



# Synthesis and characterization of novel Hg(II) complexes with new Schiff bases

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## ARTICLE INFO

### Article history:

Available online 11 March 2021

### Keywords:

Organic ligands

Schiff's bases

Mercury (II) complexes

## ABSTRACT

The research included the use of new Schiff's bases to prepare novel mercury (II) complexes as follows:

Schiff's bases ligands prepared using aromatic aldehydes and various aromatic primary amines [S<sub>1</sub>-S<sub>6</sub>]. Six mercury complexes [H<sub>1</sub>-H<sub>6</sub>] were prepared by the interaction of mild moles of organic Schiff's bases with 1 mol of mercury salt (CH<sub>3</sub>COO)<sub>2</sub>Hg. The Schiff's bases prepared spectroscopically were diagnosed by the UV-visible spectrum, the infrared spectrum (FT-IR), and the nuclear magnetic resonance spectrum (<sup>1</sup>H NMR). The reaction mechanism was proposed in light of these results, as it confirmed the validity of the proposed chemical compositions. Metallic complexes prepared spectrally were diagnosed by the UV-visible spectrum, the infrared spectrum and the mass spectrum (Lc-Mass), and analysis of the elements C.H.N.S. The mechanism of interaction was suggested in light of these results, as it confirmed the validity of the proposed chemical compositions, magnetic and electrical conductivity sensitivity of all the prepared complexes was measured. Lc-Mass spectrum results, analysis of the elements C.H.N.S, measurement of molar conductivity, magnetic moment measurements have proven that azomethine compounds interacting with cadmium chloride and mercury acetate are di ligand.

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Second International Conference on Aspects of Materials Science and Engineering (ICAMSE 2021).

## 1. Introduction

Organic complexes are important compounds in synthesis science [1–11]. Organic ligands have the ability to form metal complexes, and ligands possessing one or more atoms carrying an electron duplex have the ability to form a symmetric bond with a central metal atom [12]. The donor Schiff rules for an electron duplex may be an N atom in the azomethine group or O or S for substitutes that they are related to the central metal and by means of coordinating covalent bonds, and the organic ligands are single, double-clawed or multi-clawed according to the quality of the donor atom and the composition of the ligand [13]. Schiff bases are used as the ligands because they are more soluble in complexes with the common solvent and are also more stable [14]. It has importance in many industrial and biological fields, as the amine compounds containing the N atom are considered to be of great importance in the preparation of compounds that are of importance in the field of medicine. Example of one organic complexes

is the prepared complex by azomethine compounds and mercury (II).

## 2. Materials and methods

### 2.1. General procedure for prepare of azomethine compounds

Dissolve (0.0028 mol 0.5 g) of 4,5-dichloro-o-phenylenediamine in (20 mL of absolute ethanol in Baker's 30 mL capacity) and heated for 5 min at 50 °C, and at the same time dissolve (1.05 g, 0.0056 mol) of 4-Bromobenzaldehyde in (10 mL) in the same solvent in a baker's capacity (30 mL) with three drops of ice acetic acid as a catalyst and heated for 5 min at 50 °C. The contents were mixed in a round-bottom flask with a magnetic stirrer and a condenser. The mixture was period of (3 h) and after the completion of the sublimation period the solution was cooled, filtered and then recrystallized from absolute ethanol and the amine compound (S<sub>1</sub>) was obtained, and in the same way the rest of the amine compounds were prepared. Table 1 showed some physical properties of the prepared azomethine compounds [15].

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**Table 1**Colors, melting points, and percentages of yield of prepared azomethine compounds (S<sub>1</sub>-S<sub>6</sub>).

