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New Metal Complexes Derived from Azo Linked Schiff-Base ligand: Synthesis, Spectral Investigation and Biological Evaluation

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ABSTRACT

A new azo-Schiff base ligand derived from a p-anisidine molecule, as well as its monomeric metal complexes, were synthesized and studied. The titled ligand, (1-((E)-((4-methoxy phenyl) imino) methyl)-3-((E)-(4-nitrophenyl)diazenyl) naphthalen-2-ol) (HL), was synthesized by a 1:1 mole ratio reaction of p-anisidine and ((E)-2-hydroxy-3-((4-nitrophenyl)diazenyl). In a mole ratio of 1:1 (L:M), the interaction of HL with chosen metal ions, including Cr(III), Mn(II), Co(II), Ni(II), and Cu(II), resulted in the creation of monomeric coordination compounds. The synthesized compounds were analyzed using a variety of analytical and spectroscopic techniques. Elemental microanalysis, 1H and 13C NMR, FT-IR, electronic and mass spectra, magnetic susceptibility, and conductance are among the techniques used. The synthesis of six and four-coordinate coordination molecules was confirmed by characterization data. Thermal stability (TGA) of HL and Co-complex is investigated. The antibacterial activity of the synthesized compounds was investigated against a variety of microorganisms (bacteria and fungus species). According to the data gathered, the ligand's antibacterial effectiveness improved after forming a complex..

INTRODUCTION

The azo compounds or dyes are characterized by the presence of the azo moiety (–N=N–) in their structure, conjugated with two, distinct or identical, mono- or polycyclic aromatic or hetero-aromatic systems[1]. The introduction of different functional groups to the backbone of a compound can significantly impact its electronic and structural flexibility, which can influence its range of potential applications [2]. Therefore, the design and synthesis of these compounds have become crucial areas of research for developing new materials with diverse applications [3]. An example of these species is the formation of Schiff bases that incorporate the azo moiety within their structure [4]. The introduction of the azo group may improve the properties of the compound for both biological and industrial applications [5].

The ability of Schiff bases to interact and form stable complexes with a wide range of metal ions makes them a crucial ligand in coordination chemistry [6,7]. Furthermore, the applications of Schiff bases are diverse and include their role in fields such as inorganic and analytical chemistry [8,9], as well as medicinal and pharmacological areas [10] and biological [11] Schiff bases with azo moieties have a wide range of applications beyond their use in biological systems. They can also be utilised as pigments or dyes [12-14], catalysts [15], intermediate agents, corrosion inhibitors [16], and polymer stabilizers [17]. Schiff bases have been utilized as a membrane in the ion-selective electrode approach for sensing ions [18]. The title azo-Schiff base ligand was created in two steps: first, the azo species (E)-2-hydroxy-3-((4-nitrophenyl)diazenyl),-1 naphthaldehyde, (L), was formed, followed by a reaction with p-anisidine to produce the title ligand (HL). The ligand was subsequently reacted in a mole ratio of 1:1 (L:M) with Cr(III), Mn(II), Co(II), Ni(II), and

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Cu(II)ions, resulting in the formation of monomeric paramagnetic complexes.The antibacterial and antifungal properties of the synthesised compounds were examined. This was aimed to explore the biological activity of compounds and to observe the impact of the metal ion and the coordination sphere of the compound on the biological activity of the ligand upon complexation.

Experimental

Materials and Methods: The NMR spectra (^{1}H and ^{13}C-NMR) for the ligand were recorded in dimethyl sulfoxide using a Brucker 400 MHZ instrument (400 MHz for ^{1}H and 100 MHz for ^{13}C). FT-IR spectra were recorded as potassium bromide discs in the range 4000-400cm-1 using FTIR-600 Fourier Transform Infrared Spectroscopy. Electrospray (+) mass spectroscopy was performed on a SciexEsi mass analysis. An electrothermal Stuart apparatus, model SMP40, was used to determine melting points. The electronic spectra were acquired in the region 1000-200nm using a quartz cell of (1.0) cm length with a concentration of 10^{-3}mol L^{-1} of samples in DMSO at 25 °C using an electronic spectra spectrophotometer type Shimadzu UV-160. A Eutech Instruments Cyber scan with 510 digital conductivity meter was used to assess the complexes' molar conductivity at 25 °C for 10-3–10-5 M solutions of the compounds in DMSOA Heraeus instrument (Vario EL) and a Shimadzu (A A-7000) atomic absorption spectrophotometer were used to determine the metal percentage and elemental analysis (C, H, and N), respectively.The amount of chloride in the complexes was measured using a potentiometric titration method on the 686–Titro Processor-665 Dosim A-Metrohm / Switzerland. Thermal gravimetric analysis (TGA) of the substances was performed using a STA PT-1000 Linseis Company / Germany analyzer. Magnetic moments at 303 K were quantified using a magnetic moments balance on Johnson Matthey.

