Synthesis, Characterization and Biological Efficacies from Some New Dinuclear Metal Complexes for Base 3-(3,4-Dihydroxy-phenyl)-2-[(2-hydroxy-3-methylperoxy-benzylidene)-amino]-2-methyl Propionic Acid

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Abstract: *The reaction of methyldopa with* o*-vanillin in refluxing ethanol afforded Schiff base and characterized through physical analysis with a number of spectra also the study of biological activity. The geometry of the Schiff base was identified through using (C.H.N) analysis, Mass, ^{1}H-NMR, FT-IR, UV-Vis spectroscopy. Metal complexes of Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} and Hg^{2+} with Schiff base have been prepared in the molar ratio 2:1 (Metal:L), (L = Schiff base ligand) except Hg^{2+} at molar ratio 1:1 (Hg:L). The prepared complexes were characterized by using Mass, FT-IR and UV-Vis spectral studies, on other than magnetic properties and flame atomic absorption, conductivity measurements. According to the results a dinuclear octahedral geometry has been suggested for Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+} complexes, dinuclear tetrahedral for Cd^{2+} and mononuclear tetrahedral for Hg^{2+} complex. This work highlights the relevance of metal complexation strategy to stabilize the ligands and improve their bioactivity. Schiff base complexes have been screen for their antibacterial activity against Gram negative and positive bacteria and antifungal activity showing promising antibacterial and biological activity.*

Keywords: *methyldopa;* o*-vanillin; Schiff base complexes; spectral studies; biological efficacy*

■ INTRODUCTION

Schiff bases a special class of organic ligands with a variety of donor atoms revealing interesting coordination modes towards numerous metals [1-2]. These are the condensation product of an active carbonyl group acting as an electrophile and an amino group as a nucleophile. Due to their structural varieties and unique characteristics, these are the most versatile studied ligands in coordination chemistry. Among the Schiff base derivatives, those having phenol moiety have attracted considerable attention due to their wide range of biological activities Metal complexes such as Zn, Cd, Co, Ni, Pd, Ag, and Hg have different biological activities such as antimicrobial [3-4], antifungal [5-7], antioxidant [5,8] and anticancer [9-12]. These type complexes have also many different properties such as catalytic activity, porosity, magnetism, and conductivity [13-14]. C–C and C–N cross-coupling reactions are very important for natural products, drug design and industrial starting materials. For this reason, it is an important reaction group for organic chemistry. Among the Schiff base derivatives, those having carbonyl and phenol groups' moiety have attracted considerable attention due to their wide range of biological activities [15-16]. Methyldopa (M-dopa), the L-isomer of alpha-methyldopa, is levo-3-(3,4-dihydroxyphenyl)-2-methylalanine. Its empirical methyldopa is used in the clinical treatment of the following disorders: hypertension (or high blood pressure) gestational hypertension (or pregnancy-induced hypertension). Aldomet (L-methyldopa) is an antihypertensive drug and is an aromatic amino-acid de carboxyl's inhibitor in animals and man. A literature survey revealed that a little work has been reported on metal complexes of Schiff bases derived from methyldopa derivative [17], Schiff bases derived from *o*-vanillin are well known for their interesting ligational properties and exclusive applications in different fields. The interaction of these donor ligands and metal ions gives complexes of different geometries, and a literature survey reveals that these complexes are potentially more biologically active. Thus, in recent years Schiff bases and their metal complexes have attained much attraction because of their extensive biological activities [18-19]. The authors reported the catalytic effects of the Schiff base. The present paper aims to prepare, characterize the chemical structure and to study the antibacterial activity and antifungal from Schiff base ligand prepared which is derived from methyldopa as well as *o*-vanillin and its metal complexes with Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} and Hg^{2+} are being reported.

■ EXPERIMENTAL SECTION

Materials

All the reagents used for the synthesis of methyldopa (Sigma-Aldrich), *o*-vanillin (Fluka), solvents such as aceton, chloroform as well benzene (Merck), but dimethyl sulfoxide also dimethylformamide (BDH), and inorganic salts such as $CrCl_3·6H_2O$, $MnCl_2·4H_2O$, $NiCl_2·6H_2O$, $CuCl_2·H_2O$ also $HgCl_2$ (Merck), $CoCl_2·6H_2O$ (Riedial-Dehaen), $ZnCl_2$ (Aldrih) as well as $CdCl_2·H_2O$ (Fluka) and were used as supplied.