Yield %	m.p. °C	Color	Comp. Code
94	80–82	Red	S <sub>1</sub>
96	114–116	Yellowish green	S <sub>2</sub>
92	125–127	Dark red	S <sub>3</sub>
80	127–129	Yellow	S <sub>4</sub>
80	40–41	White Crystal	S <sub>5</sub>
88	164–166	Yellow light Crystal	S <sub>6</sub>

**Table 2**The UV-Visible spectra of synthesized azomethine compounds (S<sub>1</sub>-S<sub>9</sub>).

Transition	Max/nmλ	Compound
*π → π	235 nm	S <sub>1</sub>
n → π*	390 nm	
*π → π	235 nm	S <sub>2</sub>
n → π*	450 nm	
*π → π	235 nm	S <sub>3</sub>
n → π*	455 nm	
*π → π	235 nm	S <sub>4</sub>
n → π*	415 nm	
*π → π	235 nm	S <sub>5</sub>
n → π*	375 nm	
*π → π	235 nm	S <sub>6</sub>
n → π*	370 nm	

## 2.2. General procedure for synthesis of mercury II complexes

(0.3 g, 0.001 mol) of ligand (S<sub>1</sub>) was dissolved in (10 mL) of absolute ethanol in a baker's capacity (25 mL) heated for 5 min at a temperature of 50 °C. Then (0.0005 mol, 0.159 g) of mercury salt (CH<sub>3</sub>COO)<sub>2</sub>Hg was dissolved in (5 mL) of absolute ethanol in another baker (10 mL) capacity that was heated for five minutes, then the contents were mixed in a in a round-bottom flask equipped with a magnetic stirrer and a condenser for escalation for 3 h. After the end of the sublimation period, the solution was cooled, filtered, and then recrystallized from absolute ethanol. In the same way, all the mercury complexes were present after their reaction with the remaining ligands. Table 5 and 6 showed some physical properties and structures of the prepared Mercury II complexes [16,17].

## 3. Results and discussion

### 3.1. Azomethine compounds

Azomethine compounds were prepared from the reaction of a number of different aromatic aldehydes with different di-amines by escalating them in absolute ethanol and in the presence of drops of ice acetic acid as a catalyst for the reaction and as shown in the general equation for the following reaction (Fig. 1) [18–20].

The best yield of the prepared azomethine was for compound S<sub>2</sub> 96%, the higher m. p. for azomethine was for compound S<sub>4</sub> (250–

**Table 3**

The FT-IR of prepared azomethine compounds.

OtherGroups	ν C-Cl	ν = C-HAzomethine	ν = C-HAromatic	νC = NAzomethine	νC = CAromatic	νC-N	Comp.Code
---	1078	3140	3110	1640	1600	1093	S <sub>1</sub>
C-Br: 815	—	3208	3123	1610	1587	1064	S <sub>2</sub>
C-Br: 786, CN: 2221N-H: 3378	—	3114	3065	1647	1613	1060	S <sub>3</sub>
C-Br: 786,C-F: 1245	—	3275	3148	1620	1585	1076	S <sub>4</sub>
C-Br: 777	1064	3150	3085	1665	1586	1092	S <sub>5</sub>
CN: 2219,N-H: 3328	1061	3205	3040	1645	1614	1091	S <sub>6</sub>

**Table 4**The <sup>1</sup>H NMR spectra of some prepared azomethine compounds.

Number of proton and type of Single	Chemical shift (ppm)δ	Functional Group	Comp. Code
(2H) Singlet(16H) Multiplet	δ = 8.3=δ 7.33–8.08	2CH = NAr = CH	S <sub>4</sub>
(2H) Singlet (10H) Multiplet	=δ 9.99	2CH = N	S <sub>5</sub>
(2H) Singlet	=δ 7.80–7.88	Ar = CH	
(2H) Singlet	δ = 12.96	2CH = N	S <sub>6</sub>
(2H) Singlet	=δ 8.49	NH–	
(2H) Singlet	=δ 9.99	2 = CH five membered cycle	
(8H) Multiplet	=δ 7.61–8.40	Ar = CH	

251 °C), see table 1 for some physical properties of azomethine compounds.

#### 3.1.1. Solubility of azomethine compounds

All prepared azomethine compounds soluble in absolute ethanol, absolute ethanol, DMSO and insoluble in distilled water.

#### 3.1.2. Uv-Visible spectra of azomethine compounds

The compounds were diagnosed with Uv-Visible spectra, the transitions of S<sub>1</sub> shows the transition of type π → π\* at (235 nm) caused by C = C bonds of aromatic rings and transitions of type n → π\* for C=N group at (430 nm) [21]. Table 2 shows the types of transitions and wavelengths for all prepared ligands.