Synthesis

The formation of the azo Schiff ligand was achieved in two steps and as follows;

Preparation of (L)

The following documented procedure [19,20] was used to prepare (L): 20 ml of an ethanol-water (10-10) solution were added to a 250 ml round-bottomed flask that had previously been charged with sodium nitrite (0.69 g, 10 mm) and 1-amino-4-nitrobenzene (1.38 g, 10.01 mm). The mixture was cooled to 0-5°C in an icy bath and then a solution of 3ml of hydrochloric acid (36%) with 10ml of water was added dropwise with stirring over a period of 1h.The obtained diazonium salt solution was then coupled with the cooled mixture of NaOH (0.4g, 10mm) and 2-hydroxy-1-naphthaldehyde (1.72g, 10.01mm). The reaction mixture was allowed to stir for 2h. The resulting precipitate was filtered at pH 4 and then washed thoroughly with cold water and left to dry at pH 6-7. The precipitate that was orange-red was filtered out then rinsed with 5ml of cold ethanol before air-drying, Yield: 2.09g (65%), m.p.254-256°C.

Preparation of the ligand: The preparation of HL was accomplished using a general procedure reported in [10] as well as the following: *p*-anisidine(0.119g, 0.933mmol) in 10ml ethanol with three drops glacial acetic acid was added with stirring to a mixture of (L) (0.3g,0.933mmol) in 20ml of a mixture of ethanol–benzene (1:1). The reaction mixture was heated to 70-80 °C for 6h. After filtering the solution while it was still hot, RT was allowed to allow it to slowly evaporate. After being crushed out of the solution, the orange powder was gathered, dried in the air, and then recrystallized from ethanol. 0.353g (88.60%), m.p. = 120–122ºC, yield.

Preparation of complexes: An analogous procedure to that reported for the Cr(III)-complex was adopted to prepare complexes as follows; To a mixture of HL (0.2g, 0.469mmol) in 10ml of EtOH was added an ethanolic solution of KOH (0.03g, 0.469mmol)in 10ml EtOH. The mixture was stirred and a solution of $CrCl_3.6H_2O$ (0.12g, 0.469mmol) dissolved in ethanol (5ml) was added dropwise. The stirred reaction mixture was heated at reflux for 3h and the solid that formed was filtered off, washed with cold ethanol and dried in air. Yield: 0.15g (56.47%), m.p.>300dec. Scheme (1). Table 1 lists the complexes' yields, colors, amounts of metal salts, and melting points.

Microbiological Evaluation: The Kirby-Bauer technique was used to test bacteria and fungal sensitivity to the produced compounds. The organisms were

combined with a (85 percent Sodium Chloride) solution until a suspension was formed (1/2 M.C.f). This suspension was applied to the surface using a Petri plate filled with Mueller Hinton agar. All of the holes were made at the same distance and with the same degree of concentration. The preferred concentration (100 L) of the test sample (1 mg/mL) in dimethylsulfoxide was used in the wells. The zone of inhibition was measured and compared to the standard values after 24 hours of incubation at 37 °C. Separate research on the effect of dimethylsulfoxide solutions on microbiological testing revealed that they had no effect

Table 1: Yields, colours, metal salts quantities and melting points of compounds.

Complexes	Weight of metal salt(g)	Weight of complex(g)	Colour	m.p. °C	Yield (%)
[Cr(L) $Cl_2.H_2O$]	0.12	0.15	Brown	>300*	56.47
[Mn(L)Cl $(H_2O)_2$]	0.09	0.17	Reddish-brown	285-287	65.68
[Co(L)Cl].H_2O	0.11	0.21	Yellow	296-298	80.98
[Ni(L)Cl($H_2O)_2$]	0.11	0.16	Dark Green	>300*	61.40
[Cu(L)Cl $(H_2O)_2$]	0.08	0.18	Yellowish -brown	250-252	68.47

*= Decomposed.

RESULTS AND DISCUSSION

Making the azo Schiff base ligand (1-(((4-methoxyphenyl)imino)methyl)-3-((E)-(4-nitrophenyl) diazenyl) naphthalen-2-ol) (HL) was accomplished from the reaction of (L) with (*p*-anisidine) in a mole ratio of 1:1 in EtOH medium (Fig. 1). The potentially monobasic multidentate azo Schiff ligand was reacted with Cr(III) , Mn(II) , Co(II), Ni(II) and Cu(II)metal chlorides in a 1:1 (L:M) mole ratio yielding six and four-coordinate monomeric paramagnetic coordination compounds of the general formula [Cr(L)Cl_2.H_2O], [M(L)Cl.$(H_2O)_2$] where M= where M= Mn(II) , Ni(II) , Cu(II)and [Co(L)Cl].H_2O Scheme 1. The isolated monomeric compounds are solids that are stable in the air, that dissolving in dimethylsulfoxide and dimethylformamide. The obtained microanalysis data including the metal and chloride contents of compounds are in good agreement with the calculated values, Table 2. The molar conductance of the complexes in DMSO solutions indicated that the complexes are nonelectrolytes.