Instrumentation

Melting points of the Schiff base ligand and all its metal complexes were determined by using Stuart Melting Point Apparatus. Metal contents to all compounds have been determined by using atomic absorption technicality by AA–680 Shimadzu. The conductometric measurements of the Schiff base ligand and metal complexes were carried out in DMSO solution using CON 510 Conductivity at room temperature. Vibrational spectra were recorded to the Schiff base ligand and all complexes using KBr pellets on FT-IR-600 FT-IR Spectrophotometer, in the region 4000–400 cm^{-1} range. ^1H-NMR for Schiff base ligand was registered on by NMR Bruker 400 MHz at DMSO-d_6 for TMS as the inner standard. Mass spectra to Schiff base ligand as well all its compounds have been registered by MS Model 5973 Network Mass Selection Technology (HP) with Triple–Axis Detector by the analyzer Quadrupole at 230 °C. Electronic spectral studies were performed on using Shimadzu-U.V-160 to the Schiff base ligand and its metal complexes as well as metal(II) complexes at DMSO (10^{-3} M) in the range (200–1100) nm. Magnetic susceptibility for prepared metal(II) complexes was measured on Auto Magnetic Susceptibility Balance Sherwood Scientific. In the chloride test with each complex (5×10^{-2} g) has been washed using concentrated nitric acid and diluted with water. To the resultant solution from the complexes, an aqueous solution of silver nitrate was added, a white precipitate of silver chloride was formed in the case of metals complexes has chloride content where as in the case of metals complexes [20], no precipitate was observed with all metal complexes.

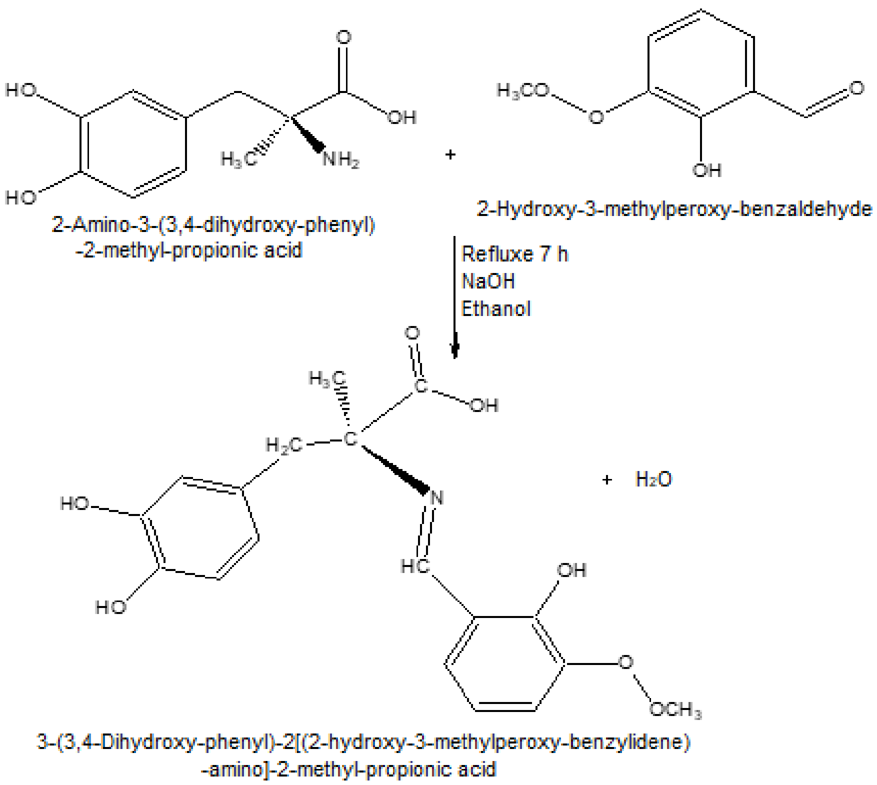
Procedure

Prepare for Schiff base ligand [3-(3,4-dihydroxy-phenyl)-2-[(2-hydroxy-3-methylperoxy-benzylidene)-amino]-2-methyl propionic acid]

Schiff base ligand (L) has been prepared through adding 1mmol of (0.2112 g) of methyldopa (2-amino-3-(3,4-dihydroxy-phenyl)-2-methyl-propionic acid) with 25 mL) of ethanol with (1 mmol of 0.0040 g) of sodium hydroxide to the solution and was added (1 mmol, 0.1522 g) of *o*-vanillin (2-hydroxy-3-methoxy-benzaldehyde) dissolved of (25 mL) ethanol. The mixture was refluxed with stirring for (7 h). The resulting solution was evaporated to half volume and the precipitated produced was collected by filtration, washed twice with distilled water, and dried over anhydrous calcium chloride. The deep orange solid mass formed. Yield: 70%. %Calculated: C: 62.599%, H: 5.545%, N: 4.056%. Found: C: 61.511%, H: 4.056%, N: 3.609%. The condensation of methyldopa and *o*-vanillin in ethanol gives according to the following reaction in Scheme 1.

Preparation of the metal complexes

A general method has been used for prepare of all chelate complexes except the Hg^{2+} complex. A solution (0.3454 g, 1 mmol) of Schiff base ligand dissolved in (20 mL) of ethanol with (0.0040 g, 1 mmol) of sodium



Scheme 1. Synthesis of Schiff base ligand (L)

hydroxide was added with stirring a stoichiometric amount (1:2) (ligand:metal) ratio for $CrCl_3{\cdot}6H_2O$ (0.4529 g, 2 mmol), $MnCl_2{\cdot}4H_2O$ (0.394 g, 2 mmol), $CoCl_2{\cdot}6H_2O$ (0.476 g, 2 mmol), $NiCl_2{\cdot}6H_2O$ (0.476 g, 2 mmol), $CuCl_2{\cdot}2H_2O$ (0.3410 g, 2 mmol), $ZnCl_2$ (0.372 g, 2 mmol) and $CdCl_2{\cdot}H_2O$ (0.402 g, 2 mmol). But the Hg^{2+} complex with a stoichiometric amount (1:1) (ligand:metal) ratio for $HgCl_2$ (0.2715 g, 1 mmol), dissolved with distilled water. Each mixture was refluxed for 3 h for each of the eight complexes. At room temperature on cooling, colored compounds deposited out in every case. They have been filtrated, washed for acetone as well as dried over anhydrous calcium chloride.

