Synthesis and Identification of Some New Metal Complexes of Mixed Schiff Base Ligands

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Abstract: The free Schiff base ligand (HL₁) which was prepared mixed with the Schiff base ligand (HL₂). The product then was reacted with some transition metal salts: (Cr³⁺, Ni²⁺, Cd²⁺, Mn²⁺, Zn²⁺ and Pd²⁺) to get new transition metal complexes. The ligand which were prepared and their transition metal complexes were characterized by physic-chemical spectroscopic techniques such as: FT-IR, UV-Vis, (C.H.N) spectra, molar conductivity, magnetic moment, mass spectrometer techniques and microanalysis techniques. The results showed the formation and the high purity of the free Schiff base ligands and their metal complexes, indicating that they are in a good agreement with the theoretical values. The fragments of the prepared free Schiff base ligand were identified by mass spectrometer techniques. All analysis of ligands and their metal complexes were in good agreement with the theoretical values which indicated the purity of Schiff base ligands and their metal complexes. From the above data, the molecular structures for all the metal complexes where proposed to be octahedral except Capper and Palladium were square planar.

Keywords: Synthesis, identification, transition metal complexes, Mixed ligand, Schiff base.

1. Introduction

The branch of inorganic chemistry that deals with the study of coordination compounds is called coordination chemistry (¹). The concept of a metal complex has been originated by Alfred Werner who (in 1913) was awarded the first Nobel Prize in inorganic chemistry. (²) Whereas the study of a range of coordination compounds is connected to the nature of metal and the ligand (³). In general, coordination compound is a metal surrounded by neutral molecules or ions called ligands. Ligands are Lewis bases they contain at least one unshared electrons. They are also called complexing agents. Metal ions have empty valance orbitals, they act as Lewis acids (⁴).

Schiff base In modern coordination chemistry, many different inorganic and organic compounds are used as ligands. But there are two most important classes of ligands in the modern coordination chemistry, namely, azomethines and oximes (⁵). On the other hand ligands, a metal surrounded by a cluster of ions or molecules are used for preparation of complex compounds named as Schiff's bases (⁶). Tetra-dentate Schiff's bases are well known for their coordination with various metal ions, forming stable compounds (⁷⁸⁹). In general Schiff bases (azomethines) have been known since 1864 when Hugo Schiff reported the condensation of primary amines with carbonyl compounds. Now days, the research field dealing with Schiff base coordination chemistry has expanded enormously (¹⁰). The common imines are crystalline solids, which are feebly basic but at least some form insoluble salts with strong acids (¹¹). On the other hand the color of the Schiff bases are due to the presence of this azomethine (>C=N) linkage and can vary by introducing other auxochromatic group (¹²).

2. Experimental

A. Instrumentation

Melting point measurements were carried out at the laboratories of the College of Science for women, University of Baghdad, Ultraviolet- Visible Spectrophotometer type (UV-160A Shimadzu) in the region 200-1100 nm. The measurements were carried out at the laboratories of Ibn-Sina Company Baghdad, Iraq. FT.IR Spectra Infrared spectra of the prepared compounds were recorded as potassium bromide disc by using Shimadzu, (8400S) Fourier Transform Infrared Spectrophotometer in the range 4000-400 cm⁻¹. The spectra were carried out at the laboratories of Ibn-Sina Company Baghdad, Iraq. Element (C.N.H) and Molar conductivity Electrical conductivity measurements of the complexes were recorded at (25°± 2°C) for (1×10⁻⁵M) M solution of the samples in DMSO, using a Philips PW-digital conductivity meter. The measurements were carried out at College of Science, University of Babylon.

B. Synthesis of Compounds

1. Preparation of (Z) 4 (2-hydroxybenzylideneamino)-1, 5-dimethyl-2-phenyl-1H-pyrrozol-3 (2H) -one (L₁)

The Schiff base ligand was prepared by the condensation of the p-amino-2, 3-dimethyl-1-phenyl-3-pyzolare-5-on (0.5 g, 0.0247 mol) with the (0.26 cm³, 0.0247 mol) salicylaldehyde in methanol 15cm³. The resulting mixture was then refluxed for 1h. The yellow solid was collected by filtration, dried at (40°C) for five hours and then recrystallized from absolute ethanol to give yellow needles, collected by filtration and then dried in oven for four hours at temperature (60°C), m.p (188-189°C) and the yield (86%).

