Synthesis, Structure and Characterization of Novel Acylselenourea Ligand and its Complexes; Antibacterial Activity and Thermal Analysis

Talib H. Mawat[1], Badralbdoor Salah Al-Tameemi[2], and Riyad R. Jalood[3]
[1, 2, 3]Department of anaesthesiology techniques, Al-Hadi University College, Baghdad-10011, Iraq.
Email: talib.phd.88@gmail.com

Abstract

Synthesis of Novel of ligand (E)-N-(2-benzylidenehydrazine-1-carbonoselenoyl) benzamide with three of mononuclear metals complexes. The acyl chloride in mixture of Potassium selenocyanate and hydrazine hydrate for formation precursor N-(hydrazinecarbonoselenoyl) benzamide that reacted with benzaldehyde, subsequently novel ligand was synthesis. The H2L reaction with Cu (II), Zn (II), and Cd (II), ions have commanded to separation of novel of complexes with overall formula K[MLCl], (M=Cu (II), Zn (II) and Cd(II). The synthesized of Acylselenourea-compounds have been characterized by C, H and N analysis, FT-IR, UV-Visible, 1H- and 13C-, and Se-NMR, as well as Mass spectra, effective magnetic moments, molar conductance, and TG-DSC. The separation of square planer geometry around (Cu (II) and tetra-hedral geometry around Zn (II) and Cd (II) ions has been seen in analytical and spectroscopic investigations of complexes. The ligand of H2L and also its metal complexes have been discovered to be antibacterial against Gram (-) bacterium types such as Escherichia coli, Klebsiella pneumoniae, and Bacillus sabtuius., in addition to, metal complexes could have a better level of resistance to microbial activity than free ligand, according to strains of the Gram (+) bacterium Staphylococcus aureus.

Keywords: Acyl chloride; Potassium selenocyanate; Acylselenourea; Antibacterial activity; Thermal analysis.

1. Introduction

Selenium was found in 1817. Furthermore, numerous substances are employed as organoselenium.

The chemistry of compounds which contain Selenium is frequently comparable to which of the equivalent S counterparts, in difference to the considerably better-developed chemistry of organic compounds which contain Sulphur and oxygen [1].

The synthesis of heterocycles of Se, is less developed due to the poisonousness and instability of lot of Se-compounds. Derivatives of organic selenium were synthesized as anticancer agents in spite of the significant toxicity of lot of selenium compounds [1].

The present fascination with selenium-containing chemical compounds derives from their extraordinary synthesis and biological capabilities. Despite the fact that the existence of isoselenocyanates was long disputed, the synthesis of aryl and alkyl derivatives has been accomplished in recent decades. For the synthesis of linear and cyclic selenoorganic chemicals, acyl isoselenocyanates are valuable building blocks [2].

Acyl isoselenocyanates are important intermediates in the production of selenium-based heterocycles [3]. A reaction of acyl chloride produced acyl isoselenocyanates. Potassium selenocyanate is a family of chemical compounds that include oxygen, nitrogen, and selenium as imine moiety heteroatoms [3]. These compounds were found to have a wide range of chemical and biological uses [4]. They combine "hard" elements such as N, O and "soft" elements such as S, Se, or Te, giver atoms, allowing them to cooperate with a wide range of metal ions [5]. Organic molecules with oxygen, nitrogen, and selenium groups on their backbones are valuable materials because they can form constant complexes of metal. Schiff-bases are compounds of selenium including ligands and complexes with a variety of biological and pharmacological properties, including anticancer and antibacterial properties [6]. Additionally, these chemicals may be employed as antioxidants and biological agents, involving anti-inflammatory, anti-bacterial, antiviral, and anticancer properties [7].

Se-containing compounds have features that are comparable to those of their S-containing counterparts, with a few significant exceptions. Organic Se-compounds, for example, are oxidation- and photo-sensitive in some circumstances, and appear to be less stable in general than their S equivalents. They are also frequently foul-smelling and very poisonous.

As a result, novel organic Se compound techniques that use more stable and less hazardous starting materials are perfect. Aroyl isoselenocyanates appear to be such products having the potential to be used in the synthesis of Se compounds [8].

