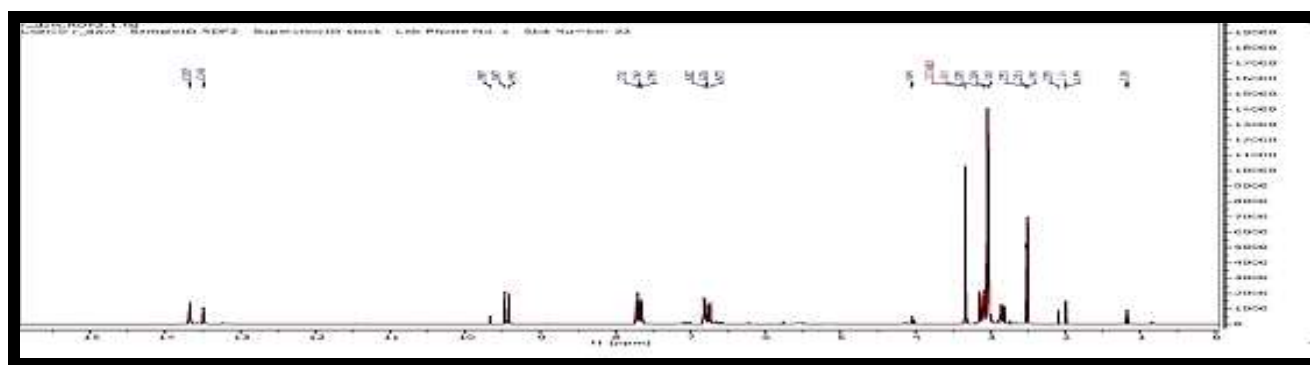


Fig.11: ¹HNMR spectrum of L

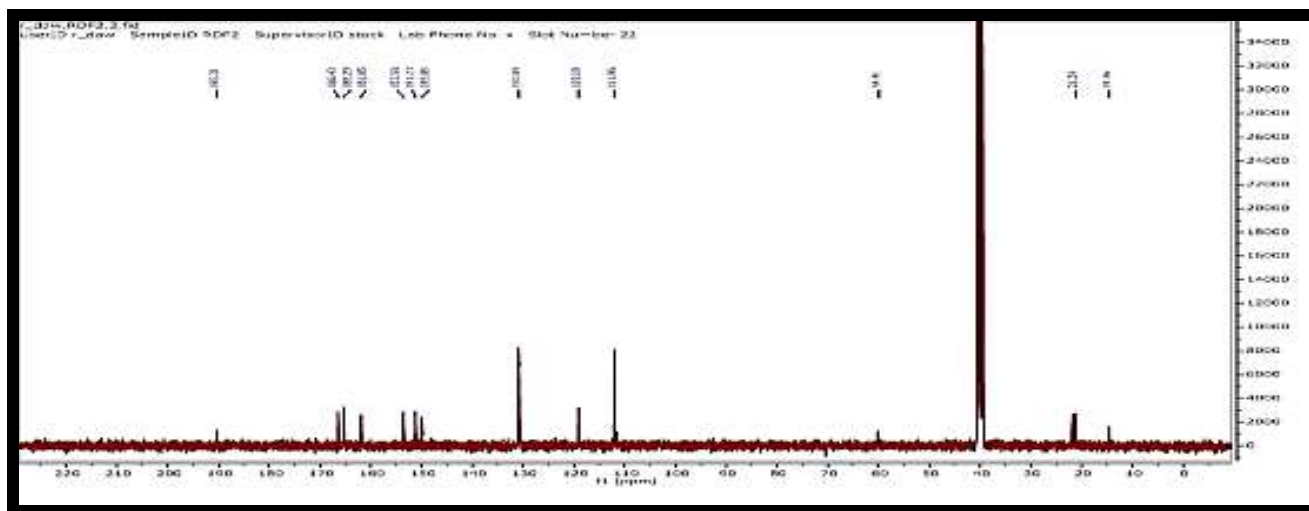


Fig.12: ¹³CNMR spectrum of L

Biological Activity

The are many factors influence on the biological activities of ligands and metal complexes such as type of ligand, type of metal ion ,electron configuration of metal ion , the transition series and geometry of complexes [31].

In Vitro Antibacterial Activity

The antibacterial screening of all synthesis compounds were tested against (*Escherichia Coli* , *Klebsiella Pneumonia*) as gram negative bacteria and (*Staphylococcus aureus*, streptococcus sp.) as gram positive bacteria with agar diffusion method , using (1*10⁻³ M) of studied compounds in DMSO. The antibacterial activities of studied compounds

(L&C1-C4) were compared with antibiotics Amicillin .The antibacterial data were listed in Table.8)and the zones of inhibition are measured in(mm) Triazoles are known as antifungal compounds but in this work they appeared antibacterial activity that’s may be because of heterocyclic ring contains (azoles and sulfur) and metal ions of the synthesized complexes.