Biological activities

The biological activities of Schiff base ligand and its metal complexes have been studied for their antibacterial against four species of bacteria two strain from a gram positive as well two strain of a gram negative and antifungal against *Candida albicans* by diffusion method [21]. The screened compounds were dissolved individually in DMSO in order to make up a solution of 10^{-3} M concentration for each from these complexes. Discs have been placed at the exterior from agar solid nutrients dishes seeded through the examined bacteria and fungi. Diameters of inhibition zones (mm) have been measured on the end from a nursery period that was 24 h at 37 °C with bacteria and fungi.

■ RESULTS AND DISCUSSION

Elemental Analysis and Conductance Measurements

The reaction of the Schiff base ligand with the metal chloride (Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} as well Hg^{2+}) gave colored complexes at good yields. The analytical data along with some physical properties of the ligand and its metal complexes are summarized in Table 1. The Schiff base ligand, on interaction with Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, and Hg^{2+}, yields compounds corresponding to the general formula $[M_2(L)(H_2O)_n]X_2{\cdot}H_2O$. [M = Cr^{3+}, n = 7, X = 2)], [M = (Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}), n = 7, X = 0], [M = Cd^{2+}, n = 3, X = 0] and [M = Hg^{2+}, n = 1, X = 0] Fig. 1. The analytical data show that the metal to ligand ratio of the

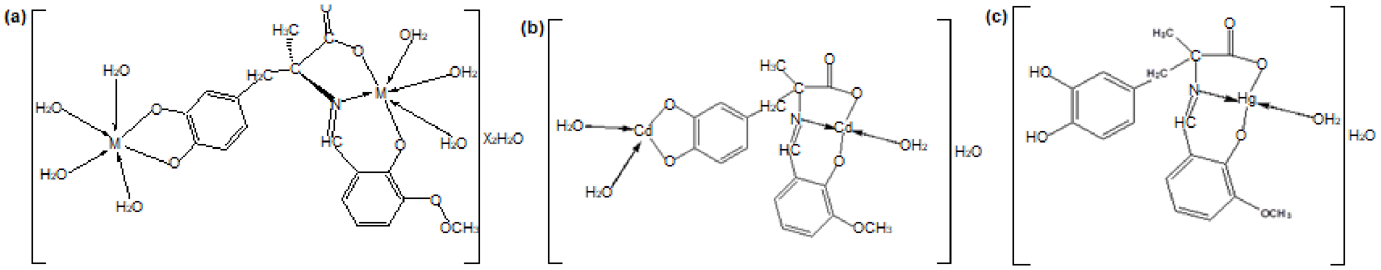


Fig 1. (a) Binuclear octahedral for Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+} complexes, (b) Binuclear tetrahedral for Cd^{2+}complex and (c) Mononuclear tetrahedral for Hg^{2+} complex

Table 1. Analytical and physical data for Schiff base ligand as well as its compounds

Compounds	MWt./g mol^{-1}	Empirical Formula	Color	MP °C	M% Calculate (Found)	Λ_m(ohm^{-1} cm^2 mol^{-1}) in DMSO, 10^{-3} M.
Schiff base ligand (L)	345.37	$C_{18}H_{19}NO_6$	Deep orange	120	-	-
$[Cr_2(L)(H_2O)_7]\cdot Cl_2H_2O$	660.27	$C_{18}H_{31}NO_{14}Cl_2Cr_2$	Deep green	> 350 dec.	15.75 (14.17)	52.30
$[Mn_2(L)(H_2O)_7]\cdot H_2O$ Valine(Val)	595.33	$C_{18}H_{31}NO_{14}Mn_2$	Deep green	> 350 dec.	18.46 (17.67)	25.64
$[Co_2(L)(H_2O)_7]\cdot H_2O$ $[Co(Ala)(Val)(H_2O)_2]H_2$	603.23	$C_{18}H_{31}NO_{14}Co_2$	Deep brown	> 350 dec.	19.54 (18.92)	27.14
$[Ni_2(L)(H_2O)_7]\cdot H_2O$	602.75	$C_{18}H_{31}NO_{14}Ni_2$	Deep brown	> 350 dec.	19.48 (18.19)	28.94
$[Cu_2(L)(H_2O)_7]\cdot H_2O$	612.46	$C_{18}H_{31}NO_{14}Cu_2$	Deep brown	> 350 dec.	20.75 (19.01)	27.14
$[Zn_2(L)(H_2O)_7]\cdot H_2O$	616.13	$C_{18}H_{31}NO_{14}Zn_2$	Pale green	> 350 dec.	21.22 (21.06)	23.44
$[Cd_2(L)(H_2O)_3]\cdot H_2O$	638.19	$C_{18}H_{25}NO_{10}Cd_2$	Pale green	> 350 dec.	35.23 (34.48)	24.04
$[Hg(L)(H_2O)]\cdot H_2O$	579.96	$C_{18}H_{21}NO_8Hg$	Pale brown	> 350 dec.	34.59 (33.73)	25.94

