RESEARCH ARTICLE

New Metal Complexes with Mannich -β-amino carbonyl ligand; Preparation, spectral Characterisation and Biological Activity

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ABSTRACT

New metal complexes and a new beta-amino maniche carbonyl ligand were prepared and characterized. (((4-(tert-butyl)-2-((S)-(phenylamino) (p-tolyl) methyl)cyclohexan-1-one)) (HL) was formed from the reaction of aniline and 4-methylbesaldehyde with 4- (tert-butyl)cyclohexane-1-one at a 1:1:1 mol ratio respectively reaction of (4-methyl-2-((R)-(phenylamino)(p-tolyl) methyl)cyclohexan-1-one (HL) and MnII, CoII, NiII, CuII, ZnII and CdII metal ions in a 2:1 (L:M) ratio led to the isolation of monomeric complexes from analytical and spectroscopic techniques including; elemental microanalysis, magnetic susceptibility, conductivity, TGA, and FTIR, electronic and mass spectra and ^{1}H, ^{13}C-NMR characterization data indicated to a four- and six-coordinate isolate.Complexes Many bacterial and fungal strains were tested, and the data obtained showed that these complexes are more active against a variety of organisms, under experiment, than free associations.

Keywords: 4-(tert-butyl)cyclohexan-1-one, β-amino carbonyl, Thermal analysis, *Candida and Rhizopus porium*, Metal Complexes.

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INTRODUCTION

The Mannich reaction is The production of a carbon-carbon bond in organic synthesis is considered one of the most important reactions.[1-3] The three-component reaction is an important reaction to obtain beta-amino carbonate. In addition, beta-amino carbonyl compounds are very important compounds as building blocks in the formation of natural products and pharmaceutical preparations.[4,5] These preparations can be easily formed by the Mannich reaction.[6-10] Mannich bases have a vital role in medicinal chemistry because of their ability to form stable metal complexes with most transition metal ions, which have medical significance.[11,12] The mineral complexes produced by the Mannich reaction demonstrated antianginal, anticancer, antitubercular, anthelmintic, Hypolipidemic and flavoring activity.[13] In addition, Manish compounds have been considered to be used in removing heavy metals from water and treating waste.[14] The resulting Mannich bonds helped achieve environmentally friendly process requirements in a way that reduced steps, waste production, and energy consumption.[15] In addition, these methods often have defects in harsh reaction conditions, difficulty in product separation, and long reaction times, which reduces their use in the formation of complex molecules. The complexes of these complexes have many applications in different fields. The most important of them are their role as reagents in catalysis, biomedicine and analytical chemistry.[16,17] industry,[18] agriculture[19] and environmental chemistry.[20] In this paper, a new Mannich-amino carbonyl ligand and its metal complexes were prepared and characterized. Recently, we reported the formation of a Mannich-Base complex.[21,22]

METHODS AND MATERIALS

The NMR spectra (^{13}C- and ^{1}H-NMR) for the ligand were recorded in DMSO-d_6 using a Brucker 300 MHZ instrument (300 MHz for ^{1}H and 125 MHz for ^{13}C) with a (TMS) as an internal reference. Mass spectra for the ligand were obtained using positive mode Electrospray mass spectrophotometer (+) (Sciex Esi mass analysis).The electronic spectra were recorded using an Electronic spectra spectrophotometer type Shimadzu UV-160 in the range 1000 to 200 nm using quartz cell of (1.0) cm length with concentration 10^{-3} mol L^{-1} of samples in DMSO at 25°C. The FTIR spectra were recorded as potassium bromide discs in the range 4000 to 400 cm^{-1} using FTIR-600 Fourier Transform Infrared Spectra. Elements analysis (C, H and N) and metal content were carried out on a Heraeus instrument (Vario EL) and Shimadzu (A

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A-7000) atomic absorption spectrophotometer, respectively. Melting points were determined on an electro-thermal Stuart apparatus, model SMP40. The chloride content for complexes was determined using the potentiometric titration method on 686–Titro Processor-665 Dosim A-Metrohm/Swiss. The molar conductivity measurements of the complexes were recorded at 25 ºC for 10^{-3} to 10^{-5} M solutions of the samples in DMSO using an Eutech Instruments Cyber scan con 510 digital conductivity meter. Magnetic moments at 30°C were measured with a magnetic moments balance on Johnson Matthey. Thermo gravimetric analysis was carried out using Differential Scanning Calorimetry (DSC) on STA PT-1000 Linseis Company/Germany.The evaluation of compounds against four bacterial and two types of fungi.