This activity is believed to be caused by the chelation effect which reduces polarization of the metal ion by fractional sharing of the positive charge with supporter atoms of the ligand in the complexes .The increases the lipophilic character, favoring the permeation through lipid layers of the bacterial membrane [32] .

Table.8:Evaluation of antibacterial activity of the compounds

Compounds	Average zone of inhibition (mm)			
	Gram Positive		Gram negative	
	<i>Staphylococcus Aurous</i>	<i>Streptococcus sp.</i>	<i>Escherichia coli</i>	<i>Klebsilla Pneumonia</i>
DMSO	non	10	12	non
L1	10	18	10	10
C1	non	16	non	non
C2	15	12	12	14
C3	14	10	non	12
C4	non	6	non	non
Ampicillin	12	14	10	16

non=non inhibition zone

These bacteria are known for their resistance to most of the developed antibiotics and are known to be the major cause of many health issues and infections [33]. According to the results obtained from the *In-vitro* test of these compounds they can be potential antibiotic drugs that’s of course after performing many *In-vivo* studies and exploring their cytotoxicity and behavior in the biological systems.

Antifungal activity of the Synthesized Complexes

The fungi which were used in this work (*Aspergillus Flavus*) and the solvent was DMSO. The inhibition zones of the complexes were measured in (mm) and their results are listed in (Table.9). The synthesized complexes were showed good results. The inhibition zones of these complexes compared to the inhibition zone of the broad spectrum

antibiotic (Fluconazole) where, some complexes gave inhibition zones that were smaller than those of the antibiotic but still considered as good results [34], other complexes showed similar results and other complexes showed even better results than the antibiotic (Fluconazole).

According to the results obtained from the *in-vitro* test of these complexes they can be potential antibiotic drugs that's of course after performing many *in-vivo* studies and exploring their cytotoxicity and behavior in the biological systems. The antifungal activity of triazoles derivatives was more potential than the activity against bacteria that's mean the complexes bind to fungal structure: cell wall, plasma membrane and DNA structure by affecting as [35]:

Anti-metabolites

These complexes (triazoles) interfere with the formation of key bio-molecules within the cell, e.g. nucleotides. These derivatives interrupt DNA replication, consequently and cell division. Examples of antimetabolites include; foliate antagonists (methotrexate), purine antagonists (6-mercaptopurine) and

pyrimidine antagonists (5-fluorouracil), enzyme inhibitors (bleomycin) and groove binders (distamycin).

Spindle Inhibitors

Such agents prevent correct cell division by interfering with the cytoskeletal components enabling one cell to divide into two cells [36].

Triazoles

(synthetic compounds) which are have azole in (one or more) rings with three atoms of nitrogen in a five membered ring take action by inhibition of the cytochrome P450-dependent exchange of lanosterol to ergosterol triazoles perform as cytochrome P450 14 α -demethylase inhibitors. This enzyme is concerned in the change of lanosterol to ergosterol which is supportive in the cell wall production.

In this mechanism the basic nitrogen of the azole ring is strongly bound to the heme iron of the fungal cytochrome P450 prevent substrate and oxygen binding. Inhibition of the 14 α -demethylase consequences in buildup of sterols and causes permeability change and fail of membrane proteins.

Table.9: Evaluation of antifungal activity of the compounds

Compounds	Aspergillus Flavus
DMSO	non
L1	11
C1	non
C2	13
C3	21
C4	12
Fluconazole	20

non =non inhibition zone

Conclusion

The Schiff-bases were prepared from aromatic aldehyde and triazole derivative (1, 2-bis (4-amino-5-mercapto-1, 2, 4-triazole-3-yl) ethane) using reflux as reported in literature, Four solid complexes have been isolated with new ligand.

These complexes of the type (2:1) where the order is metal: ligand, were identified and their structures were confirmed by elemental analysis (CHNS), atomic absorption, thermal analysis (TG, DTG), FTIR, UV-Vis., ¹H-NMR, ¹³C-NMR, molar conductance and magnetic properties. In this study the synthesized ligand represent a group of bidentate ligands and as the binuclear center of Schiff-bases type exhibiting good complexation properties. In all complexes the coordination of Schiff- bases with metal ions

took place through the azomethine nitrogen and thiol groups. All the synthesized complexes were tested *in-vitro* against some gram positive and gram negative bacteria and their results were compared to the broad spectrum antibiotic (Ampicillin).

Some of the complexes showed activity against the tested bacteria but the Cd-complex showed very good results and some of the synthesized complexes were even better than the antibiotic itself. Triazoles are known as antifungal compounds but in this work they appeared antibacterial activity that's may be because of heterocyclic ring contains (nitrogen and sulfur) and metal ions of the synthesized complexes. All the synthesized complexes were tested *In-vitro* against some fungi and their results were compared to the antibiotic (Fluconazole).

Some of the complexes showed activity against the tested fungi.

The antibacterial activity of complexes from triazole derivatives was more potential than the activity against fungi.

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