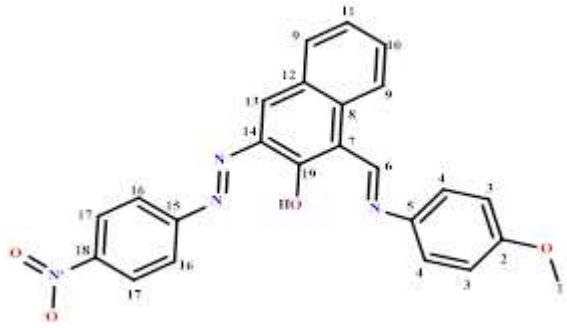
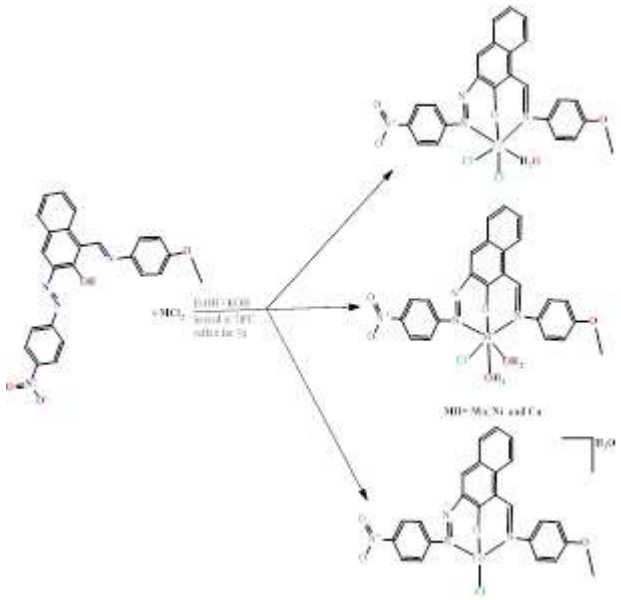


Figure1: Chemical structure of HL.

Table 2: Physical Properties and Microanalysis of the HL and its complexes clusters

Complex	Molecular formula	M.Wt	Micro analysis found, (calculated)%				
			C	H	N	M	Cl
[Cr(L)Cl_2. H_2O]	$C_{24}H_{19}Cl_2CrN_4O_5$	566.34	(50.90) 50.35	(3.38) 3.14	(9.89) 9.22	(9.18) 9.02	(12.52) 12.00
[Mn(L)Cl.($H_2O)_2$]	$C_{24}H_{21}ClMnN_4O_6$	551.84	(52.24) 52.02	(3.84) 3.21	(10.15) 10.00	(9.96) 9.41	(6.42) 6.13
[Co(L)Cl].H_2O	$C_{24}H_{19}ClCoN_4O_5$	552.86	(54.31) 54.11	(4.01) 3.95	(10.13) 10.00	(10.66) 10.41	(6.41) 6.19
[Ni(L)Cl(H $_2O)_2$]	$C_{24}H_{21}ClNiN_4O_6$	555.60	(51.88) 51.15	(3.81) 3.39	(10.08) 9.91	(10.56) 10.27	(6.38) 6.18

$[Cu(L)Cl(H_2O)_2]$	**$C_{24}H_{21}ClCuN_4O_6$**	**560.45**	**(51.43) 51.14**	**(3.78) 3.54**	**(10.00) 9. 86**	**(11.34) 11.12**	**(6.33) 6.00**