2. Preparation of Schiff base ligand (2- (2-hydroxy benzylideneamino) ethyl) isoindoline-1, 3-dione (L₂)

A Synthesis of 2-(2-aminoethyl) isoindoline-1, 3-dione: Isobenzofuran-1, 3-dione (0.148 g, 1 mole) was dissolved in
absolute ethanol (15 cm$^3$) with stirring. 2-Aminoethanaminium (0.06 g, 1 mole) was dissolved in absolute ethanol (10 cm$^3$) and added to the tosobenzofuran-1, 3-dione solution were mixed in 1:1 mole ratio. The mixture solution was heated under reflux at temperature (40 °C) for (2 hours). During this period, a white precipitate was formed. The white solid was collected by filtration and then washed with ethanol (2 cm$^3$) and then dried in oven at temperature 50-70 °C for two hours, and then kept in desiccator, m.p (123-125 °C) & the yield (88 %)

2- (2-aminoethyl) isoindoline-1, 3-dione (0.19 g, 1 mole) was dissolved in absolute ethanol (15 cm$^3$) with stirring. Salicylaldehyde (0.122 g, 1 mole) was dissolved in absolute ethanol (5cm$^3$), and added to the 2- (2-aminoethyl) isoindoline-1, 3-dione solution were mixed in 1:1 mole ratio. The mixture was heated with stirring under reflux at temperature (40 °C) for 3 hours. During this period the colorless solution turned to the yellow solid. The yellow solid was collected by filtration and then washed with absolute ethanol and then dried in oven for six hours at temperature (60 °C) and then recrystalized from absolute ethanol. The yellow powder collected by filtration and then dried in oven for five hours at temperature (60 °C), m.p (115-117 °C) and the yield (87 %). The white solid was collected by filtration and then washed with ethanol (2 cm$^3$) and then dried in oven at temperature 50-70 °C for two hours, and then kept in desiccator, m.p (123-125 °C) & the yield (88 %)

3. Preparation of Cu$^{2+}$ Complex

Schiff base ligand 4- (2-hydroxybenzylideneamino) -1, 5-dimethyl-2-phenyl-1H-pyrazol-3 (2H) -one (L$^1$) (1 g, 3.253 mmole) was dissolved in absolute ethanol (20 cm$^3$), Copper (II) chloride (0.437 g, 3.253 mmole) was dissolved in absolute ethanol (15cm$^3$) and added to the 4- (2-hydroxybenzylideneamino) ethyl] isoindoline-1, 3-dione (L$_2$) was added to the mixture in each case. The solution mixture was refluxed for 4 hours. The mixture was stirred and heated under reflux for two hours at temperature (50-70 °C). During this period, the colour changed for all complexes. The precipitate was collected by filtration, washed with absolute ethanol (10cm$^3$), and then recrystalized from absolute ethanol. A dark-green were obtained, m.p. (244-246 °C), Yield: 77%.

A similar method as described in section (3) to prepare the other complexes.

3. Result and Dissection

FT-IR spectra

In table (1) The Infrared spectra of the both free Schiff base ligands were measured in the range (4000-400) cm$^{-1}$, using KBrpellets.

The infrared spectrum of the free Schiff base ligand, 2[2 (2-hydroxybenzylideneamino) ethyl] isoindoline-1, 3-dione (HL$_1$) appeared weak a broad band at (3433) cm$^{-1}$ was attributed to the stretching vibration of (OH) because of the intra molecular hydrogen bonding (13).

The band at (3410) cm$^{-1}$ stretching vibration (OH) of the free Schiff base ligand (HL$_2$), the same band appeared (3410) cm$^{-1}$ in the palladium complex that means no coordinated the oxygen atom of phenolic group to the palladium complex.

The band at (2974) cm$^{-1}$, (2812) cm$^{-1}$, (1724) cm$^{-1}$, (1608) cm$^{-1}$, (1546) cm$^{-1}$ were assigned to the stretching vibration of $\nu$ (C-H) aromatic, $\nu$ (C-H) aliphatic, $\nu$ (C=O), $\nu$ (C=N) and (C=C) respectively. The other bands at (1249) cm$^{-1}$ was attributed to stretching vibration $\nu$ (C-C), 1072 cm$^{-1}$ due to $\nu$ (C-O).