Selenium compounds may chelate elements and create stable compounds with them [9]. Seleno-compounds are used as reagents in chemistry of organic, chemistry of analytical, and biochemistry. As a result, researchers looked into adding the selenium atom to homocyclic and heterocyclic molecules to create compounds of selenium with low toxicity, high reactivity, and high stability [4]. As a result, the formation of heterocyclic selenium and heterocyclic selenium molecules has become more advanced and is one of the most important challenges in modern chemistry, due to their influence on medical and applications of biological, as well as their use as intermediates for organic synthesis.

An N-(2-benzylidenehydrazine-1-carbonoselenoyl) benzamide ligand and its metal complexes were synthesized and structurally characterized in this research. The ligand was created by reacting N-(hydrazinecarbonoselenoyl)benzamide with benzaldehyde as a precursor.

doi.org/10.31838/hiv22.02.321 Received: 01.04.22, Revised: 02.05.22, Accepted: 09.08.22

The reaction of acylselenourea of ligand (H_2L) with Cu (II), Zn (II), and Cd (II) ions, as well as its metals complexes, yielded a group of three complexes. Likewise, the antibacterial activity of the produced compounds was examined.

2. Experimental

2.1 Chemicals and Method

All of the laboratory chemicals used in this paper were mercantilely offered and used without extra purification. The procedure for preparing the chemical N-(hydrazinecarbonoselenoyl) benzamide may be found in Ref [10]. In the manufacture of ligand, this molecule is employed as a precursor.

2.2 Physical Instruments

The melting points were determined using a Stuart apparatus of electric and thermal, model SMP-30. The KBr approach was used to assess FTIR spectra on a Perkin–Elmer FT-IR 1725X spectrophotometer in the 400–4000cm–1 range and CsI discs in the 250–4000cm–1 range happening a (FTIR-8400-S) Shimadzu of spectrometer. With the use of UV-visible spectrophotometer type Shimadzu, electronic spectrum values in the range 200-1100nm for 10-3M solutions in DMSO at room temperature were observed. The 1H and 13CNMR spectra in DMSO-d6 solutions were acquired using a Brucker 400MHz meter of spectra, respectively, with (tetra-methylsilane, TMS) as an inside standard. Using a Brucker 400MHz spectrometer and dimethylselenide (Me_2Se) as one of the internal standards, 77SeNMR spectra were obtained in the DMSO-d6 solution. The Agilent LCmssx spectrometer was used to record ESMS (i.e. electrospray mass spectra). The EuroEA3000 was used to do elemental analysis (H, C, and N). Using the (FAA) 680Gatomic absorption spectro-photometer, the metals were determined. For the measurement of chloride content, the Potentio-meteric titration method was used, which employs a 686Titro (processor-665, Dosimat-Metrohm) Swiss. The conductivity tests were carried out using DMSO, solutions and a CON510 is a conductivity metre with a digital display. (Eutech Instruments), and the magnetic moments of the R.T. were calculated. The Evans' technique was used to do the magnetic measurements at 298 K using an MSB-MK1 balance (Sherwood Scientific DE.). The SDT Q600 V20.9 Build 20 TG-DSC was used to conduct thermal studies (thermogravimetry (TG) and differential scanning calorimetry (DSC).

2.3 Preparation of H2L

Compound of N-(hydrazinecarbonoselenoyl)benzamide was prepared by add solution of acyl chloride (4mmol) to a solution of 0.29gm potassium selenocyanate (2mmol) in 10ml dry acetone. At a temperature of 25 degrees Celsius, the reaction mixture was stirred, for 20min. Hydrate of the hydrazine (99.90%, 0.1ml, 2mmol), 5 mL dry acetone was added to the mixture and allowed to stir for 30 minutes at R.T. The mixture was then agitated at 60oC for 2 hours with Benzaldehyde (4mmol) in EtOH. The compound was extracted by diethyl ether and washed with water, resulted in the formation of ligand, See Scheme (1). Yield: 0.17g (59%), m.p= 175-178°C. Data of FT-IR (cm-1): 3345 ν(N2-H), 3310 ν(N1-H), 3029 ν(C-H)aromatic, 1675 ν(C=O), 1635 ν(C=N)imine, 1581 ν(C=C)aromatic, 1284 for Selenone of C=Se. 1HNMR spectrum of H_2L (400MHz in DMSO-d6) displayed signals at δH; 8.01 (2H, d, JHH= 8 Hz C3, 3`-H), 7.79 (2H, d, JHH= 12 Hz C11, 11`-H), 7.57 (1H, t, JHH= 12 Hz C1-H), 7.41 (1H, t, JHH= 8 Hz C13-H), 7.30 (4H, t, JHH= 8 Hz C2, 2`,12,12`-H), 9.18 (1H, br, N1-H), 4.30 (1H, br, N2-H), 2.33 (1H, s, C9-H) ppm.