dec. = Decompose

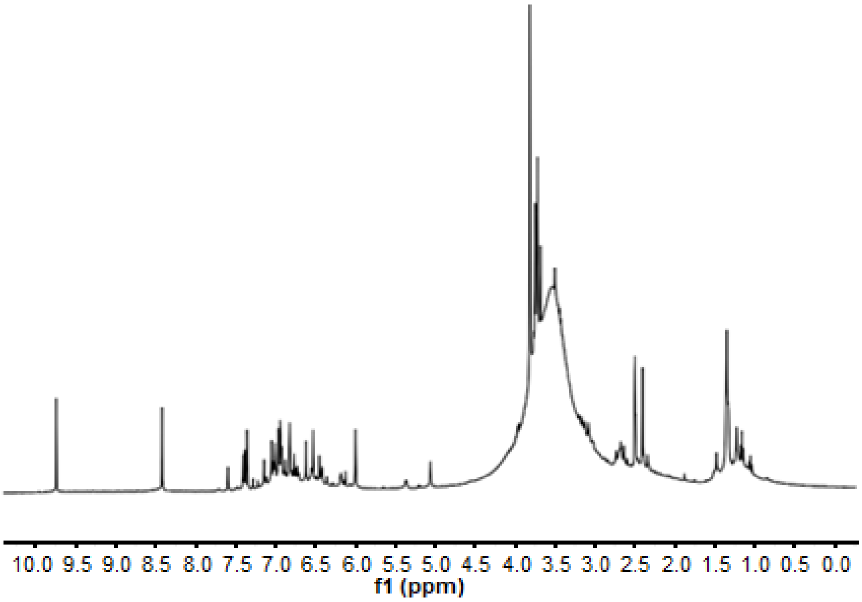


Fig 2. ^{1}H-NMR spectrum for Schiff base ligand

complexes is (2:1) except the Hg^{2+} complex is (1:1). The low molar conductance values of the complexes except the Cr^{3+} complex reveal their non-electrolytic nature [22]. All the complexes are no hygroscopic, stable, solid, stable in water except Cr^{3+} complex and at common organic solvents like acetone, chloroform, and benzene, but soluble at ethanol, methanol, DMSO and DMF.

^{1}H-NMR Spectra of the Schiff Base Ligand

^{1}H-NMR spectra for Schiff base ligand (L) at DMSO-d$_6$ solvent in Fig. 2, appears chemical shift at δ = 9.74 and 8.42 ppm due to –OH proton of the carboxyl and azomethane groups respectively. The spectrum displays various signals in δ = 6.00–7.58 ppm assigned into aromatic protons, the signals at δ = 5.21, 5.25 and 5.45 ppm lead to (–OH) of phenol. Resonance in δ = 2.73, 1.18, and 3.82 ppm due to protons of CH$_2$, CH$_3$ and methoxy groups sequences, the signals at δ = 2.50 ppm and δ = 3.50 indicated into DMSO-d$_6$ and water (H$_2$O) respectively [23-25].

UV-Visible Spectra and Magnetic Susceptibility Measurements

UV-Vis spectra for Schiff base ligand as well as its metal compounds dissolved at DMSO (10^{-3} M) have been obtained and listed in Table 2. The Schiff base ligand