The infrared spectrum of the other free Schiff base ligand, 4- (2-hydroxybenzylidene amino) -1, 5-dimethyl-2-phenyl-1H-pyrazol-3 (2H) -one (HL$^2$). The weak broad absorption band at (3410) cm$^{-1}$ due to the stretching vibration of (OH) due to intramolecular hydrogen bonding.

The FT-IR spectra of the prepared complexes where compared with that of free ligands (HL$_1$) and (HL$_2$) in order to determine the coordination sites involved in complexation, that is mean the position of some guid bands in the spectrum of the free ligands where expected to change up on complexation.

The band at 3433 cm$^{-1}$ and 3410 cm$^{-1}$ of the free Schiff base ligands, (HL$_1$) and (HL$_2$) respectively are absent in the Ni (II), Cu (II), Mn (II), and Zn (II) complexes which is indicated the deprotonation of phenol proton prior to and indicated the coordination of the phenolic group with Nickel Copper, Manganese and Zinc ions. The bands at (3371-3402) cm$^{-1}$ and medium sharp band appeared at (933) cm$^{-1}$ and (964) cm$^{-1}$ where assigned to the stretching vibration and rocking of (OH) of water which were indicated the presence of water molecules inside the coordination sphere of the Mn (II), Zn (II), and Cd (II) complexes respectively.

The bands at (3394) cm$^{-1}$ and (3367) cm$^{-1}$ due to stretching vibration of hydrated water molecule of Cu (II) complex

The band at (1685) cm$^{-1}$ which is belong to the carbonyl group of (HL$_2$) was shifted to lower frequency in the prepared complexes Nickel, manganese, Zinc and cadmium complexes, which is indicated to coordinated with the above metal ions (14). The bands of (C=O) in the free Schiff base ligands, (HL$_1$) and (HL$_2$) which are observed at (1608) cm$^{-1}$ and (1627) cm$^{-1}$ respectively were shifted to lower frequency in all the spectra of the prepared complexes, this indicates the participitation of the nitrogen atom of the azomethine group in coordination. The bands which are observed at rang (1492-1585) cm$^{-1}$ assigned to the stretching vibration of (C=C) for all the spectra of metal complexes. The band at (3433) cm$^{-1}$ in the free Schiff base ligand (HL$_2$) showed no changed in the spectrum at Cadmium complex, this indicated uncoordinated the oxygen of phenolic group of the Schiff base ligand (HL$_1$).

| Table 1: FT-IR of free Schiff base ligands and their metal complexes in (cm$^{-1}$) |
|---------------------------------------------------------------|
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Mass Spectrometer
The mass spectrum of the 2- (2-aminoethyl) isoindoline-1, 3-dione has been studied at temperature (210°C). The main high resolution mass spectrometer of this compound is obtained at 210°C which is appeared at very clear and higher relative abundance. The molecular ion peak was observed at m/z=190 (M) (relative abundance is 65%) for C9H6O2N2 which is in excellent agreement with the theoretical value. The other peaks are detected at (M/Z=194) (relative abundance is 63%), corresponding to [M (190) + (C9H4O2N2)] and [M (190) - (C9H4O2N2)] respectively. The other peaks which is obtained from the fragmentation of C9H8O2N2 (M/Z=194) are detected at m/z=166 (relative abundance is 10%), 165 (relative abundance is 100%) and 147 (relative abundance is 10%). All the fragmentations can be shown in table (2) Figure (1) and scheme (1).

Table 2: The fragmentation pattern data for the 2- (2-aminoethyl) isoindoline-1, 3-dione at 210°C

| Molecular ion | Relative abundance | Assignment |
|---------------|-------------------|------------|
| 190           | 65%               | C9H6O2N2   |
| 165           | 100%              | C9H6O2N2   |
| 147           | 10%               | C9H6O2N2   |
| 194           | 63%               | C10H10O2N2 |
| 194           | 63%               | C10H10O2N2 |
| 166           | 10%               | C10H10O2N2 |
| 165           | 100%              | C10H10O2N2 |
| 147           | 10%               | C10H10O2N2 |

The main high resolution mass spectrometer of the free Schiff base ligand, 2-[2-hydroxybenzylideneamino] ethyl] isoindoline-1, 3-dione is carried out at temperature (170°C) which is illustrated in figure (2), table (3) and Scheme (2). The molecular ion peak for the free Schiff base ligand was showed at m/z=294 (M) (relative abundance is 33%) for C17H12O2N2 which is in a good agreement with the theoretical value. The other molecular ion peaks are detected at m/z=268 (relative abundance is 100%), 194 (relative abundance is 8%), 166 (relative abundance is 100%), 146 (relative abundance is 100%) and 147 (relative abundance is 12%) corresponding to [M (294) - (C9H4O2N2)], [M (268) - (C9H4O2N2)], [M (194) - (C9H4O2N2)], [M (194) - (C9H4O2N2)] and [M (134) - (C9H4O2N2)] OR [M (294) - (C9H4O2N2)], [M (268) - (C9H4O2N2)], [M (194) - (C9H4O2N2)] and [M (134) - (C9H4O2N2)].