Scheme 1: **General synthesis route of HL complexes.**

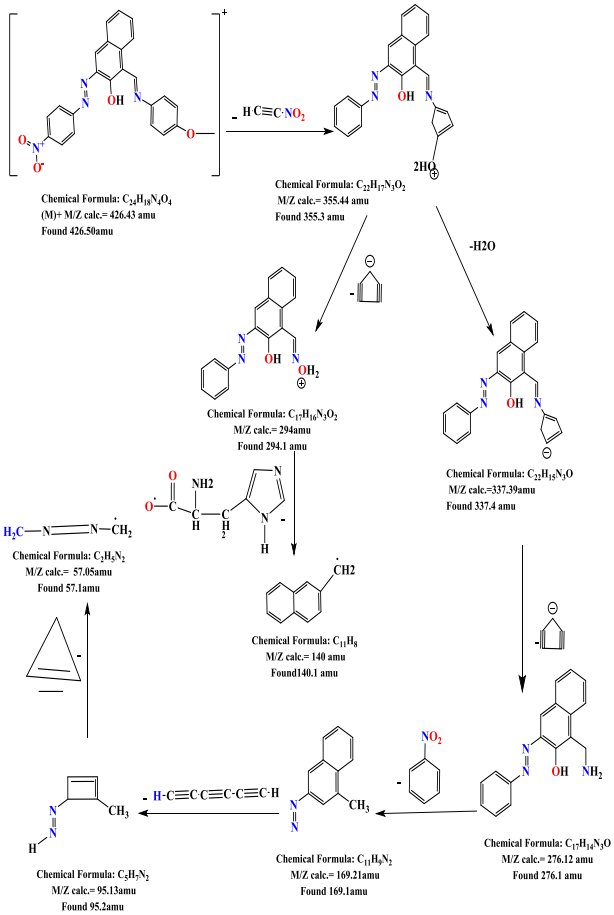
FT-IR and NMRdata:

The main infrared bands of complexes along with their assignments are listed in Table 3.There was a peak in the HL spectrum at 3421cm^{-1} due to the ν(OH) of the phenolic group [22]. The band observed at 1635cm^{-1} are due to ν(C=N)of the imine group. The spectra of Cr(III) , Mn(II) , Co(II), Ni(II) and Cu(II)revealed a distinctive range at 1623-1618cm^{-1} that correlated to ν(C=N)imine. The appearance of this band upon complexation account for the coordination of the metal ion with the nitrogen atom of the azomethine group ν(C=N)imine[23]. The band in HL that was associated to the ν(N=N) azo group and was detected at 1462 cm-1 was displaced to emerge at 1454, 1458, 1456, 1485, and 1454 cm-1 in Cr(III), Mn(II), Co(II), Ni(II), and Cu(II), respectively. This may be connected to how the complexation involved the nitrogen atom.Furthermore, Additional bands between (600-400)cm^{-1} that were not visible in the HL spectrum were seen in the metal complexes' spectra. Bands associated with ν(M-O) were discovered between and(586-540)cm^{-1} [25].The FT-IR spectradetected peaks correlated to *ν*(Cr-N), *ν*(Mn-N), *ν*(Co-N),*ν*(Ni-N) and *ν*(Cu-N)in the range(468-416)cm^{1} [26]. The bands identified in the FT-IR spectra are associated with ν(Cr-Cl), ν(Mn-Cl), ν(Co-Cl), ν(N-iCl), and ν(Cu-Cl) and are located at 223;291, 264, 241, 298, and 217cm-1, respectively [27]. Finally, peaks were detected at 3450, 3398, 3431, 3512 and 3438cm^{-1} in the of $Cr^{(III)}$, $Mn^{(II)}$, $Co^{(II)}$, $Ni^{(II)}$ and $Cu^{(II)}$, respectively. were correlated to aqua water molecules. In complexes Cr(III) , Mn(II) , Co(II), Ni(II) and Cu(II), bands that were detected at 750, 750, 748and 752cm^{-1} is related to ν(Cr-O), ν(Mn-O) ν(Ni-O) and ν(Cu-O) coordinated water [27]. The ^{1}H NMR spectra of HL^{1} is illustrated in Fig (2).The spectrum indicated two sets of signals in the aliphatic and aromatic regions. The aromatic region showed several chemical shifts between 8.970-7.602ppm. The chemical shift at 8.970-8.949ppm that equivalent to three proton and appear as single is related to (C_{13})-H (3H, t, *J* = 8.4Hz). The chemical shift at 8.528-8.507ppm that equivalent to tow proton and appear as single is related to ($C_{17,17'}$)-H (2H,d, *J* = 8.4Hz). The chemical shift at 8.131-8.108ppm that equivalent to three proton and appears as a doublet is related to ($C_{9,9'}$)-H (3H, t, *J* = 9.2Hz). The chemical shift at 7.992-7.924ppm that equivalent to tow proton and appears as a doublet is related to ($C_{16,16'}$)-H (2H,d). The chemical shift at 7.886-7.824ppm that equivalent to two proton and appears as a doublet is related to ($C_{4,4'}$)-H (2H, d,*J* =7.6Hz).The three sets the triplet peak at 7.695-7.602ppm that is equal to three proton and is credited to (C_{10})–H (3H, t), the three sets the triplet peak at 7.385-7.311ppm that is equal to three proton and is credited to (C_{11})–H (3H, t) and the chemical shift at 7.085-7.026ppm that equivalent to tow proton and appear as single is related to (C_3)-H (2H,d).A signal at 10.809-10.360ppm that belongs to OH and equivalent to one proton (1H, OH, s). A signal at 9.653ppm that belongs to (C_6)-H proton of CH=N and equivalent to one proton (1H,CH=N, s).The singlet peak at 1.071-1.038ppmthat is equal tothree protons are allocated to the CH_3 group (C_1)-H (3H, s,O–(Me)). The DMSO-d_6 solution produced peaks in the spectrum, as well as traces of water molecules at 2.508and 3.381-3433ppm, consecutively. The ^{13}C-NMR spectrum of HL^{1} is illustrated inFig(3).The resonances at δ = 168.39, 164.58, 159.21-159.10, 155.70, 138.74, 137.65and 136.32ppm were assigned to (C_2), (C_{16}), (C_6), (C_{19}), (C_{20}),(C_5) and (C_{15}), respectively. Signals related to (C_8), (C_{14}),(C_{13}), (C_{12}), (C_{10}), ($C_{18,18'}$), (C_{11}) and ($C_{4,4'}$)