Table 2. Electronic spectral of the Schiff base ligand and its metal complexes

Compounds	(λ nm)	ABS	w.n cm^{-1}	ϵ_{max} (L mol^1 cm^{-1})	Assignments	μ$_{eff}$(B.M.)	Suggested Structure
Ligand	279	1.019	35842	1019	π-π^*	-	-
	342	0.486	29239	486	n-π^*		
[Cr$_2$(L)(H$_2$O)$_7$]·Cl$_2$.H$_2$O	276	2.202	36231	2202	L.F.	3.66	Octahedral
	364	0.947	27472	947	C.T.		
	449	0.634	22271	634	$^4A_2g \rightarrow {}^4T_1g(p)$		
	552	0.036	18115	36	$^4A_2g \rightarrow {}^4T_1g(F)$		
	670	0.028	14925	28	$^4A_2g \rightarrow {}^4T_2g(F)$		
[Mn$_2$(L)(H$_2$O)$_7$]·H$_2$O	277	1.509	36101	1509	L.F.	6.05	Octahedral
	347	0.777	28818	777	C.T.		
	380	0.566	26315	566	C.T.		
	520	0.203	19230	203	$^6A_1g \rightarrow {}^4A_1g, {}^4Eg(G)$		
	809	0.027	12360	27	$^6A_1g \rightarrow {}^4T_2g(G)$		
					$^6A_1g \rightarrow {}^4T_1g(G)$		
[Co$_2$(L)(H$_2$O)$_7$]·H$_2$O	276	2.347	36231	2347	L-F	5.25	Octahedral
	347	1.315	28818	1315	C.T.		
	374	0.855	26737	855	C.T.		
	502	0.207	19920	207	$^4T_1g(F) \rightarrow {}^4T_1g(P)$		
	730	0.074	13698	74	$^4T_1g(F) \rightarrow {}^4A_2g$		
	988	0.052	101121	52	$^4T_1g(F) \rightarrow {}^4T_2g(F)$		
[Ni$_2$(L)(H$_2$O)$_7$]·H$_2$O	275	1.761	36363	1761	L-F.	2.89	Octahedral
	375	0.546	26666	546	C.T.		
	575	0.112	17482	112	$^3A_2g \rightarrow {}^3T_1g(P)$		
	750	0.063	13333	63	$^3A_2g \rightarrow {}^3T_1g(F)$		
	870	0.033	11494	33	$^3A_2g \rightarrow {}^3T_2g(F)$		
[Cu$_2$(L)(H$_2$O)$_7$]·H$_2$O	279	1.770	34842	1770	L-F.	1.73	Octahedral
	370	0.553	27027	553	C.T.		
	827	0.025	12091	25	$^2Eg \rightarrow {}^2T_2g$		
[Zn$_2$(L)(H$_2$O)$_7$]·H$_2$O	277	1.430	36101	1430	L.F.	Dia	Octahedral
	372	0.355	26881	355	C.T.		
[Cd$_2$(L)(H$_2$O)$_3$]·H$_2$O	277	1.430	36101	1430	L-F.	Dia	Tetrahedral
	372	0.355	26881	355	C.T.		
[Hg(L)(H$_2$O)]·H$_2$O	271	1.635	36900	1635	L-F.	Dia	Tetrahedral
	380	0.488	26315	488	C.T.		

the spectrum shows peaks at 279 and 342 nm lead to (π–π*) and (n–π*) electronic transition [26]. The spectrum of Cr^{3+} complex display two peaks at 276 and 364 nm described to ligand felid and charge transfer respectively, other three peaks at 449, 552 and 670 nm which were assigned to electronic transition type $^4A_2g \rightarrow {}^4T_1g(p)$, $^4A_2g \rightarrow {}^4T_1g(F)$ and $^4A_2g \rightarrow {}^4T_2g(F)$ respectively, also the value of the magnetic moment at 3.66 B.M may be taken as additional evidence for octahedral geometry [27]. The spectrum of Mn^{2+} complex displays three peaks at 277, 347 and 380 nm due to the ligand field and charge transfer. Peaks at 520 and 809 nm assigned to electronic transition type $^6A_1g \rightarrow {}^4A_1g$, $^4Eg(G)$, $^6A_1g \rightarrow {}^4T_2g(G)$ and $^6A_1g \rightarrow {}^4T_1g(G)$ respectively, the magnetic moment of this complex was found at 6.05 B.M which was so close for the octahedral environment [28-29]. The spectrum of Co^{2+} complex appears three peaks at 276, 347 and 374 nm which were described to ligand field and charge transfer, peaks at 502, 730 and 988 nm due to electronic transition type $^4T_1g(F) \rightarrow {}^4T_1g(P)$, $^4T_1g(F) \rightarrow {}^4A_2g$ and $^4T_1g(F) \rightarrow {}^4T_2g(F)$ respectively, also the value of the magnetic moment at 5.25 B.M may be taken as additional evidence for octahedral geometry [30]. The Ni^{2+} complex exhibited two absorption peaks at 275 and 375 nm due to the ligand field and charge transfer. The other three peaks at 572, 750 and 870 nm have been appointed in to electronic transition type $^3A_2g \rightarrow {}^3T_1g(P)$, $^3A_2g \rightarrow {}^3T_1g(F)$ and $^3A_2g \rightarrow {}^3T_2g(F)$ respectively. The magnetic moment for this compound was found in 2.89 B.M which was very close for octahedral geometry [31]. The Cu^{2+} complex appears two peaks at 279 and 370 nm due to the ligand field as well charge transfer, whilst the third peak at 827 nm described to electronic transition type $^2Eg \rightarrow {}^2T_2g$, the magnetic moment for this compound was found at 1.73 B.M which was octahedral geometry [32]. Electronic spectra for Zn^{2+}, Cd^{2+} and Hg^{2+} compounds do display the charge transfer, as well the magnetic susceptibility offers that three compounds have diamagnetic moments because the d-d transition is not possible subsequently electronic spectra did not give any productive information, at Zn^{2+} complex this result agrees with the previous work of octahedral geometry but the Cd^{2+} as well Hg^{2+} complexes for geometry are tetrahedral [33-34].