Synthesis

Synthesis of Mannich-base (((4-(tert-butyl)-2-((S) -(phenylamino) (p-tolyl)methyl) cyclohexan-1-one)) (HL)

The composite was prepared according to the source in.[23-28] which shows Mannich condensation and as follows: To a solution of anhydrous calcium chloride 0.5 g, 5 mmol in ethanol (10 mL) was added successfully; 4-methylbisaldehyde (0.4 mL, 3 mmol), aniline (0.46 mL, 5 mmol) and p-methylcyclohexanone (0.5 mL, 3 mmol) and 3 drops of HCl concentrate. The reaction mixture was continued by stirring for about 12 hours at room temperature and a white powder was obtained through a filtration process that was formed, washed with EtOH (30 mL) and water (30 mL), and then dried in air, Yield: 0.7 g (70%), m.p.=162–164ºC. Mwt =349.52a mu. Elemental analysis: (C.H.N Found, (Calc. %); C = 82.19 (82.47), H= 8.35(8.94), N=3.96 (4.01).

Synthesis of mannich-base complexes

To a solution of HL (0.3 g, 0.8 mmol) in ethanol (10 ml) At room temperature was added a solution of metal chloride salt in (10 mL) of ethanol. The mixture was stirred overnight. The reaction mixture was allowed to slowly evaporate at room temperature and the resulting solid product was filtered and washed with 10 mL of diethyl ether and 20 mL of ethanol. Scheme 1. Yields, Colours, Metal salts quantities, and melting points of complexes are given in Table 1.

Microbiological evaluation

The sensitivity of bacteria and fungi against compounds prepared by Kirby Bauer method was investigated. In this part the organism's colony was mixed with an 85% NaCl solution until it became a suspension (0.5 µMkF). Place this suspension on the surface of a Petri dish filled with Mueller-Hinton agar. Then holes were made with the same exact concentration and distance. The indicated concentration (100 µl) of 1 mg/ml test sample in dimethyl sulfoxide was introduced into the wells. The plates were then placed in an incubator at 37°C for 24 hours, after which the zones of inhibition were measured and compared with standard values.[29] The role of dimethyl sulfoxide solutions in microbiological evaluation was then examined separately, indicating no activity against any strains of fungi or bacteria.

RESULTS AND DISCUSSION

The ligand4-(tert-butyl)-2-((S)-(phenylamino)(p-tolyl) methyl)cyclohexan-1-one (HL) was obtained by the Mannich method by adding $CaCl_2$ as a catalyst. 4-(tert-butyl) reaction Cyclohexanone, aniline and 4-methylbenzaldehyde with a molar ratio of 1:1:1, respectively. The compound is a toothed type that gives the carbonyl oxygen atom and the nitrogen atom of the secondary amine as donor atoms. The reaction of the ligand with metal chloride Mn(II), Co(II), Ni(II), Cu(II), Zn(II) and Cd(II), at a ratio of 2:1 (L:M) leads to the isolation of Six-coordinate neutral monomeric compounds of the general formula $[M(HL)_2Cl_2]$ with Mn(II), Co(II), Ni(II) and Cu(II) as four-coordinate compounds and $[M(HL)_2]Cl_2$ with zinc ions (II) and cadmium(II). (Scheme (1)). The isolated monomeric compounds are air-stable solids that dissolve in dimethyl sulfoxide and dimethyl formamide, other commonly used organic solvents. The complexation behavior and geometry of the complexes were assumed from their chemical and physical data, respectively, and these data agree (Table 2). Well, with the suggested formulas. Conductivity measurements of compounds in dimethyl sulfoxide solutions indicate that the compounds are electrolytes or non-electrolytes. The Mannich base entity has been confirmed before C, H, N, M, Cl (Table 2), FTIR (Table 3), and electronic spectroscopy (Table 4).