13CNMR spectrum (100 MHz in DMSO-d6) of H_2L displays indicators around δC; 178.98 ppm that due to (C=O) group and 170.44 ppm which is related with the (C=Se). As well as, 146.23 (C=N), 136.40 (C4), 134.76 (C10), 132.40 (C1), 130.87 (C13), 128.21 (C11, 11`), 126.69 (C2, 2`, 12, 12`), 125.49 (C3, 3`) ppm.

77SeNMR spectrum of H_2L (76MHz in DMSO-d6) reveals signal at δSe; 179.27ppm for C=Se moiety.

The ESM(+) spectra of H_2L presented a peak with m/z= 331.3 [(M+H)]+ (11%) for $C_{15}H_{13}N_3OSe$, requires= 330.3 Peaks detected at m/z=305.2 (10%), 220.5 (53%), 130.3 (100%) and 67.3 (10%) correspond to [M+H-(C_2H_2)]+, [(M+H)-{(C_2H_2)+(N_2+C_3NH_7)}]+, [(M+H)-{(C_2H_2)+ (N_2+C_3NH_7)+(C_7H_6)}]+ and [(M+H)-{(C_2H_2)+(N_2+C_3NH_7)+(C_7H_6)+(C_3H_7O+$2H_2$)}],respectively.

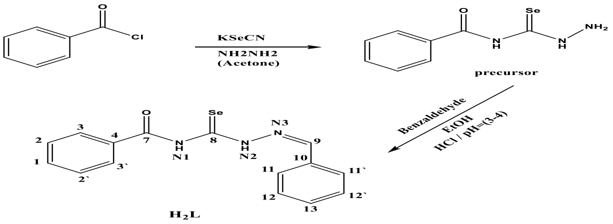
2.4 Synthesis of General Metal Complexes via H2L

To solution of H_2L (1.91mmol) in MEOH (10 ml) in a 1:1 (L: M) mole ration, A metal chloride (1.91mmol) solution with methanol (10 ml) was added to mixture the reaction was carried out, in presence of KOH as a base. After allowing the reaction mixture to reflux for 2 hours, it followed by cooling to a room temperature. The precipitate of compound was filtered out, rinsed in cold 100% ethanol, and dried in the air, see Scheme (2).

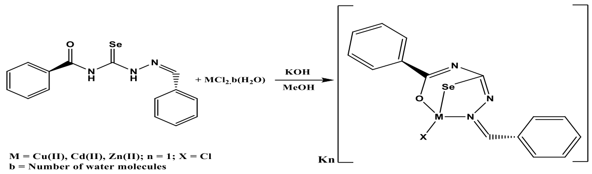
NMR Information

1HNMR spectrum (400MHz in DMSO-d6) of K[Zn(L)Cl] presented signals at δH; 8.45 (2H, d; JHH= 8 Hz C3, 3`-H), 8.24 (2H, d; JHH= 8 Hz C11, 11`-H), 7.94 (1H, t, C1-H), 7.57 (1H, t, C13-H), 7.38 (4H, t, C2, 2`,12,12`-H), 2.32 (1H, s, C9-H) ppm.

13CNMR spectra of K [Zn (L) Cl] (100MHz in DMSO-d6) indicated peaks with δC; 174.75 ppm that due to (C-O) group and 167.15 ppm which is related with the (C-Se). Additionally, 150.13 (C=N), 137.06 (C4), 134.76 (C10), 132.92 (C1), 130.56 (C13), 128.21 (C11, 11`), 126.84 (C2, 2`, 12, 12`), 124.54 (C3, 3`) ppm. 77SeNMR spectrum of K [Zn (L) Cl] (76MHz in DMSO- d6) reveals signal at δSe; 254.15 ppm (C-Se) group.



Scheme1: Synthesis route of ligand H2L.



Scheme2: Synthesis route and suggested structures of H2L complexes.