were detected at 133.46,132.10,129.74-129.26,128.75-128.00,127.34,126.05, 124.98-124.15 and 122.84-122.77ppm, respectively. The chemical shifts that appeared at 121.38-121.23,117.63,108.63,56.49-55.90and19.03ppm are assigned to ($C_{17,17}$), (C_9), ($C_{3,3}$), (C_7) and (C_1),respectively. The spectrum revealed peak at 39.31-40.56ppm which is associated with the solvent (DMSO-d_6).

Mass spectrum:

The electrospray (+) mass spectrum of HL, Fig4, displays the parent ion peak at M/Z=426.50amu. This peak is related to $(M)^+$. The assignment of the fragmentation ions and their relative abundance is shown in Scheme (2).



Scheme 1: The relative quantity and fragmentation distribution of HL pieces

Electronic spectra (UV-Vis) and magnetic susceptibility:

Data on the magnetic moments and electronic spectra are compiled in Table 4. The compounds' electronic spectra showed a number of peaks near 271-264nm, which can be attributed to $\pi\rightarrow\pi^*$ and $n\rightarrow\pi^*$, respectively. The additional peaks observed near 491-455 nm were assigned as charge transfer (C.T) [28,29]. The electronic spectrum of the Cr(III)-complex exhibits bands at 681and 987nm due to $^4A_2g\rightarrow{}^4T_2g$ and $^4A_2g\rightarrow{}^4T_1g_{(F)}$, revealing a distorted octahedral structure. This assignment is consistent with the Cr-complex magnetic moment value of 3.75. A deformed octahedral structure around the Mn center is confirmed by a band in the d-d region at 891nm associated to 6A1g→4Eg(D) in the electronic spectra of [Mn(L)Cl(H2O)2]. The 5.75 Mn(II)-complex magnetic moment value is consistent with this assignment. The d-d area at 755 nm in the [Co(L)Cl].H2O disclosed band is caused by 4T1(F)→4A2(F), which indicates a four-coordinated complex with a tetrahedral shape surrounding the Co(II) center. The magnetic moment value μ_{eff} = 4.28BM for the complex is consistent with the tetrahedral configuration around the Co atom[29,30]. An octahedral structure surrounding the metal center was revealed by a peak in the Ni(II)-complex at 890 nm, which was ascribed to 3A2g→3T1g(F). The octahedralshape agrees with the magnetic moment value μ_{eff} =3.73 BM of the Ni(II)-complex. The [Cu(L)Cl(H_2O)$_2$]spectrum revealed a peak at 741nm, which was attributed to $^2T_2g\rightarrow{}^2B_2g$, indicating a distorted octahedral arrangement about the metal centre [29,30]. The copper complex's μeff = 1.82 BM magnetic moment value is consistent with the distorted octahedral shape.

Table 3: The FT-IR spectral data of compounds (cm^{-1}

Compounds	ν(C=N)	ν (C=C)	N N=N	sν N-O asν N-O	ν C-O ν C-N	ν (M-O)	ν (M-OH)	ν M-N	ν M-Cl
HL	1635	1604, 1573,	1462	1512, 1354	1300 1257	-	-	-	
[Cr(L) Cl_2H_2O]	1623	1604, 1552	1454	1512, 1357	1334, 1255	540	3450 750	468	291, 223

[Mn(L) Cl(H_2O)$_2$]	1622	1581, 1548	1458	1506, 1394	1334, 1228	586	3398 750	416	264
[Co(L) Cl]. H_2O	1618	1591, 1541	1456	1506, 1367	1344, 1249	580	3431	451	241
[Ni(L) Cl(H_2O)$_2$]	1623	1600, 1548	1485	1512, 1357	1328, 1255	540	3512 748	460	298
[Cu(L) Cl(H_2O)$_2$]	1622	1593, 1556	1454	1510, 1398	1336, 1228	557	3438 752	468	217

Table 4 shows the electronic spectra of HL complexes in DMSO solutions.