Infrared Spectra and Mode of Bonding

FT-IR spectra of Schiff base (L) and the prepared its metal complexes have been compared, and the data was recorded in Table 3 and Fig. 3, 4 for the ligand and its metal complexes, respectively. The FT-IR spectrum of Schiff base exhibited broad bands at (3230–3350) cm^{-1}, which have been appointed to the stretching vibration of

Fig 3. IR spectrum of ligand

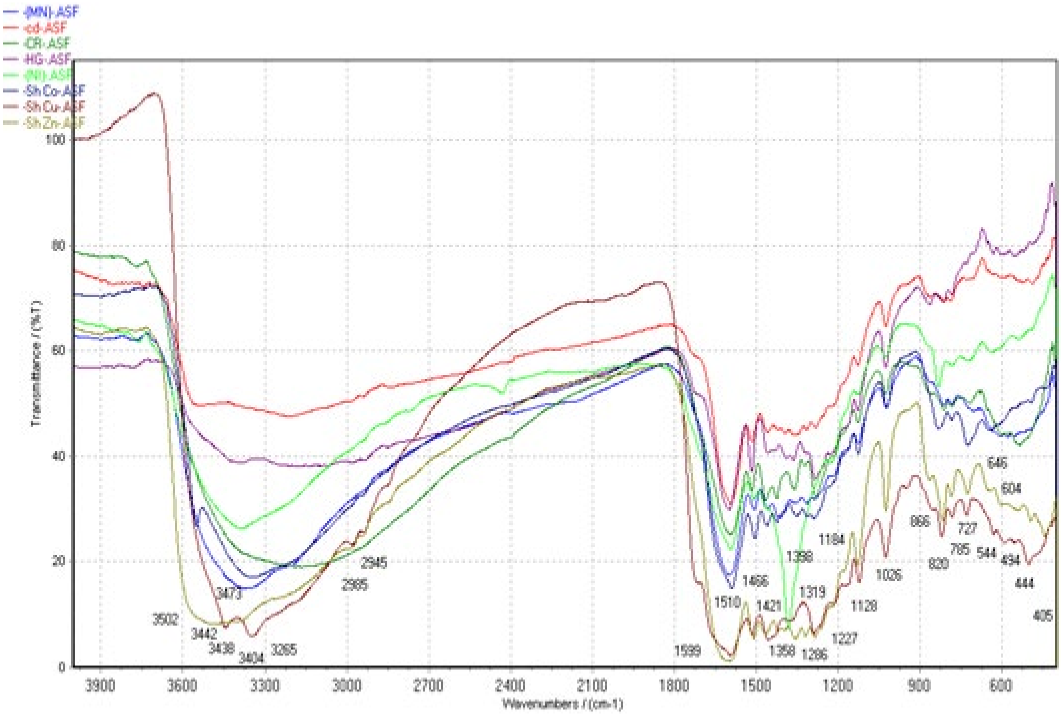


Fig 4. IR spectrum of all metal complexes

Table 3: Selected FT.IR Data (4000–400) cm^{-1} for Schiff base ligand as well its metal compounds

Compounds	υ (H_2O)hydrate and Coord.	υ (OH), υ(C=N)	$\upsilon_{asy,sy}(COO^-)$	δ(H_2O)	υ(M-N)	υ(M-O)
Schiff base (L)	-	3230-3350 br., 1674 s.	1520 sh., 1387 m.	-	-	-
$[Cr_2(L)(H_2O)_7]\cdot Cl_2H_2O$	3410 br., 3330 br.	-, 1596 s.	1518 sh., 1361 sh.	719 w.	602 w.	534 w.
$[Mn_2(L)(H_2O)_7]\cdot H_2O$	3352 br., 3372 br.	-, 1601 s.	1508 sh., 1358 m.	816 w.	609 w.	496 w.
$[Co_2(L)(H_2O)_7]\cdot H_2O$	3550 br., 3334 br.	-, 1589 s.	1504 sh., 1354 m.	727 w.	494 w.	436 w.
$[Ni_2(L)(H_2O)_7]\cdot H_2O$	3386 br., 3356 br.	-, 1593 s.	1510 sho, 1381 sh.	723 w.	544 w.	490 w.
$[Cu_2(L)(H_2O)_7]\cdot H_2O$	3442 br., 3346 br.	-, 1593 s.	1516 s., 1381 m.	731 w.	503 w.	465 w.
$[Zn_2(L)(H_2O)_7]\cdot H_2O$	3504 br., 3400 br.	-,1597 s.	1508 sh., 1358 m.	727 w.	523 w.	496 w.
$[Cd_2(L)(H_2O)_3]\cdot H_2O$	3545 br., 3360 br.	-, 1595 sh.	1516 sh., 1358 m.	708 w.	521 w.	485 w.
$[Hg(L)(H_2O)]\cdot H_2O$	3384 br., 3350 br.	3266 br., 1601 sh.	1518 sh., 1385 m.	733 w.	552 w.	486 w.

br.=broad, sh.-sharp, s.-strong, sho.=shoulder, w.=weak

υ(OH) carboxylic and phenol groups, these bands disappear in the all spectra of complexes described to coordinated these groups in coordination [35], except the Hg^{2+} complex the coordinated through the (OH) for carboxyl and phenol of *o*-vanillin. Band in (1674) cm^{-1} whom has been assigned into ν(C=N) group of Schiff base ligand, suffered a great change to lower frequency was observed on complexation with a metal ion, lead to coordinated of this group at coordination [36].