3. Result and Discussion

Air stable of H2L with also its complexes are solvable in DMSO, DMF, and CHCl3, and except for other sorts of typical organic solvents. From their spectroscopic and analytical investigations, the expected spatial configurations of chemicals were predicted. The conductivity of H2L mononucleating complexes in DMSO ranges from 30.14 to 48.16 cm2/Ωmol, indicating that they have a 1:1 electrolytic characteristic [11].

3.1 FTIR Spectra

The FTIR spectrum for H2L had discovered multiple distinct functional group bands at 3345, 3310, 1675, 1635 and 1280 cm-1 ascribed to ν(N2-H), ν(N1-H), ν(C=O), imine of C=N and selenone of C=Se, respectively [12-14]. The spectra revealed no bands round 2400cm-1 that might be assigned to ν(Se-H), indicating which the ligand existed in also its form of selenone [12].

Table 1 lists the greatest obvious bands of FTIR for H2L and also its complexes, as well as their designations. As a result of complexation, the FT-IR spectra of H2L and also its complexes showed bands of ligand with appropriate shifts. The carbonyl C=O and imine group's ν(C=N), which were found at 1675 and 1635 cm-1 respectively, in free ligand of H2L, were displaced to wavenumber of lower in complexes H2L and looked round 1645-1650cm-1 for carbonyl group and 1630-1631cm-1, for imine group. The delocalisation of metal electron density into the ligand-system is coupled with a change to a lower wavenumber. The coordination of oxygen and nitrogen toward metals ions were verified by such shifting, revealing the nature of strong of the connection between metal ions and the carbonyl and the imine groups [14, 15]. In both complexes, the ν(C-Se) groups detected about 724-735cm-1, compared to 772cm-1 for the free ligand H2L [13]. The (N2-H) and (N1-H) bands found at 3345 and 3310 cm-1 in H2L are not present in the spectra of complexes, indicating that the ligand is deprotonated during complexation [15, 16]. The absorption bands at (1610-1615) and (1645-1650) cm-1 in the complexes spectra, were connected to the production of (N=C-Se) and (N=C-O), respectively. The bands at 410-441 and 323-340cm-1 in the FTIR spectra of complexes were ascribed for (Metal-N) and (Metal-Se); respectively [17]. Bands round 255-274cm-1 are ascribed to (M-Cl).

Table1: FTIR frequency values in (cm-1) of compounds.

Compounds	ν(N2-H)	ν(N1-H)	N-C=O N=C-O	N-C=Se N=C-Se	H-C=N	C=C	C-Se	M-N	M-Se	M-Cl
H2L	3345	3310	1675	1590	1635	1581	1280 772	_	_	_
K[Cu(L)Cl]		_	1650	_1610	1630	1570	1241 739	410 433	323	257
K[Zn(L)Cl]		_	1645	_1612	1631	1575	1234 724	422 441	324	255
K[Cd(L)Cl]		_	1647	_1615	1630	1572	1249 735	420 419	340	274

3.2 NMR Spectra

The 1HNMR spectrum of Se-ligand (H2L), in solvent of DMSO-d6 revealed peaks at δH= 9.18 and 4.30ppm (1H, br), which correspond to one proton ascribed to (N1-H) and (N2-H) groups, respectively, indicating the existence of carbonyl and selenone forms in the ligand (Figure 1a). At 8.01ppm, the doublet signal was connected to (C3, 3'-H) protons. Peak at 7.79ppm, corresponding to two protons attributed to (C11, 11'-H) protons. Peaks at 7.57, 7.41, and 7.30ppm, respectively, are ascribed to (C1-H), (C13-H), and (C2, 2', 12, 12'-H) protons, indicating resonance.

The 13CNMR spectrum, of H2L in solvent of DMSO-d6 exhibitions peak at δc= 178.98 and 170.44ppm assigned to (C=O) and selenone of C=Se group, respectively [17]. 77SeNMR spectra of H2L in solvent of DMSO-d6 exhibitions signal at δSe= 179.27ppm ascribed to selenone of C=Se group, (see Figure 2a).