Complex	Λ(nm)	Molar extinction coefficient ε_{max} (dm^3 mol^{-1} cm^{-1})	Assignment	μ_{eff}	Suggested geometry
[Cr(L)Cl$_2$H$_2$O]1	267 316 489 681 987	556 476 483 42 52	Ligand field Ligand field Charge transfer $^4A_2g \rightarrow {}^2T_1g$ $^4A_2g \rightarrow {}^2T_2g^{(F)}$	3.75	Distorted octahedral
[Mn(L)Cl (H_2O)$_2$]1	267 324 479 891	986 739 1237 23	Ligand field Ligand field Charge transfer $^6A_{1g} \rightarrow {}^4E_g^{(D)}$	5.75	Distorted octahedral
[Co(L) Cl].H_2O	267 328 486 755	958 820 2190 32	Ligand field Ligand field Charge transfer $^4T_1{}^{(F)} \rightarrow {}^4A_2{}_{(F)}$	4.28	Tetrahedral
[Ni(L)Cl (H_2O)$_2$]1	271 327 491 890	317 250 582 11	Ligand field Ligand field Charge transfer $^3A_2g \rightarrow {}^3T_1g^{(F)}$	3.73	Distorted octahedral
[Cu(L) Cl (H_2O)$_2$]1	264 346 455 741	689 348 193 9	Ligand field Ligand field Charge transfer $^2T_2g \rightarrow {}^2B_2g$	1.82	Distorted octahedral

Thermal analysis: An argon atmosphere was used for the solid ligand (HL) thermal breakdown analysis. We measured the weight loss from room temperature to 550ºC. According to the TGA data, the ligand breaks down in four stages (Fig. 5). The TGA curve at 95-169°C, which shows the weight loss at the first peak, may be related to the loss of (H2O) segments (obs. = 0.711mg, 4.292%; calc. = 0.711mg mg, 4.221%). The loss of the (2H2 +NH3) segment may be shown by the second step measured at 192-235°C (obs.= 0.818 mg, 4.938%; calc0.817 mg, 4.924 %).(CO+H2O) segment is linked to the third phase, which occurs between 249 and 303°C (obs. = 1.810mg, 10.927%; calc. = 1.80mg, 10.78%). The (C6H6+HCN+CO) segment may have been lost, as shown by the fourth step reported at 309–446°C (obs.=5.152mg, 31.102%;

calc.=31.189mg,5.166%). The remaining components of the($C_{16}HN_2$) calc.=208.43mg,48.777. The first peak may be related to the melting point of the ligand. The thermogram of the [Co(L)Cl].H_2Ocomplex proceeds in two steps, Fig 6. The initial peak measured at64-107˚C may be due to loss of molecules from the (H_2O) segment; (obs.=0.250mg, 3.091%; calc.= 0.263mg, 3.255%). The second step happened at408-529˚Cshowed the loss of ($CO+2N_2+3H_2$) fragment;(obs.= 1.296mg, 16.022%; calc.=1.291mg ,16.278%). The remaining components of the ($CoO_2+C_{22}H_{11}+Cl+CO$) obs.=444.86mg, 80.465.

Biological activity: The antibacterial evaluation of the synthesized ligand HL and its metal complexes was carried out against four types of bacteria: Staphylococcusaureus, *Bacillus subtilis, Escherichia coli, and Pseudomonas aeruginosa*. The role of the DMSO solvent against the tested bacteria was excluded throughout separate investigations [31]. Further, the effect of the title compounds against the tested bacteria was compared with the commercial drug Gentamicin. Table 5 shows the inhibition zone results of the title compounds against the development of several bacterial strains. The recorded results indicated that the complexes were more active**,** Fig7. The experimental results concluded the following aspects:

1. Each compound demonstrated effectiveness against both positive and negative microorganisms.

2. Based on the collected information, Co(II) - complex show greater microbiological activity against the bacteria tested.
3. The metal complexes of HL showed moderate antibacterial activity, compared with Gentamicin.

Candida albicans was used as the test organism for the antifungal effectiveness of the HL ligand and its metal complexes.Separately, the function of DMSO in the biological screening was determined using DMSO-only solutions, which exhibited no activity towards fungal species. [32-38]. The commercial drug against fungus,

Metronidazole, has been used as a reference in this study. The results of the anti-fungal activity testing against the chemicals are displayed in Table 6. The findings include the following ones,Fig7.The tested compounds showed excellent results against *Candida albicans*

The coordination compounds showed enhancement in the anti-fungal activity, compared with the free ligand. This may relate to the chelation effect.

1. The Cr(III) and Co(II)-complexes indicated the highest inhibition activity against *Candida albicans.*
2. The coordination compounds indicated excellent activity, compared with Metronidazole.