Table 3: Fragmentation pattern data for the free Schiff base at temp.170°C

| Molecular ion m/z | Relative abundance | Assignment |
|-------------------|-------------------|------------|
| 294               | 33%               | C17H12O2N2 |
| 268               | 100%              | C17H12O2N2 |
| 194               | 8%                | C17H12O2N2 |
| 166               | 100%              | C17H12O2N2 |
| 146               | 63%               | C17H12O2N2 |
| 134               | 8%                | C17H12O2N2 |
| 120               | 12%               | C17H12O2N2 |
Scheme (2) The fragmentation pattern of Schiff base ligand (2- (2- (2-hydroxy benzylideneamino) ethyl) isoindoline-1, 3-dione at 170°C

Figure 1: Mass spectrum of Schiff base from 2- (2- amino ethyl) iso – indoline – 1, 3 – doine at 210°C

Figure 2: Mass spectrum of Schiff base (HL₁) at temp. 170°C.
The color of the prepared transition metal complexes are different from the color of their metal salts and ligands, this is good indication of coordination of the central metal ion through the donor atoms of their ligands, therefore the color of the prepared transition metal showed different characterization and positions (16-17). Electronic spectra of 2-(2-aminoethyl) isoindoline-1, 3-dione and Schiff base ligands

The electronic absorption spectra in the ultraviolet and visible region of the spectrum are characterized by the presence of several sharp bands of relatively high intensity and high molar absorptive the weak broad absorption band which are appeared in the visible region of the spectrum with low absorption intensity and low molar extinction coefficient belong to the transition of the metal ions within the (d-d) electronic transition (15).

The visible electronic spectra of the prepared metal complexes should lend themselves most easily to theoretical interpretation because of the presence of unpaired electrons in the d– orbital.

The spectrum of the free Schiff base ligand (HL1) showed two absorption bands, the first band at (266nm, 37593cm⁻¹) attributed to (π-π*) electronic transition, the second band at (316nm, 31645cm⁻¹) assigned to (n-π*) electronic transition of azomethine group as illustrated in figure (5).

The spectrum of the second free Schiff base ligand (HL2) exhibited two absorption bands, the first band at (271nm, 36900cm⁻¹) due to (π-π*) electronic transition.
Electronic spectra of the prepared metal complexes

The electronic transitions of the complex are characterized to the octahedral geometry around the nickel ion, the value of magnetic effective is 3.04 B.M. which confirmed the suggested structure is octahedral geometry around to nicked ion (20, 21).

The spectrum of copper complex, \([\text{Cu (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) showed four absorption peak, the first peak is high intensity and high molar extinction coefficient displayed at (272nm, 36764cm\(^{-1}\)) attributed to (\(\pi-\pi^*\)) electronic, the second peak at (357nm, 28011cm\(^{-1}\)) assigned to (n-\(\pi^*\)) electronic transition, the third peak at (492nm, 20408cm\(^{-1}\)) attributed to (d-d) transition type (\(^2\)B\(_{1g}\)\(\rightarrow\)\(^2\)E\(_g\)) and the fourth peak appeared low intensity absorption and low molar extinction coefficient is observed at (998nm, 10020cm\(^{-1}\)) can be assigned (\(^2\)B\(_{1g}\)\(\rightarrow\)^3A\(_{1g}\)) electronic transition. From these electronic transitions which is suggested the copper complex is octahedral geometry around the copper ion (22, 23) which is illustrated in figure (8).

The spectrum of manganese complex, \([\text{Mn (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) which is illustrated in figure (9) exhibited four absorption bands, the first second and third are high intensity absorption and high molar extinction coefficient are appeared at (274 nm, 36496 cm\(^{-1}\)) and (345nm, 28958 cm\(^{-1}\)) and (357nm, 28011 cm\(^{-1}\)) assigned to (n-\(\pi^*\)), (n-\(\pi^*\)) and charge transfer (C.T.) with in (\(^5\)A\(_{1g}\)\(\rightarrow\)^3A\(_{1g}\), \(^4\)E (g)) electronic transitions, we can suggested the manganese complex is octahedral geometry around the manganese ion (24, 25).