1HNMR spectra of complex of K[Zn(L)Cl] in DMSO-d6 revealed no peaks around 9.00 and 4.00ppm that may be allotted to the (N1-H) and (N2-H) groups, respectively, indicating that the N-H group was deprotonated at the time formation of complex [17]. The doublet of peaks at 8.45 and 8.24ppm correspond to two protons in the complex, which have been assigned to the aromatic protons (C3, 3'-H) and (C11, 11'-H) respectively. In comparison to the upfield chemical shift observed in free ligand H2L, these protons appeared to be looking downfield due to the stiffness that happened during the formation of the complex, (see Figure 1b).

Peaks at 174.75 and 167.15ppm are given to the (C-O) and (C-Se) moiety, respectively, in the 13CNMR spectra of K [Zn (L) Cl] complexes in solvent of DMSO-d6, (see Figure 2b). The complexations cause a considerable upfield shift of C-O and C-Se compared to the free ligand, indicating which the C-O and C-Se groups are involved in the coordination. As a result of the metal center's ability to de-localize electron density to the ligand-system (especially the selenium d-system), C-O and C-Se exhibit lesser order of bond and greater selenide character than C-Se. At 150.13ppm, a signal linked with the imine moiety emerged, which occurred with stronger chemical shifting than the free ligand. This is due to the imine group's role, in complexation. The 77SeNMR spectrum of K[Zn(L)Cl] in solvent of DMSO-d6 show a signal at 254.15 ppm, which corresponds to the (C-Se) group. In comparison to free ligand, the chemical shift of signals showed downfield, indicating formation of complex and ligand coordination to the centre of metal in forms of selenide [17]. (See Figure 3)

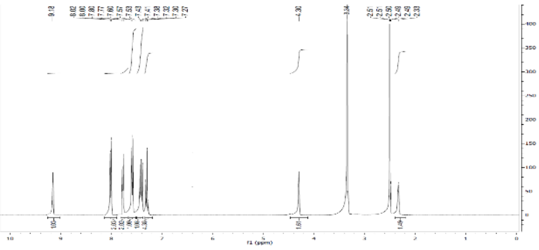


Figure (1a): 1HNMR spectrum of H2L.

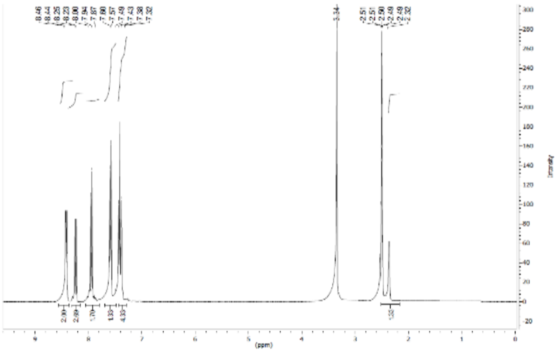


Figure (1b): 1HNMR spectrum of Zn-Complex.

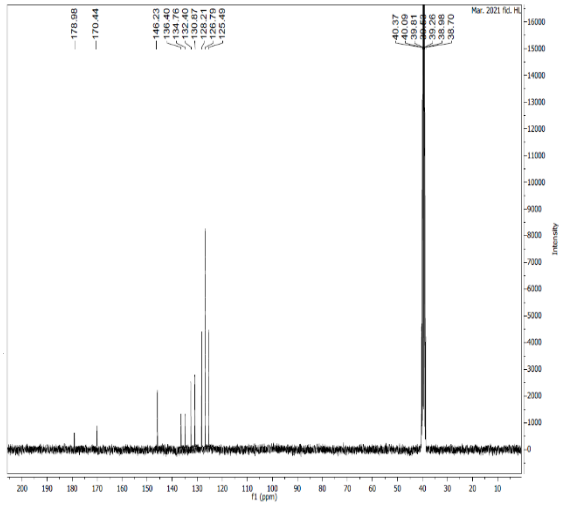


Figure (2a): 13CNMR spectra for H2L.

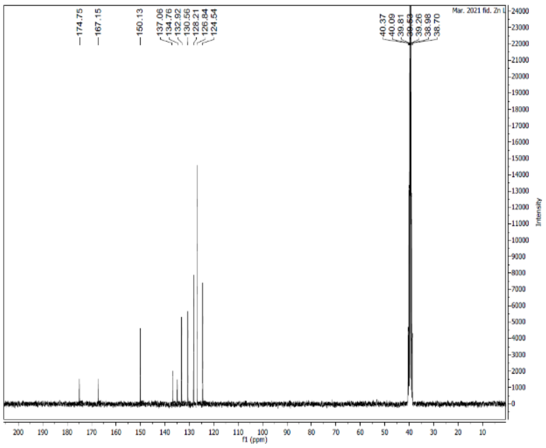


Figure (2b): 13CNMR spectra for K [Zn (L)Cl].