FTIR and NMR Data

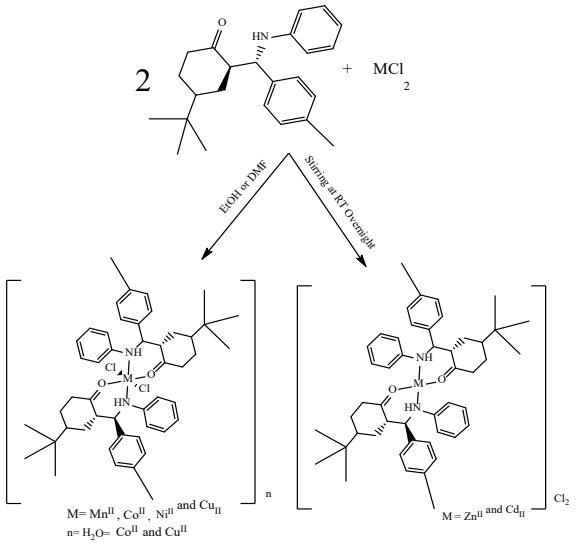
The infrared bands important for vehicles along with their tasks are shown in (Table 3). The HL spectrum revealed a peak at 3410 cm^{-1} due to the peak (NH) of the secondary amine and the spectrum showed a band at 1697 cm-1 assigned to ν (C=O) of the carbonyl group.[30] The band at 1697 cm-1 related to ν(C=O)keto in the free ligand was shifted to the lower frequency at 1664, 1686, 1664, 1666,1681 and 1643 cm^{-1} in the complexes, respectively. The displacement of the

Table 1: Yields, colors, metal salts quantities, melting points of HL complexes

Complex	Weight of metal salt(g)	Weight of complex(g)	Yield (%)	Colour	m.p. ºC
$[Mn(HL)_2Cl_2]$	0. 16	0. 21	52.17	Deep purple	266
$[Co(HL)_2Cl_2].H_2O$	0. 19	0.27	51.38	Purple	289
$[Ni(HL)_2Cl_2]$	0.19	0.30	50.7	pale green	245
$[Cu(HL)_2Cl_2].H_2O$	0.13	0. 21	52.05	green	275
$[Zn(HL)_2]Cl_2$	0.10	0.31	60.0	White	240
$[Cd(HL)_2]Cl_2$	0.16	0.29	57.9	White	296

Table 2: Physical properties and microanalysis of HL its complexes

Complex	*Molecular formula*	*M.Wt*	*Micro analysis found calculated (%)*				
			C	*H*	*N*	*M*	*Cl*
[Mn(HL)2 Cl2]	C48H62Cl2MnN2O2	824.97	69.31 (69.82)	7.00 (7.51)	3.11 (3.39)	6.24 (6.65)	8.28 (8.60)
[Co(HL)2Cl2].H2O	C48H64Cl2CoN2O3	846.98	67.89 (68.00)	7.31 (7.55)	3.19 (3.30)	6.41 (6.95)	8.09 (8.38)
[Ni(HL)2Cl2]	C48H62Cl2N2NiO2	828.73	69.32 (69.50)	7.14 (7.48)	3.10 (3.37)	7.00 (7.08)	8.38 (8.56)
[Cu(HL)2Cl2].H2O	C48H64Cl2CuN2O3	851.59	67.25 (67.63)	7. 33 (7.51)	3.04 (3.28)	7.00 (7.46)	8.22 (8.33)
[Zn(HL)2] Cl2	C48H62Cl2N2O2Zn	835.42	68.61 (68.94)	7.29 (7.42)	3.00 (3.35)	7.55 (7.82)	8.16 (8.49)
[Cd(HL)2] Cl2	C48H62CdCl2N2O2	882.45	65.04 (65.27)	6.91 (7.02)	2.97 (3.17)	12.51 (12.73)	7.88 (8.04)