#### 3.1.3. Ft-Ir spectra of azomethine compounds

As for the FT-IR spectra of the prepared azomethine compounds, they are as follows: The spectrum of the compound (S<sub>1</sub>) showed a stretch absorption beam at (1640 cm<sup>-1</sup>) belongs to C = N, stretch absorption bundle belongs to C = C aromatic at (1600 cm<sup>-1</sup>), stretch absorption refers to aromatic C-H at (3110 cm<sup>-1</sup>), and stretch absorption bundle belongs to C-H of azomethine at (3140 cm<sup>-1</sup>), stretch absorption band returns to C-N at (1093 cm<sup>-1</sup>) [22]. Table 3 shows all absorption band of all azomethine compounds.

3.1.3.1. H Nmr spectra of azomethine compounds. The <sup>1</sup>H NMR spectra of compound (S<sub>4</sub>) showed a signals at the chemical shift (δ ppm) as follow: (δ = 8.3) belonging to the group proton HC = N and a multiple signal at (δ = 7.33–8.08) related to the aromatic ring protons. Table 4 shows the <sup>1</sup>H NMR spectra of the some prepared azomethine compounds [23].

### 3.2. Mercury complexes

The melting points, color and the yield ratio of the prepared complexes were measured and diagnosed with UV-Visible and FT-IR spectroscopy, elemental analysis C.H.N.S, molar conductivity and magnetic sensitivity were measured. The best yield of the prepared Mercury complex was for H<sub>1</sub> 64%, the higher m. p. for complexes was for compound H<sub>2</sub> (262–264 °C). See table 5 and Fig. 2 for

**Table 5**  
Colors, melting points, and percentages of yield of Mercury II complexes (H<sub>1</sub>–H<sub>6</sub>).

M:L	m.p C	Yield %	Color	Comp. code
1:2	198–200	64	Bright Yellowish brown	H <sub>1</sub>
1:2	262–264	48	Nutty	H <sub>2</sub>
1:2	242–243	50	Yellow	H <sub>3</sub>
1:2	118–119	60	Light green	H <sub>4</sub>
1:2	160–161	62	Brown	H <sub>5</sub>
1:2	169–170	50	Dark Nutty	H <sub>6</sub>

**Table 6**  
Types of Transitions and Wavelengths of the Uv – Visible Spectra of prepared Mercury complexes.

Suggested Structure	Transition	Max/nmλ	Comp. code
Tetrahedral	*π → πn → π*	290311	H <sub>1</sub>
Tetrahedral	*π → πn → π*	265390	H <sub>2</sub>
Tetrahedral	*π → πn → π*	233273	H <sub>3</sub>
Tetrahedral	*π → πn → π*	246321	H <sub>4</sub>
Octahedral	*π → πn → π*	257399	H <sub>5</sub>
Tetrahedral	*π → πn → π*	262392	H <sub>6</sub>

some physical properties and structures of prepared Mercury II complexes.

### 3.2.1. Solubility of mercury complexes

All prepared mercury II complexes soluble in absolute ethanol, absolute ethanol, DMSO and insoluble in distilled water.

### 3.2.2. Uv–Visible spectra of mercury complexes

The dissolved mercury complexes in DMSO showed electron transitions as follows: H<sub>1</sub> showed n → π\* transitions at (290 nm) for group C = C aromatic rings and others at (311 nm) due to π → π\* transitions for group C = N. The compound (H<sub>2</sub>) showed n → π\* transitions at (265 nm) for the C = C aromatic group and others at (390 nm) due to the π → π\* transitions for the C = N group. The compound (H<sub>3</sub>) showed n → π\* transitions at (233 nm) for the C = C aromatic group and others at (273 nm) due to the n → π\* transitions for the C = N group. The compound (H<sub>4</sub>) showed n → π\* transitions at (246 nm) for the C = C aromatic group and others at (321 nm) due to the n → π\* transitions for the C = N group. The compound (H<sub>5</sub>) showed n → π\* transitions at (257 nm) for the C = C group and others at (399 nm) due to the n → π\* transitions for the C = N group. The compound (H<sub>6</sub>) showed transitions from π → π\* at (262 nm) for group C = C aromatic rings and others at (392 nm) due to transitions of type n → π\* for group C = N [23]. See Table 6 of all prepared Mercury complexes.