The bands at 1520 and 1387 cm^{-1} have been appointed into stretching vibration for Schiff base ligand of ν(COO$^-$) asymmetric as well symmetric respectively, these bands were shifted into lower frequencies, may result to coordination with metal ions [37]. The presence of water hydrate at the scope (3352–3550) cm^{-1} and coordinated in the spectra of all complexes were suggested by the very broad absorption bands around (3330–3400) cm^{-1} and show peaks at (708–816) cm^{-1} due to stretching, rocking and wagging modes of coordination water molecules [38]. Some new bands' weak intensity observed in the regions around (436–609) cm^{-1} may be ascribed to ν(M-N) and ν(M-O) vibration respectively [39]. According to the result data the geometry has been suggested at.

Mass Spectra for Schiff Base Ligand as Well Its Metal Compounds

The mass spectra fragmentation patterns for free Schiff base (L) were in good agreement with the suggested structure in Fig. 5. The mass spectrum was characterized by an intense peak at (m/z = 345.37), which corresponding [M$^+$]. The mass spectra of Fig. 6 is for Co complex each

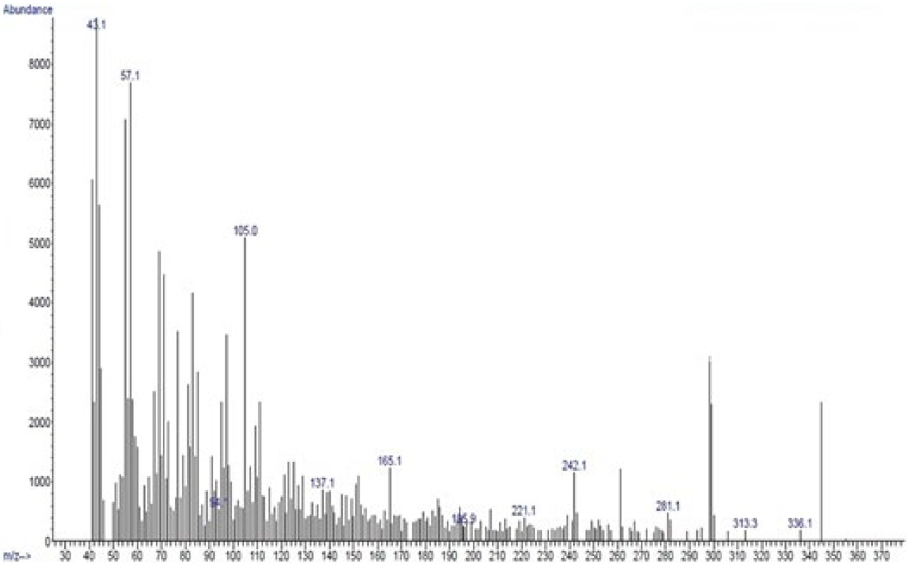


Fig 5. Mass spectral of the Schiff base

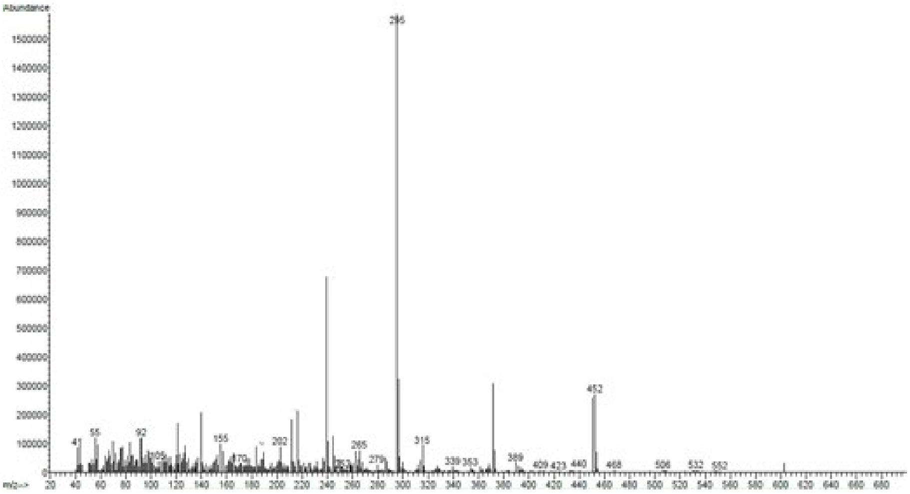


Fig 6. Mass spectral of the Co complex

spectrum of Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} and Hg^{2+} complexes, respectively. Displayed peaks referred in the molecular ions m/z at 660.27, 595.33, 603.23, 602.73, 612.46, 620.13, 638.19 and 579.96 M^+ into Cr^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+} and Hg^{2+} complexes, consecutively. That datum is at a good convention for the suggestion of molecular formulation into the complexes.

Antimicrobial Bioassay

Antibacterial and Antifungal activity of Schiff base ligand and its metal complexes were tested in vitro against bacteria such as *Steptococcus epidermidis*, *Staphylococcus aureus*, *Klebsiella sp*. and *Escherichia coli* and fungal *Candida albicans* (yeast) through paper disc plate method [40]. The compounds have been examined at condensation 10^{-3} in DMSO Shown in Table 4, Fig. 7 and Fig. 8. From Table 4, it is clear which the inhibition through metal chelates is higher than that with Cd^{2+} complex to the against bacteria *Steptococcus epidermidis*), *Staphylococcus aureus*, *Klebsiella sp.*, and *Escherichia.* Coli compared to Schiff base and other complexes and with Hg^{2+} complex to the versus fungal *Candida albicans* (yeast).