Scheme 1: General synthesis of HL complexes

carbonyl moiety can be explained by the coordination of the oxygen atom in the carbonyl to the metal center, depending on the method reported in the literature.[31] In addition, the spectra of the metal complexes showed new bands, which were not observed in the bonding spectrum, around 690 to 619 cm^{-1} assigned to ν(M-O).[30,31] Bands recorded around 489 to 438cm^{-1} attributed to ν (M-N),[30,31] respectively. Finally, Bands recorded around 295 to 233cm^{-1} attributed to ν (M-Cl),[30,31] respectively. The nuclear magnetic resonance spectra of the Mannich-base in dimethylsulfoxide-d6 showed peaks at δH; (400 MHz, DMSO-d6): 7.24–7.23($C_{9,9'}$)-H (2H,d,*J* =4Hz), 7.08–7.05 ($C_{10,10'}$)-H (2H,d, *J* =12Hz), 6.95–6.94, 6.93–6.92($C_{14,14'}$)-H (2H,t,*J* = 4Hz),($C_{13,13'}$)-H (2H,d,*J*= 4Hz), 6.46-6.41 ($C_{15,15'}$)-H (2H,t,*J* = 8Hz), (C_7-H) (1H,d), 5.97–5.96 NH (1H,NH,d,*J*=4Hz), 2.87–2.84 (C_2)-H (1H,m,*J*=12Hz),2.44;2.44(C_6)-H(1H,t),2.22C_{17}-H (3H,s,–(Me)),(C_5)-H(2H,t) 2.19;1.99,1.72;1.53 ,C_3-H (2H,t), 1.52C_4-H (1H,m),0.79-0.75, 3(CH_3)C_{16}-H (9H,s), Figure 1. The ^{13}C-NMR spectrum of the Mannich-base in dimethylsulfoxide-d6 showedpeaks at;(100 MHz, dimethylsulfoxide-d6):148.60, 139.63(C_{12})(C_8), (C_{11}),($C_{14,14}$) ($C_{10,10}$) ($C_{9,9}$) ($C_{15,15}$),($C_{13,13}$) 135.87,129.02 ,128.95 ,127.91 ,115.98,113.09. 55.96, 55.22, 46.43, 41.90, 32.58, 32.53, 28.81 (C_7) (C_2), (C_4) (C_6) (C_{16}) (C_5),(C_{18}). (C_3) (C_{17}) 27.84, 21.10. C=O =211.25 ppm, Figure 2. The nuclear magnetic resonance spectra of the $[Zn(HL)_2]Cl_2$ in dimethylsulfoxide-d6 showed peaks at δH;(400MHz, DMSO-d6): 7.23–7.22($C_{14,14'}$)-H (1H, d, *J* = 4Hz).6.97–6.96 ($C_{9,9'}$)-H (H, t, *J* = 4Hz). 6.66–6.65, 6.64–6.63 ($C_{10,10'}$)-H(1H, d, *J* = 4Hz) and ($C_{15,15'}$)-H (2H, d, *J* = 4 Hz). 6.47–6.44 ($C_{13,13'}$)-H (1H, t, *J* = 12 Hz).N-H,(1H, d, N-H, *J*=4 Hz). 4.61–4.59 (C_7)-H (1H, dd, *J* = 8 Hz). 2.48–2.45(C_2)-H (H, m). 2.44:2.44 to (C_{17})-H (2H, t,).2.22(C_5)-H(2H, m).(C_6)-H (2H, t, *J* =4Hz) 2.00:1.99. 1.98;1.97C_3-H (1H, m).1.68; 1.67 C_4-H (1H, m). 0.75 (C_{16})-H (9H,s), Figure 3.

Mass Spectrum

The positive electrospray mass spectrum of the Mannich-base showed a band at m/z =349.52 amu (M^+) (39%) for $C_{24}H_{31}NO$. Peaks detected at m/z = 241.20 (7%), 196.20 (97%), 131.10 (19%), 104.15 (70%) and 77.10 (69%) related to [M-($C_{17}H_{23}N$)],[M-($C_{17}H_{23}N$)+($C_{15}H_{16}$)], [M-($C_{17}H_{23}N$)+($C_{15}H_{16}$)+($C_{10}H_{11}^+$)], [M-($C_{17}H_{23}N$)+($C_{15}H_{16}$)+($C_{10}H_{11}^+$)+ (C_8H_8)] and [M-($C_{17}H_{23}N$)+($C_{15}H_{16}$)+($C_{10}H_{11}^+$)+(C_8H_8)+($C_6H_5^+$)], respectively, Figure 4.