### 3.2.3. Ft-IR spectra of mercury complexes

Infrared spectrum of mercury II complexes showed the following absorption: The H<sub>1</sub> complex showed a stretch absorption band belonging to group C = N at ((1610 cm<sup>-1</sup>), a stretch absorption band for group C = C aromatics at (1550 cm<sup>-1</sup>), and a stretch absorption band belonging to the aromatic CH at (3076 cm<sup>-1</sup>). An absorption band belongs to C–H azomethine at (3110 cm<sup>-1</sup>), a stretch absorption band belongs to the M–N group at (545 cm<sup>-1</sup>) for the complex, an absorption bundle belongs to the C-Cl group at (895 cm<sup>-1</sup>), and an absorption band belongs to the cyanide (CN) group at (2300 cm<sup>-1</sup>), an absorption band belonging to the NH group at (3280 cm<sup>-1</sup>) [23], Table 7 shows the absorption band of all Mercury complexes.

### 3.2.4. Lc-Mass spectra of mercury complexes

The diagnostic results of the complexes diagnosed by the Lc-Mass technique showed the emergence of a signal representing the molecular weight of the complex in addition to the emergence of multiple fissures for each complex, which confirms the formation of the complexes with the proposed formulas and the suggested molecular weights that are consistent with the rest of the results. The following Tables 8-13 showed the cleavages of these complexes:

### 3.2.5. Element microanalysis

A microanalysis of the prepared complex elements was measured and a match was found between practical percentages and theoretically calculated percentages. Table 14 illustrates the results of the accurate analysis of the elements (C.H.N.S.).

## 4. Molar conductance measurements

The measurement of molar conductivity is considered one of the important matters in knowing the ionic formulas of the metal complexes in their solutions, as these complexes were measured at a concentration (1 × 10<sup>-3</sup>) molar using the DMSO solvent at room temperature, and the results showed that the values of the molar conductivity of the synthesized mercury complexes ranged between (97.8–289.6) Ohm<sup>-1</sup>. cm<sup>-1</sup>. mol<sup>-1</sup> × 10<sup>-6</sup>. Since the con-

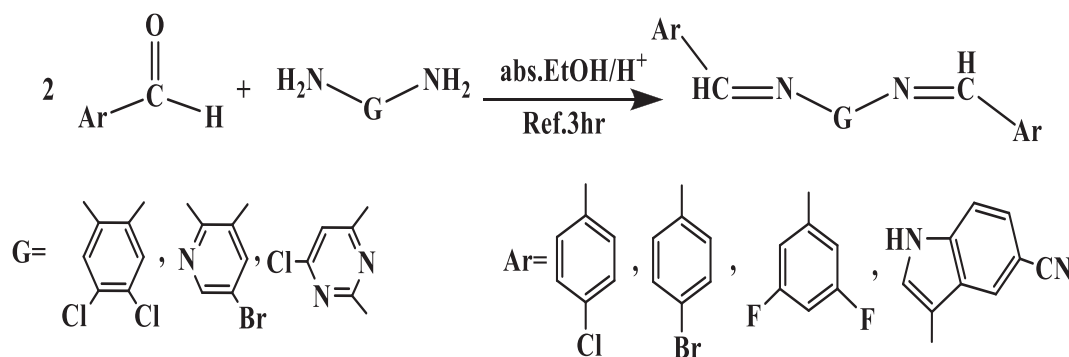


Fig. 1. The general equation for azomethine preparation.