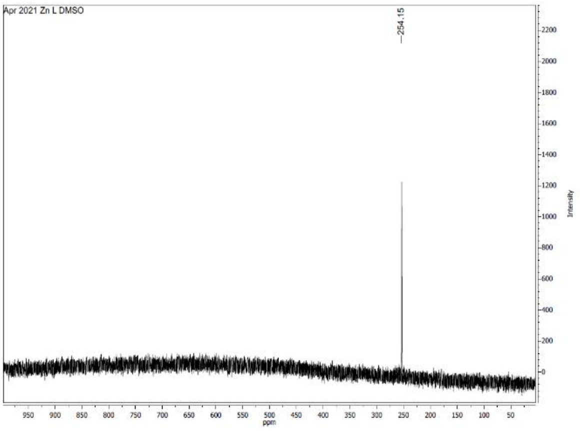


Figure (3): 77SeNMR spectra of K [Zn(L)Cl].

3.3 Mass Spectra

Positive ESM of spectrum of H2L presented a peak with m/z= 331.3 [(M+H)]+ (11%) to C15H13N3OSe, requires= 330.3 Peaks detected at m/z=305.2 (10%), 220.5 (53%), 130.3 (100%) and 67.3 (10%) correspond to [M+H-(C2H2)]+, [(M+H)-{(C2H2)+(N2+C3NH7)}]+, [(M+H)-{(C2H2)+ (N2+C3NH7)+(C7H6)}]+ and [(M+H)-{(C2H2)+(N2+C3NH7)+(C7H6)+(C3H7O+2H2}],respectively, (see Figure 4a).

K [Cu (L) Cl] electrospray (+) mass spectrum displays peak atm/z= 428.2[(M+H)] + (23%) for C15H11ClCuN3OSe requires= 427.2amu. Peaks noticed at m/z= 370.1 (21%), 305.2 (95%), 130.3 (100%) and 55.3 (20%) related to [(M+H)-(C4H10)]+, [(M+H)-{(C4H10)+(N2H4+C2H5+2H2)}]+, [(M+H)-{(C4H10)+(N2H4+C2H5+2H2)+(CO+C3H7N+CSe)}]+, [(M+H)-{(C4H10)+(C3H2N2)+(CO+C3H7N+CSe) +(C3H3Cl)}]+, respectively, (see Figure 4b).

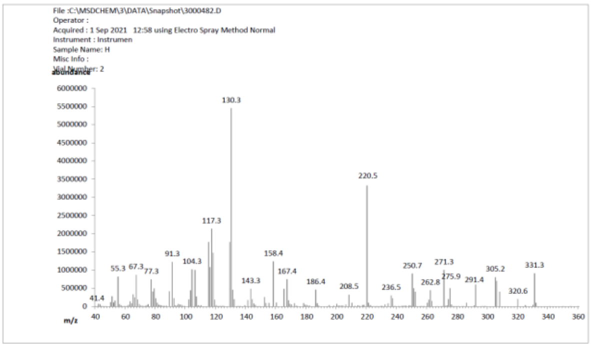


Figure (4a): The ESMS spectrum for H2L.

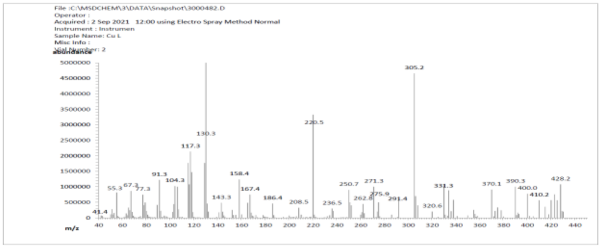


Figure (4b): The ESMS spectrum for K [Cu(L) Cl]complex.