UV-vis and Magnetic Susceptibility

Electronic spectra and magnetic moments data for Mannich base complexes are collected in (Table 4). The electronic spectra of the complexes show different peaks around 298 to 267 nm attributed to $\pi \rightarrow \pi *$ and $n \rightarrow \pi *$, respectively. Additional peaks at 385 to 298 nm are for charge transport (C.T) [32,33]. The electronic spectrum of Mn (II) reveals bands in the d-d region at 841 nm due to $^6A_1g \rightarrow {}^4T_1g(^4G)$, indicating a distorted octahedral structure about the Mn(II) center. The electronic spectrum of Co (II) reveals bands in the d-d region at 681 and 934nm that due to $^4T_1g^{(F)} \rightarrow {}^4A_2g^{(F)}$ and $^4T_1g^{(F)} \rightarrow {}^4T_2g^{(p)}$, respectively indicating a distorted octahedral structure about the Co(II) center. The obtained magnetic moment value approximates with a Co(II) compound whose

Table 3: The FTIR spectral data of compounds (cm^{-1})

Complex	*v(N-H)*	*v(H_2O)*	*v(C=O)$_{ket}$*	*δ(N-H)*	*v(C=C)$_{aro.}$*	*v(M-O)*	*v(M-N)*	*v(M-Cl)*
HL	3402	-	1697	1600	1500	-	-	-
$[Mn(HL)_2Cl_2]$	3462	-	1664	1606	1504	662	438	279,235
$[Co(HL)_2Cl_2].H_2O$	3244	3150	1686	1585	1515	619	472	256,233
$[Ni(HL)_2Cl_2]$	3327	-	1664	1603	1520	690	447	295,270
$[Cu(HL)_2Cl_2].H_2O$	3396	3357	1666	1606	1500	659	447	270,250
$[Zn(HL)_2]Cl_2$	3397	-	1681	1604	1504	632	489	-
$[Cd(HL)_2]Cl_2$	3232	-	1643	1529	1504	667	478	-

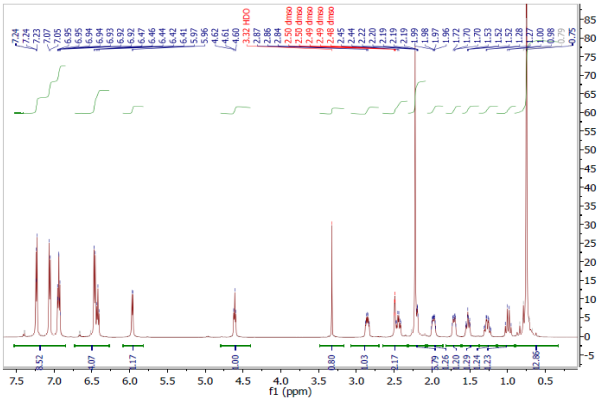


Fig.1: ^{1}H-NMR spectrumspectrum of (HL)

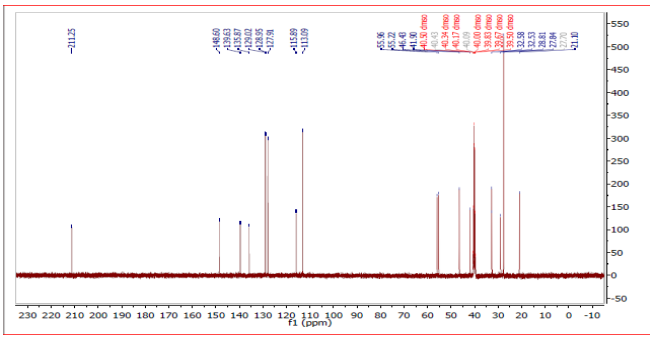


Fig.2: ^{13}C-NMR spectrum of (HL).

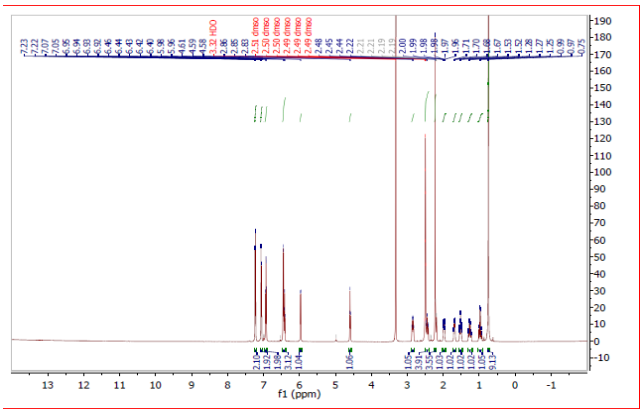


Fig.3: ^{1}H-NMR spectrum of $[Zn(HL)_2]Cl_2$.