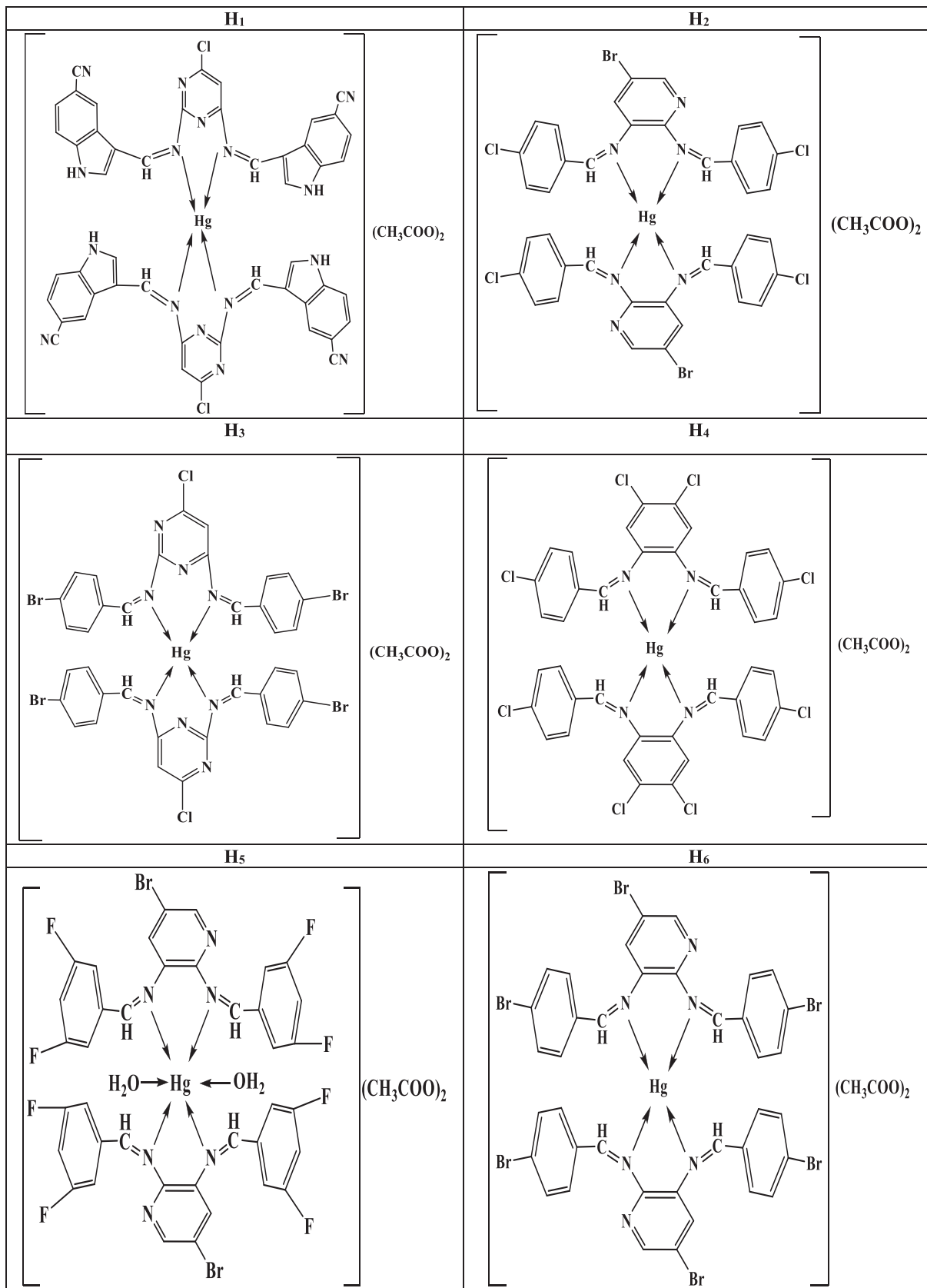


Fig. 2. Structure of prepared mercury II complexes.

**Table 7**  
Shows the absorption bands in the FT-IR spectrum of the prepared Mercury complexes.

Other Group	N–H	νM–N	νOHWater	νC–Cl	νC–HAr	νC = CAr	C–HAzomethine	νC = N	Comp. No
CN: 2300	3280	545	b 2900–3520	895	3076	1550	3110	1610	H <sub>1</sub>
C-Br:700	—	563	b 3224–3400	990	3039	1415	3125	1595	H <sub>2</sub>
C-Br: 705	—	525	—	930	3088	1410	3120	1598	H <sub>3</sub>
—	—	550	—	1080	3043	1430	3130	1610	H <sub>4</sub>
C-F:1300C-Br:680	—	561	—	—	3072	1520	3125	1600	H <sub>5</sub>
C-Br:660	—	553	—	—	3041	1450	3170	1610	H <sub>6</sub>

ν = Stretching, b = broad Ar = Aromatic.