3.4 UVvisible information and Magnetic moment measurement

Table (2) shows of data of UVvis-spectral of the H_2L and also its complexes. At 267 and 318nm, the free ligand H_2L and also its complexes showed two for the intra-ligand,

due to ($\pi\rightarrow\pi*$, and $n\rightarrow\pi*$); respectively [17].
Additional bands in the region of 278-390nm have been ascribed to ($\pi\rightarrow\pi*$, $n\rightarrow\pi*$) and charge transfer, in electronic spectra for H$_2$L complexes [18]. Complex of Cu(II) electronic At 757 and 856nm, there are peaks in the d-d area, attributable to a transition from d to d, types $^{2}B_{1}g\rightarrow{}^{2}B_{2}g$ and $^{2}B_{1}g\rightarrow{}^{2}A_{2}g$ respectively [19-21]. The deformed square planar geometry of the Cu atom was established [22]. Complex of Cu (II) was completed according to the geometry indicated. As well as, magnetic moment value denoted a deformed square planar configuration around the Cu atom [23]. The spectra of Zn (II) and Cd(II) complexes had exposed peaks which was assigned for the ligand field and Charge transfer [24]. The structure's tetrahedral geometry was predicted for the Zn (II) and Cd (II) centers [25].

Table2: Magnetic moments and UVvis spectral data in the solutions of the DMSO.

Compounds	μeff (BM)	λnm	Emax dm3 mol-1 cm-1	Assignment
H2L	-	267 318	660 1321	π → π* n→ π*
K[Cu(L)Cl]	1.70	295 370 757 856	2332 1356 45 47	π→π* n→π* 2B1g→2B2g 2B1g→2A2g
K[Zn(L)Cl]	Diamagnetic	278 320 375	944 832 1245	π→π* n→π* C.T.
K[Cd(L)Cl]	Diamagnetic	280 340 390	644 732 1145	π→π* n→π* C.T.

3.5 Thermal Analyses

The H2L ligand, as well as its metal complexes, were subjected to TGA and DSC analysis. TGA curves of H2L, and also its metal complexes, have been fixed in an argon environment from ambient temperatures to 600 ºC. The thermal study of H2L discovered the ligand is persistent up to 97.2 ºC. Peaks can be seen in the DSC curves at temperatures of 110.4, 180.3, 255.1, and 470.3 °C. The temperature reached a peak between 97.2 and 260.2 degrees Celsius. The loss of (C5H6) fragments that ascribed to (obs.= 4.0110mg; calc.= 4.0220mg, 20.11%). The loss of the (N2H4+C5H12) fragment (obs.= 5.6255mg; calc.= 5.6300mg, 28.15%) was measured in the second step at 381.4 ºC.

The thermal decay data of complex of K[Cu(L)Cl] looked to be persistent up to 98.1 ºC. The DSC study documented peaks at 190.1, 248.9 and 465.8 ºC which involved exo- and endo-thermic phases, (see Figure 4). The curve of TGA, first stage which noticed round 88.1-213.4 ºC, associated to the removal of (N2H2+C2H2) fragments, (obs.= 2.7144 mg; calc.= 2.7411 mg, 13.05%). Points distinguished at 351.3, and 495.4 ºC due to the loss of (H2Se+C5H2) (obs.= 7.0183mg; calc.= 7.0287mg, 33.47%) and (C4H6NO) (obs.= 4.0066mg; calc.= 4.1559mg, 19.79%), respectively.

While complex of Cd(II) metal displayed is sturdy up to 110.2 oC. The DSC study appeared peaks at 234.6, 255.4, 326.6 and 499.8 ºC which comprised exo- and endo-thermic for overhead temperatures.

The analysis of TGA presented peaks round 110.2-193.8 ºC showed the elimination of (N2+C6H5) molecules (obs.= 4.4460mg; calc.= 4.4460mg, 22.23%). Peaks distinguished at 306.3, and also at 448.8 ºC accredited to the loss of (C7H6) (obs.= 3.8680mg; calc.= 3.8020mg, 19.01%) and (C3H2NCl) (obs.= 3.6240mg; calc.= 3.6640mg, 18.32%), respectively, (Figure 5).

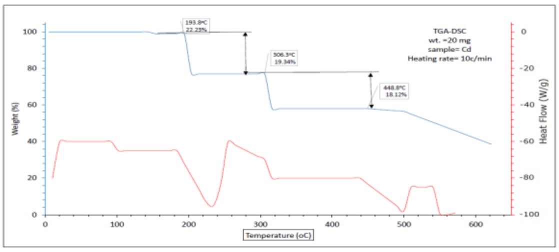


Figure (5): TGA and DSC analyses of Cd(II)-complex.