The spectra of Zinc and Cadmium complexes \([\text{Zn (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) and \([\text{Cd (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) showed three absorption bands, the first bands, the first bands at (266nm, 37594 cm\(^{-1}\)), and (267nm, 37453cm\(^{-1}\)) due to (n-\(\pi^*\)) the electronic transitions, the other absorption bands are high intensity absorption and high molar extinction coefficients appeared at (245nm, 28985 cm\(^{-1}\)) and (357 nm, 28011 cm\(^{-1}\)) attributed to (n-\(\pi^*\)) and charge transfer (C.T.) electronic transitions respectively. The absence of the absorption bands in the visible range in the electronic spectra of Zinc, and Cadmium complexes indicated no (d-d) electronic transitions happened because of the electronic configuration of the above metal and d-system. The value of magnetic moment of these metal ion were found to be 0.0B.M (diamagnetic) which are in a good agreement with theoretical values of the magnetic moment and form the corresponding electronic transition 10, 24-27).

The spectrum of Palladium complex, \([\text{pd (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) as shown in figure (12) gave absorption bands, the first sharp band appeared five at (265nm, 37736 cm\(^{-1}\)) attributed to (\(\pi-\pi^*\)) electronic transition the second band at (357nm, 28011 cm\(^{-1}\)) assigned to (n-\(\pi^*\)) electronic transition the third absorption band is high intensity absorption and high molar extinction coefficient appeared at (245nm, 28985 cm\(^{-1}\)) and (357 nm, 28011 cm\(^{-1}\)) attributed to (n-\(\pi^*\)) and charge transfer (C.T.) electronic transitions respectively. The absence of the absorption bands in the visible range in the electronic spectra of Zinc, and Cadmium complexes indicated no (d-d) electronic transitions happened because of the electronic configuration of the above metal and d-system. The value of magnetic moment of these metal ion were found to be 0.0B.M (diamagnetic) which are in a good agreement with the theoretical values of the magnetic moment and form the corresponding electronic transition which are confirmed these complexes are octahedral around Zinc, and Cadmium ions (28-30) as shown in figure (10) (11).

Electronic spectra of the prepared metal complexes

The spectra of the nickel complex, \([\text{Ni (L}_1\text{) (L}_2\text{) }\text{H}_2\text{O}],\) in figure (7) exhibited five absorption bands, the first absorption band at (268nm, 37313cm\(^{-1}\)) attributed to (\(\pi-\pi^*\)) electronic transition, the second absorption bands at (345nm, 28985cm\(^{-1}\)) attributed to (n-\(\pi^*\)) electronic transition, the other three absorption bands appeared at (416nm, 24038cm\(^{-1}\)), (453nm, 22075cm\(^{-1}\)) and (763nm, 13698cm\(^{-1}\)) can be assigned to charge transfer (C.T.), (\(^3\)A\(_{1g}\) (F)\(\rightarrow\)^3T\(_{1g}\) (p) ) and (\(^3\)A\(_{2g}\) (F)\(\rightarrow\)^3T\(_{1g}\) (F) ) electronic transitions respectively.

The value of magnetic moment of these metal ion were found to be 0.0B.M (diamagnetic) which are in a good agreement with the theoretical values of the magnetic moment and form the corresponding electronic transition which are confirmed these complexes are octahedral around Zinc, and Cadmium ions (28-30) as shown in figure (10) (11).
theoretical value. Know the value of magnetic effective and electronic transition indicated the palladium complex is square planar geometry around the Palladium ion (31-33). The suggested geometry of the complexes was demonstrated at figures (13-18).