**Table 8**  
Lc- Mass spectra of H<sub>1</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1216	M+ = [C <sub>52</sub> H <sub>32</sub> Cl <sub>2</sub> HgN <sub>16</sub> O <sub>4</sub> ] <sup>+</sup>	<b>H<sub>1</sub></b>
1133	[C <sub>48</sub> H <sub>30</sub> Cl <sub>2</sub> HgN <sub>16</sub> O <sub>2</sub> ] <sup>+</sup>	
917	[C <sub>36</sub> H <sub>30</sub> Cl <sub>2</sub> HgN <sub>12</sub> O] <sup>+</sup>	
828	[C <sub>29</sub> H <sub>22</sub> Cl <sub>2</sub> HgN <sub>12</sub> O] <sup>+</sup>	
764	[C <sub>22</sub> H <sub>16</sub> Cl <sub>2</sub> HgN <sub>10</sub> ] <sup>+</sup>	
687	[C <sub>25</sub> H <sub>27</sub> HgN <sub>9</sub> O <sub>2</sub> ] <sup>+</sup>	
544	[C <sub>20</sub> H <sub>16</sub> HgN <sub>6</sub> ] <sup>+</sup>	
435	[C <sub>26</sub> HH <sub>25</sub> N <sub>6</sub> O] <sup>+</sup>	
381	[C <sub>23</sub> H <sub>20</sub> N <sub>6</sub> ] <sup>+</sup>	
353	[C <sub>17</sub> H <sub>15</sub> CLN <sub>6</sub> O] <sup>+</sup>	
314	[C <sub>14</sub> H <sub>11</sub> CLN <sub>6</sub> O] <sup>+</sup>	
288	[C <sub>14</sub> H <sub>8</sub> CLN <sub>5</sub> ] <sup>+</sup>	
268	[C <sub>14</sub> H <sub>10</sub> CLN <sub>4</sub> ] <sup>+</sup>	
192	[C <sub>12</sub> H <sub>8</sub> N <sub>3</sub> ] <sup>+</sup>	
136	[C <sub>8</sub> H <sub>11</sub> N <sub>2</sub> ] <sup>+</sup>	
101	[C <sub>8</sub> H <sub>5</sub> ] <sup>+</sup>	

**Table 9**  
Lc- Mass spectra of H<sub>2</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1181	M+ = [C <sub>42</sub> H <sub>30</sub> Br <sub>2</sub> Cl <sub>4</sub> HgN <sub>6</sub> O <sub>4</sub> ] <sup>+</sup>	<b>H<sub>2</sub></b>
1076	[C <sub>38</sub> H <sub>26</sub> Br <sub>2</sub> Cl <sub>4</sub> HgN <sub>6</sub> O] <sup>+</sup>	
929	[C <sub>32</sub> H <sub>28</sub> Br <sub>2</sub> Cl <sub>2</sub> HgN <sub>6</sub> ] <sup>+</sup>	
876	[C <sub>38</sub> H <sub>26</sub> Br <sub>2</sub> Cl <sub>4</sub> N <sub>6</sub> O] <sup>+</sup>	
853	[C <sub>27</sub> H <sub>17</sub> Br <sub>2</sub> Cl <sub>2</sub> HgN <sub>6</sub> ] <sup>+</sup>	
759	[C <sub>25</sub> H <sub>22</sub> BrCl <sub>2</sub> HgN <sub>5</sub> O] <sup>+</sup>	
711	[C <sub>24</sub> H <sub>18</sub> BrCl <sub>2</sub> HgN <sub>4</sub> ] <sup>+</sup>	
683	[C <sub>22</sub> H <sub>26</sub> BrCl <sub>2</sub> HgN <sub>3</sub> ] <sup>+</sup>	
515	[C <sub>15</sub> H <sub>13</sub> BrHgN <sub>3</sub> ] <sup>+</sup>	
381	[C <sub>10</sub> H <sub>10</sub> CLHgN] <sup>+</sup>	
353	[C <sub>19</sub> H <sub>13</sub> Cl <sub>2</sub> N <sub>3</sub> ] <sup>+</sup>	
316	[C <sub>19</sub> H <sub>13</sub> CLN <sub>3</sub> ] <sup>+</sup>	
288	[C <sub>16</sub> H <sub>18</sub> CLN <sub>3</sub> ] <sup>+</sup>	
244	[C <sub>13</sub> H <sub>10</sub> CLN <sub>3</sub> ] <sup>+</sup>	