3.6 Bacterial Activity

Studies of bacterial activities of H2L and likewise its metals complexes were surveyed versus four of kinds of bacterial strains, such as; Escherichia coli strain, Staphylococcus aureus strain, Klebsiella pneumoniac strain and Bacillus sabtuius strain, applying the medium of agar approach of Mueller Hinton [26]. The sample has concentration which used in the test is 100ppm, in DMSO. The plates were proximately incubated, round 37oC to 24 hours.

Models were put to the test by measuring the thickness of the inhibitory zones in millimeters. DMSO solution was used as a control in an experiment that showed no activity versus any bacterial strains. Generally, when acylselenourea complexes are coordinated with metal ions, their bacterial activity are found to increase when compared to the free acylselenourea ligand. Metal complexes were shown to be more active than free H2L ligand, and they also had bacterial activities that were not seen in the free H2L.

Using the disc diffusion method, the free acylselenourea H2L ligand, and also Cu(II), Zn(II), and Cd(II) ions complexes, were partitioned versus Gram negative E. coli, Bacillus sabtuius, and Klebsiella pneumoniac bacteria strains, as well as Gram positive S. aureus bacterium strains. Only Gram negative strains of Escherichia coli showed antibacterial activity with Ligand. Compared to the free ligand, the acylselenourea complexes had antibacterial activity against all species of bacteria, however the Cu(II)-complex had less activity than the other complexes. Additional, as compared to other complexes and the free H2L ligand, the Zn(II) complex had better activity against all species of bacteria. The chelation hypothesis and Overtone's model may be used to explain the rise in complexes' activity [27, 28]. The development of the complex might be a supportive complex for crossing the microbe's cell membrane, depending on the chelation procedure. Chelation reduces the polarity of metal ions, enabling the metal to partially share its positive charge with the donor groups. Delocalizing metal charge into the ligand system throughout the whole chelate system might accomplish this. That is, the nature of the enhanced lipophilic metal chelate system facilitates its movement through the lipid layer cell membranes of microorganisms. (See Figure 6 and 7).

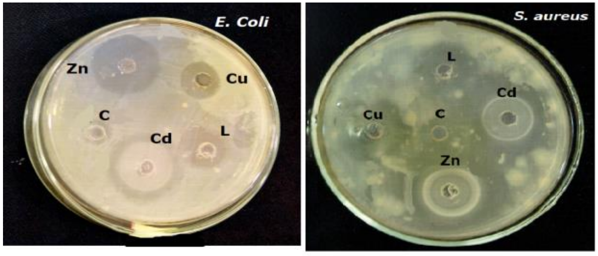


Figure (6): Inhibition diameter of H2L and also its complexes against E. coli and S. aureus.

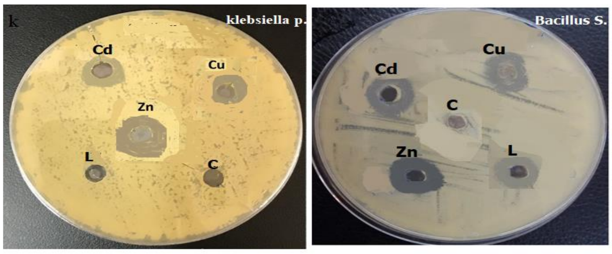


Figure (7): Inhibition diameter of H_2L and also its complexes against Klebsiella P. and Bacillus S.

4. Conclusions

A novel acylselenourea ligand and three coordination metal complexes (M = Cu(II), Zn(II), and Cd(II)) are synthesized and characterized. The H2L was created by reacting acyl-chloride with KSeCN with NH2NH2 as a precursor. During complexation, the main ligand functioned as a mono basic species that was coordinated to the metal's center by selenium, oxygen, and nitrogen atoms. Many different physicochemical tests, including thermal properties, have been used to fully identify the H2L and also its metal complexes. Spectroscopic and analytical investigations of H2L with Cu(II), Zn(II) and Cd(II), metals ions revealed the production for three coordinate complexes. The biological actions of the title compounds against various bacteria species have also been investigated. In compared to free ligand, acylselenourea complexes been demonstrated to have higher antimicrobial activity.

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