arrangement around the Co atom is a distorted octahedral.[34,35] The bands found in the Ni(II) complex at 421 and 794 nm are attributed to 3A2g(F) → 3T1g(P) and 3A2g(F) → 3T2g(F), respectively, and this confirms the presence of a distorted octahedral arrangement around the metallic centre. where the value of the magnetic moment of Cu(II) with deformable octahedral geometry is agreed. The spectrum of the Cu(II) complex shows a peak at 941 nm, which is attributed to 2Eg → 2T2g. These transitions are characteristic for a copper composite with a distorted octahedral structure [34,36]. The Zn and Cd spectra indicate that there are no bands in the d–d region. These metal ions belong to the d10 electronic configuration.[34,36]

Thermal Analysis

Thermal analysis results of the ligand (HL) $[Co(HL)_2Cl_2].H_2O$ and [Cu (HL) Cl_2].H_2O complex were determined from ambient temperature to 800°C in the atmosphere of nitrogen. The thermal decomposition analysis of solid Mannich-base ligand (HL) was carried out under a nitrogen atmosphere. The weight loss was measured from ambient temperature up to 800ºC. The TGA data clearly indicated that the decomposition of the ligand proceeds in four steps, Figure 5. The weight loss at the 1st peak, as indicated by the TGA curve at 75-149°C, many attributed to the loss of (CH_4) segments and one acetylene molecule (obs.= 0.1334mg, 4.835%; calc.= 0.1226mg, 4.589%). The second step happened from 149 to 274°C stated the elimination of (C_5H_4 + C-$(CH_3)_3$ +NH_3+ CO) fragments;(obs.= 1.313 mg, 47.58% ;calc.= 1.312 mg, 47.56 %). The third step recorded at 274-413°C may indicate the loss of (C_4H_2) segment (obs.= 0.398mg,14.43%; calc.= 0.395 mg, 14.32%). The final step at 413°C is attached to the (C_4H_5) segment (obs.= 0.4232 mg, 15.34%; calc.=0.4189 mg, 15.18%). The First peak may relate to the melting point of the ligand. The thermogram $[Co(HL)_2Cl_2].H_2O$ complex is proceeds in four steps, Figure 6. The first peak detected at 49–135°C may be attributed to the loss of a molecule of the (H_2O) segments; (obs. =0.023 mg, 2.22%; calc. =0.013 mg, 2.10). The second step occurred at 135-218°C indicating the loss of ($2CH_4$ +$2CH_3$+$2NH_3$+C_2H_6) fragment; (obs.=0.1620mg, 15.10%; calc.=0.1600 mg,15.00%). The third step recorded at 218–308°C indicated the loss of (C_6H_6 + C_5H_3 + Cl_2) fragment (obs.= 0.269 mg 25.07%; calc.= 0.246 mg, 24.9%). The fourth step recorded at308-405°C indicated

Table 4: Magnetic moment of HL complexes and electronic spectra data in DMSO solutions

Complex	*λnm*	*Wave number ῡ (cm-1)*	*Molar extinction coefficient εmax (dm3 mol-1 cm-1)*	*Assignment*	*Suggested geometry*	*μ B*
[Mn (HL)2Cl2]	298 385 841		2296 1323 66	Intra-ligand π → π*,n→π* C.T 6A1g →4T1g(4G)	Distorted octahedral	5.72
[Co(HL)2Cl2].H2O	267 301 681 934	37453 33222 14684 10706	1400 1320 87 7	Intra-ligand π → π*,n→π* C.T 4T1g(F) → 4A2g(F) 4T1g(F)→4T2g(p)	Distorted octahedral	5.08
[Ni(HL)2 Cl2]	285 421 794	26954 23753 12594	2323 45 18	Intra-ligand π → π*,n→π* 3A2g(F)→3T1g(P) 3A2g(F)→3T2g(F)	Distorted octahedral	3.25
[Cu(HL)2Cl2].H2O	293 941	34129 10626	2186 42	Intra-ligand π → π*,n→π* 2Eg→2T2g	Distorted octahedral	2.08
[Zn(HL)2]Cl2	270 298	27037 33557	1768 1884	Intra-ligand π → π*,n→π* C.T	Tetrahedral	Diamagnetic
[Cd(HL)2]Cl2	268 301	37313 33222	1554 1384	Intra-ligand π → π*,n→π* C.T	Tetrahedral	Diamagnetic