Table (5): The antibacterial activity inhibition zones (mm) for ligand and itscomplexes.

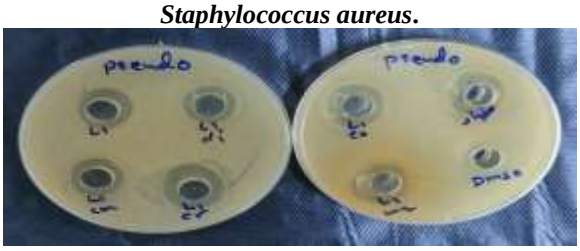
Compounds	*Escherichia coli (G–)*	*Pseudomonas aeruginosa(G–)*	*Staphylococcus aureus (G+)*	*Bacillus stubtilis (G+)*
DMSO	-	-	-	-
Gentamicin	15	16	14	13
HL	7	7	8	7
[Cr(L)Cl 2. H2O]	8	10	9	10
[Mn(L)Cl(H2O)2]	10	9	12	9
[Co(L)Cl].H2O	12	10	12	10
[Ni(L)Cl(H2O) 2]	8	7	10	7
[Cu(L)Cl(H2O)2]	7	8	8	8

Table 6. shows the antifungal inhibition zones (mm) for HL and its complexes.

Compounds	*Candida albicaus*
DMSO	-
Metronidazole	12
HL	7
[Cr(L)Cl 2. H2O]	10
[Mn(L)Cl(H2O) 2]	9
[Co(L)Cl].H2O	13
[Ni(L)Cl(H2O) 2]	9
[Cu(L)Cl(H2O) 2]	9

Bacillus subtilus

***Staphylococcus aureus*.**



Pseudomonas auroginosa

Escherichia coli

Candida albicans

Fig (7): The biological evaluation of HL and its complexes

Conclusions:

A new azo-Schiff base and its paramagnetic coordination compounds with Cr (III), Mn(II), Co(II), Ni(II) and Cu(II) are reported. The ligand (1-(((4-methoxyphenyl)imino)methyl)-3-((E)-(4-nitrophenyl) diazenyl) naphthalen-2-ol) (HL) was synthesized from the condensation of the azo aldehyde compound (L) with (*p*-anisidine) in a mole ratio of 1:1. By reacting the ligand at a mole ratio of 1:1 (L:M) with Cr (III), Mn(II), Co(II), Ni(II), and Cu(II) ions, monomeric complexes were isolated. Using a variety of physicochemical techniques, the compounds' entity, bonding mechanism, and general structure were all obtained. Furthermore, it was established how thermally stable the complexes and ligand were. Six and four-coordinate complexes were proposed in light of these results. The biological evaluation of the ligand and its coordination compounds against bacterial strains and fungi species revealed that the complexes became more active in comparison to the free ligand.

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Fig 2: ^{1}H-NMR spectrum in DMSO-d_6 solutions of HL.

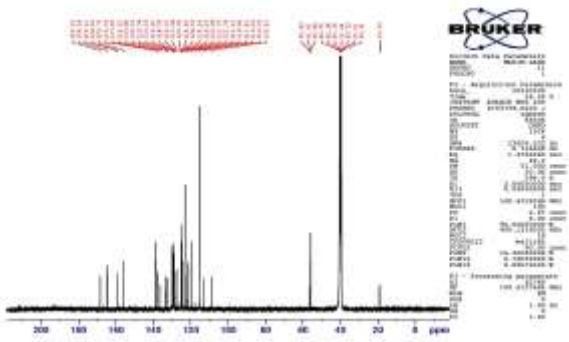

Fig 3: ^{13}C-NMR spectrum in DMSO-d_6 solutions of HL.

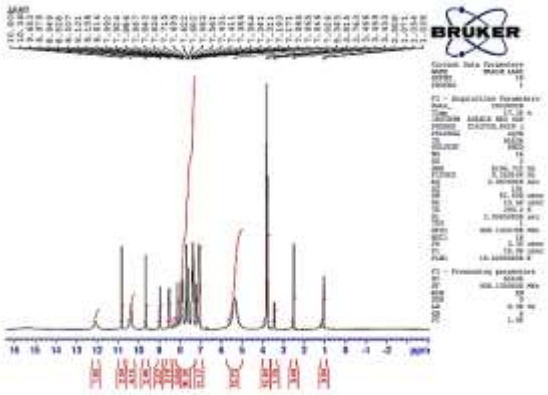

Fig 4: electrospray (+) mass spectrum of HL.