■ CONCLUSION

On the start of results got after portrayal and antibacterial, antifungal examinations clearly all the blended Schiff base metal complexes showed octahedral

Table 4. Antibacterial and antifungal activities for Schiff base ligand as well its metal compounds in the form of inhibition zone diameter (mm)

Compounds	*Steptococcus epidermidis* (G+ev)	*Staphylococcus aureus* (G+ev)	*Klebsiella sp.* (G-ev)	*Escherichia. ColiB*(G-ev)	*Candida albicans* (Yeast)
L	12	10	10	12	11
Cr-complex	-	11	-	12	-
Mn-complex	-	15	9	9	-
Co-complex	-	15	-	13	-
Ni-complex	-	-	-	11	-
Cu-complex	-	-	-	-	18
Zn-complex	12	25	14	13	22
Cd-complex	20	33	19	19	25
Hg-complex	22	30	15	21	29

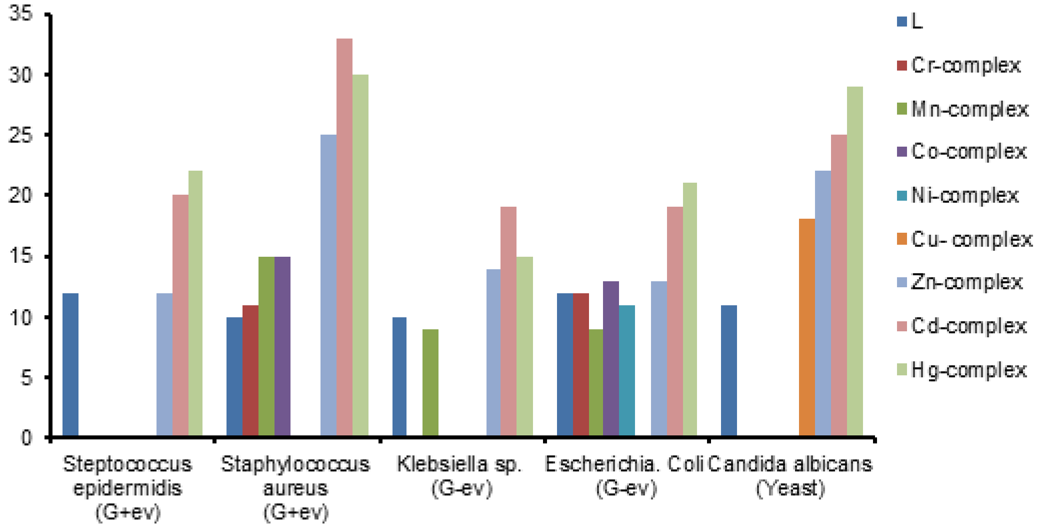


Fig 7. Results of antibacterial and antifungal screening for the Schiff base ligand and its metal compounds

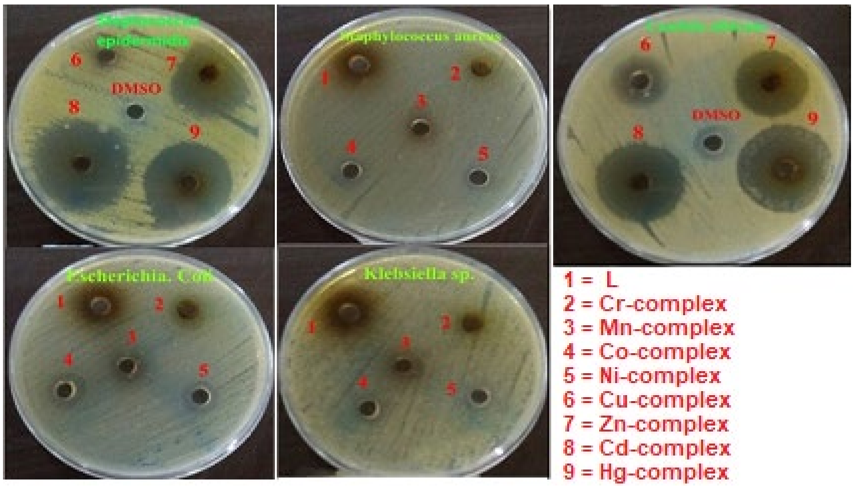


Fig 8. Antibacterial activity of investigated compounds against *Steptococcus epidermidis*, *Staphylococcus aureus*, *Klebsiella sp.* and *Escherichia coli* and antifungal activity evaluation against *Candida albicans (Yeast)* for Schiff base and its metal compounds

geometry and upgraded antibacterial, antifungal properties against chose microorganisms. These perceptions, as per diverse examinations, suggest that metal based drugs have potential as therapeutics. These preliminary outcomes, got from in vitro tries, might be enhanced by other more comprehensive studies in vivo, both in controlled conditions and in an open field for all intents and purposes assess the utilization of these complexes on the edge of biological applications.

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