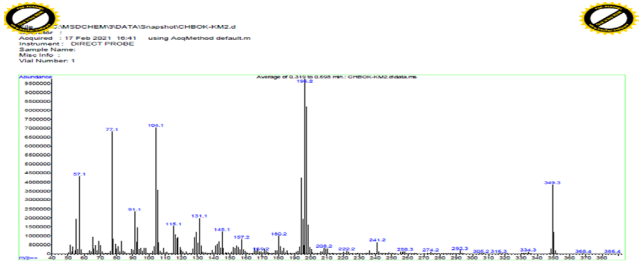


Figure 4: The electrospray (+) mass spectrum (HL).

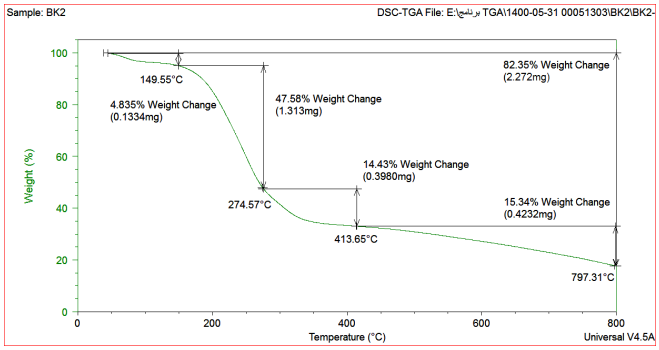


Figure 5: The thermal curves TGA of HL in N_2 atmosphere.

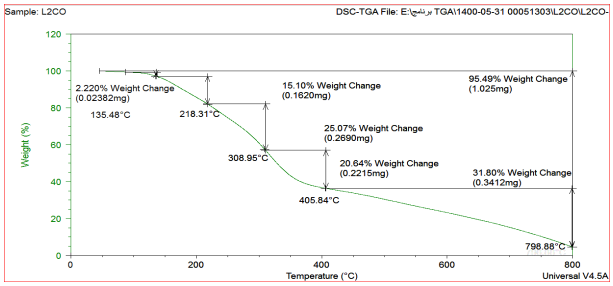


Figure 6: Thermal decomposition of $[Co(HL)_2Cl_2].H_2O$ in N_2 atmosphere.

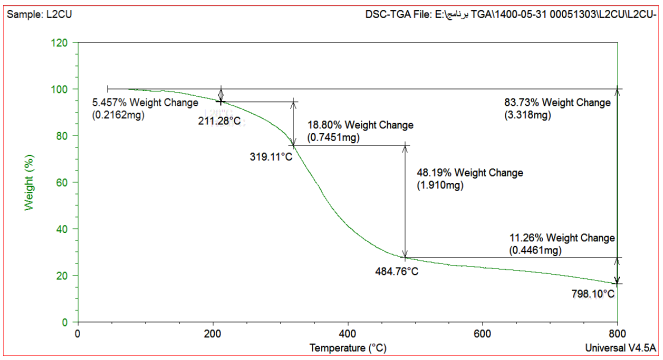


Figure 7: Thermal decomposition of $[Cu(HL)_2Cl_2].H_2O$ in N_2 atmosphere.

the loss of ($C_3H_6 + H_2 + C_6H_6 + 2C_2H_2$) fragment,(obs.=0.211 mg, 20.64%; calc.=0.200mg, 20.33%). The fifth step recorded at 405–798°C indicated the loss of ($2C_2H_2$+$2H_2$+CH_4+$2CH_2CH_2CH_2CH$=CH_2+Co)fragment,(obs.=0.3412 mg, 31.80%; calc.=0.321 mg, 31.33%). The final residue of the (C_5H_3+$2C_6H_6$) calc.= 48.64 mg, 5.74%. The combustion of the organic ligand in a nitrogen atmosphere. The thermogram of $[Cu (HL)_2 Cl_2].H_2O$ is depicted in Figure 7. The first peak detected at 45–211°C may be attributed to the loss of a molecule of the (H_2O+CO) segment (obs.=0.2162 mg, 5.457%; calc.= 0.201 mg, 5.167). The second step occurred at 211–319°C indicated the loss of (NH_3+Cl_2+C_3H_6+$3CH_3$) fragment; (obs.= 0.7451 mg, 18.80%; calc.=0.7133 mg, 18.53%). The third step occurred at 319-484°C indicated the loss of ($2C_2H_2$ + $N(CH_3)_2$ +CuO +CH_3 +$C_{16}H_{26}$ +$5H_2$)fragment; (obs.=1.910 mg,48.80%; calc.=1.90 mg, 48.53%). The fourth step occurred at 484-798°C indicated the loss of (C_2H_2+$6H_2$+C_3H_6+CH_3)fragment;(obs.= 0.4461 mg, 11.26%; calc.=0.4133 mg,11.00%). The final residue of the ($C_6H_6 + 2C_2H_2 + H_2$) calc.= 132.3 mg, 15.54%. The combustion of the organic ligand in a nitrogen atmosphere.