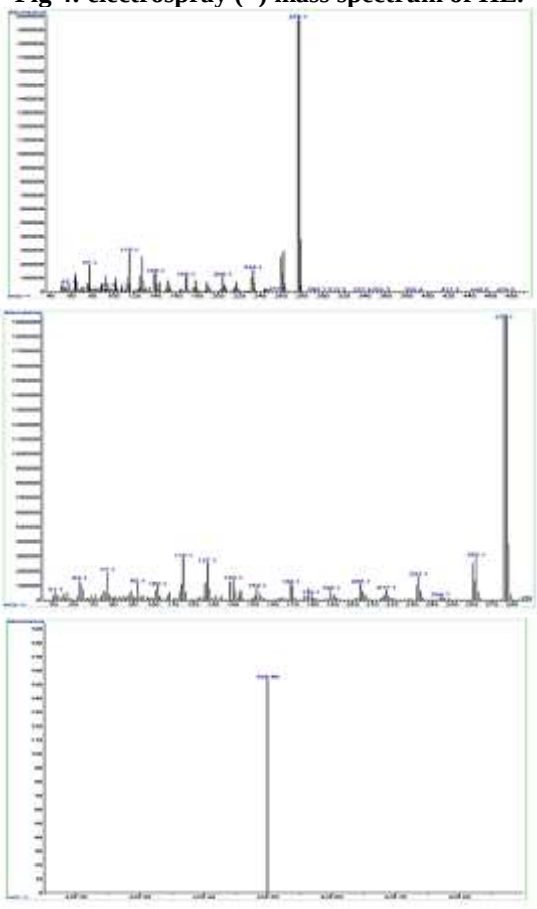

Fig 5. The TGA thermal curve of HL in an atmosphere of Ar.

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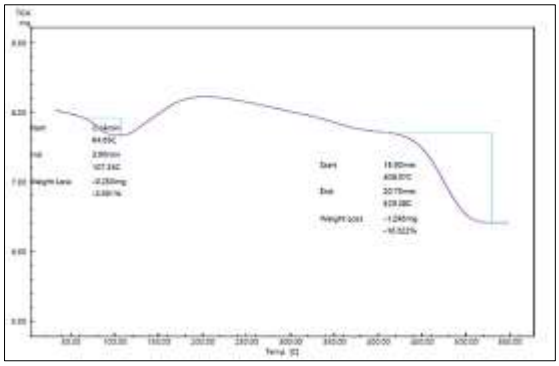

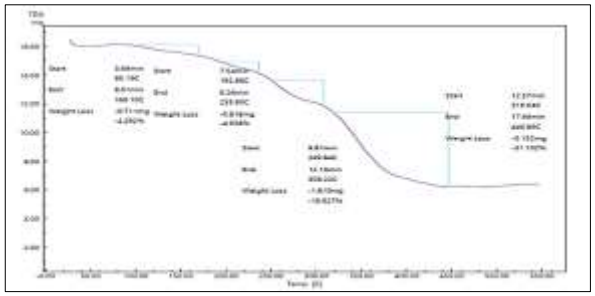

Fig 6. Thermal decomposition of [Co(L)Cl].H_2O in an atmosphere of Ar.

معقدات معدنية جديدة مشتقة من ليكاندقاعدة شيف المرتبطة بالآزو: التحضير والتشخيص الطيفي والتقييم البيولوجي

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الخلاصة

ومعقداتة المعدنية الاحادية p-anisidine تم تحضير وتشخيص ليكاند أزو– قاعدة شف الجديدة ومشتقمنليكاند هو :
(1-((E)-((4-methoxy phenyl) imino) methyl)-3-((E)-(4-nitrophenyl)diazenyl) naphthalen-2-ol) (HL),
حصلنا علية من خلال مفاعلة:

1:1 بنسب مولية p-anisidine و((E)-2-hydroxy-3-((4-nitrophenyl)diazenyl)-1-naphthaldehyde) مع بعض العناصر المعدنية المختارةHL تفاعلالنتيجة تكون معقدات احادية التناسق (L:M), 1:1 بنسب مولية Ni^{II}, Co^{II}, Mn^{II}, Cr^{III}وCu^{II} وهيشخصت الليكاندات والمعقدات بواسطة التحليل الدقيق للعناصر، محتوى المعدن والكلور ،مطياف الاشعة تحت الحمراء، ومطياف الاشعة فوق البنفسجية والرنين النووي المغناطيسي ومطيافية الكتلة بالاضافة الى فحص الحساسية المغناطيسية ،التوصيلية المولارية و ودرجات الانصهارأكدت بيانات التشخيص تكوين مركبات سداسية التناسق واخرى رباعية التناسقCoولمعقد HLالليكاند(TGA) تم فحص الاستقرار الحراريتم استكشاف النشاط المضاد للميكروبات للمركبات المحضرة تجاه العديد من الكائنات الحية الدقيقة البكتيريا والفطريات)وتظهر البيانات التي تم جمعها أن النشاط المضاد للميكروبات لليكاند قد تحسن بعد تكوين معقدات.