Table (5) the electronic spectra of 2-(2-aminoethyl)indoline-1,3-dione, free ligands and their metal complexes (conc. 1 x 10^{-3} mole /L).

| Compound | λ | Δ | ε | Assignment | Suggested structure |
|----------|---|---|---|------------|---------------------|
|          | 255 | 3636 | 2220 | 2220 | 1 - π* |
|          | 269 | 3755 | 3740 | 3740 | 1 - π* |
|          | 261 | 3616 | 3339 | 3339 | 1 - π* |
|          | 271 | 3609 | 1149 | 1149 | 1 - π* |
|          | 344 | 2909 | 2422 | 2422 | 1 - π* |
|          | 265 | 7773 | 1096 | 1096 | 1 - π* |
|          | 357 | 2810 | 1278 | 1278 | 1 - π* |
|          | 350 | 6315 | 1380 | 1380 | 1 - π* |
|          | 694 | 4409 | 6032 | 6032 | '1AAg'1H |
|          | 794 | 2594 | 6015 | 6015 | '1AAg'1Ag |
| [Ni(L_1)(H_2O)] | 232 | 3678 | 1323 | 1323 | 1 - π* |
|          | 357 | 2410 | 524 | 524 | C.T. Square planer |
| [Cu(L_1)(H_2O)] | 492 | 2025 | 310 | 310 | 1 - π* |
|          | 988 | 6020 | 111 | 111 | C.T. Square planer |
| [Mn(L_1)(H_2O)] | 266 | 7764 | 1647 | 1647 | 1 - π* |
| [Cu(L_2)(H_2O)] | 345 | 2895 | 205 | 205 | C.T. Octahedral |
|          | 357 | 2810 | 1244 | 1244 | C.T. Octahedral |
| [Co(L_1)(H_2O)] | 374 | 3684 | 1371 | 1371 | 1 - π* |
| [Co(L_2)(H_2O)] | 345 | 2895 | 1365 | 1365 | C.T. Octahedral |
| [Mo(L_1)(H_2O)] | 357 | 2810 | 1444 | 1444 | C.T. Octahedral |
| [Mo(L_2)(H_2O)] | 357 | 2810 | 1444 | 1444 | C.T. Octahedral |
| [Zn(L_1)(H_2O)] | 367 | 7743 | 1323 | 1323 | 1 - π* |
|          | 345 | 2895 | 2096 | 2096 | C.T. Octahedral |
| [Zn(L_2)(H_2O)] | 345 | 2895 | 2096 | 2096 | C.T. Octahedral |
| [Ni(L_1)(H_2O)] | 357 | 2810 | 1244 | 1244 | C.T. Octahedral |
| [Ni(L_2)(H_2O)] | 345 | 2895 | 2096 | 2096 | C.T. Octahedral |

Figure 7: Electronic spectrum of, [ Ni (L_1) (L_2) (H_2O) ] complex

Figure 8: Electronic spectrum of [Cu (L_1) (L_2) (H_2O) ] complex

Figure 9: Electronic spectrum of [Mn (L_1) (L_2) H_2O] complex

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Figure 10: Electronic spectrum of [Zn (L₁) (L₂) H₂O] complex

Figure 11: Electronic spectrum of [Cd (L₁) (L₂) (H₂O)] complex

Figure 12: Electronic spectrum of [pd (L₁) (L₂) H₂O] complex

Figure 13: Suggested the structure of [Zn (L₁) (L₂) H₂O]

Figure 14: Suggested the structure of [Mn (L₁) (L₂) H₂O]

Figure 15: Suggested the structure of [pd (L₁) (HL₂) Cl]

Figure 16: Suggested the structure of [Ni (L₁) (L₂) H₂O]

Figure 17: Suggested the structure of [Cd (HL₁) (L₂) Cl. H₂O]

Figure 18: Suggested the structure of [Cu (L₁) (L₂) H₂O]

4. Conclusion

1) From all the data of the infrared spectra of the metal complexes suggested that the metal ion coordinated to the Schiff base ligand through the oxygen atom of phenol
and the nitrogen atom of the azomethine groups respectively. According to the results characterization of the metal complexes by using different techniques UV-Vis, C.H.N., atomic absorption (A.A), magnetic moment and molar conductivity have been proposed geometric for complexes are octahedral for [Mn (L₂) (L₁) H₂O], [Ni (L₁) (L₂) H₂O], [Cd (HL₁) (L₂) Cl₂H₂O] and [Zn (HL₂) ᵃCl₂], square planar for [pd (L₁) (HL₂) CI] and [Cu (L₁) (L₂) H₂O].

2) The molar conductivity measurements of the complexes were indicated all complexes are non-electrolytic nature.

3) The magnetic measurements were indicated that the above metal Cu²⁺, Mn²⁺ and Ni complexes are paramagnetic, except the Pd²⁺, Zn²⁺ and Cd²⁺ complexes are diamagnetic.

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