Table 5: The biological evaluation of HL and its complexes

Compounds	*Escherichia coli (G−)*	*Pseudomonas aeruginosa (G−)*	*Bacillus stubtilis (G+)*	*Staphylococcus aureus (G+)*	*Candida*	*Rhizopus porium*
HL	14	15	10	13	14	15
$[Mn(HL)_2Cl_2]$	20	16	22	19	19	22
$[Co(HL)_2Cl_2].H_2$	15	20	16	19	22	19
$[Ni\ (HL)_2\ Cl_2]$.	16	17	15	15	17	16
$[Cu(HL)_2Cl_2].H_2O$	17	16	16	14	17	17
$[Zn\ (HL)_2].Cl_2$	15	17	14	18	16	16
$[Cd\ (HL)_2].Cl_2$	23	25	**26**	**20**	21	30

Biological Activity

The resulting ligand and its metal complexes were tested for their microbiological activity against two bacterial strains: G-negative *(Escherichia coli and Pseudomonas aeruginosa) and* G-positive (*Staphylococcus aureus and Bacillus stubtilis*). Additional to two types of fungi were explored (*Rhizopus porium and Candida*). The bacteria used are the most harmful and deadly types of bacteria. These bacteria are widely detected in hospital operating rooms. In addition, two types of fungi were used that had an effect on humans, animals and plants. Table 5 shows the development of diameter area (mm) for the inhibition of HL complexes against the growth of different strains of bacteria and fungi. The strains of bacteria selected in the framework of this study showed high resistance against HL, and this indicates that the ligand did not show any activity against all types of bacteria. However, In addition, the mineral complexes demonstrated antimicrobial activity against several bacterial species, compared to the free binder, and the higher activity of the complexes, especially the Zn(II) and Cd(II) complexes, can be argued on the basis of chelation theory and Overtones. Model.[37] Through the chelation hypothesis, the compound has the ability to move across the cell membrane of the organism. This is related to a decrease in the polarity of the metal ion, which occurs through partial sharing of the positive charge of the metal with the donor groups. This would strengthen the lipophilic property, allowing the compound to cross the lipid layer of the cell tissue.[38] The reason is due to the size of the metal ion and/or the stability of the compound in the tested medium, and thus the compound suffers from decomposition in the medium. The effectiveness of the complexes against fungi was revealed. In general, the increased antifungal activity of the complexes can be explained by the concept of chelation,[39] and thus this relates to the delocalization of π-electrons across the entire chelated segment. It indicates that the polarity of the compound and the central metal atom decreases, and this decrease leads to the penetration of the compound through the fatty tissue of the cell membrane.

CONCLUSION

The preparation and characterization of a new bidentate Mannich -*β*-amino carbonyl compounds are reported. The formation of the ligand 4-(tert-butyl)-2-((S)-(phenylamino) (p-tolyl)methyl)cyclohexan-1-one (HL) was achieved from the reaction of 4-(tert-butyl) cyclohexanone, aniline and 4-methylbenzaldehyde in a 1:1:1 mole ratio, respectively. The reaction of the ligand with Nickel (II), Cadmium (II) Mangnies (II), Copper (II), Cobalt (II), and zinc (II) ions in a molar ratio of 2: 1 (L: M) led to the isolation of monomeric complexes. After that, spectroscopic, physical and chemical methods were carried out to confirm the method of association on all complexes. These results lead to the preparation of four and six coordination complexes.

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