**Table 10**  
Lc- Mass spectra of H<sub>3</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1272	M+ = [C <sub>40</sub> H <sub>28</sub> Br <sub>4</sub> Cl <sub>2</sub> HgN <sub>8</sub> O <sub>4</sub> ] <sup>+</sup>	<b>H<sub>3</sub></b>
1153	[C <sub>36</sub> H <sub>22</sub> Br <sub>4</sub> Cl <sub>2</sub> HgN <sub>8</sub> ] <sup>+</sup>	
950	[C <sub>36</sub> H <sub>22</sub> Br <sub>4</sub> Cl <sub>2</sub> N <sub>8</sub> ] <sup>+</sup>	
793	[C <sub>21</sub> H <sub>15</sub> Br <sub>2</sub> Cl <sub>2</sub> HgN <sub>7</sub> ] <sup>+</sup>	
711	[C <sub>19</sub> H <sub>18</sub> CLHgN <sub>5</sub> ] <sup>+</sup>	
685	[C <sub>20</sub> H <sub>20</sub> Br <sub>2</sub> HgN <sub>5</sub> ] <sup>+</sup>	
613	[C <sub>15</sub> H <sub>16</sub> Br <sub>2</sub> HgN <sub>4</sub> ] <sup>+</sup>	
545	[C <sub>16</sub> H <sub>16</sub> BrHgN <sub>4</sub> ] <sup>+</sup>	
529	[C <sub>15</sub> H <sub>13</sub> BrHgN <sub>4</sub> ] <sup>+</sup>	
507	[C <sub>17</sub> H <sub>13</sub> CLHgN <sub>4</sub> ] <sup>+</sup>	

**Table 11**  
Lc- Mass spectra of H<sub>4</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1159	M+ = [C <sub>44</sub> H <sub>30</sub> Cl <sub>8</sub> HgN <sub>4</sub> O <sub>4</sub> ] <sup>+</sup>	<b>H<sub>4</sub></b>
1102	[C <sub>42</sub> H <sub>27</sub> Cl <sub>8</sub> HgN <sub>4</sub> O <sub>2</sub> ] <sup>+</sup>	
811	[C <sub>27</sub> H <sub>18</sub> Cl <sub>6</sub> HgN <sub>4</sub> ] <sup>+</sup>	
683	[C <sub>22</sub> H <sub>15</sub> Cl <sub>4</sub> HgN <sub>2</sub> O <sub>2</sub> ] <sup>+</sup>	
547	[C <sub>17</sub> H <sub>11</sub> Cl <sub>3</sub> N <sub>2</sub> ] <sup>+</sup> × 2	
416	[C <sub>20</sub> H <sub>12</sub> Cl <sub>4</sub> N <sub>2</sub> ] <sup>+</sup>	
352	[C <sub>17</sub> H <sub>15</sub> Cl <sub>3</sub> N <sub>2</sub> ] <sup>+</sup>	
339	[C <sub>16</sub> H <sub>13</sub> Cl <sub>3</sub> N <sub>2</sub> ] <sup>+</sup>	
316	[C <sub>17</sub> H <sub>13</sub> Cl <sub>2</sub> N <sub>2</sub> ] <sup>+</sup>	
297	[C <sub>13</sub> H <sub>6</sub> Cl <sub>3</sub> N <sub>2</sub> ] <sup>+</sup>	
288	[C <sub>13</sub> H <sub>12</sub> Cl <sub>3</sub> N] <sup>+</sup>	
255	[C <sub>13</sub> H <sub>14</sub> Cl <sub>2</sub> N] <sup>+</sup>	
239	[C <sub>12</sub> H <sub>10</sub> Cl <sub>2</sub> N] <sup>+</sup>	

**Table 12**  
Lc- Mass spectra of H<sub>5</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1226	M+ = [C <sub>42</sub> H <sub>30</sub> Br <sub>2</sub> F <sub>8</sub> HgN <sub>6</sub> O <sub>6</sub> ] <sup>+</sup>	<b>H<sub>5</sub></b>
1170	[C <sub>40</sub> H <sub>27</sub> Br <sub>2</sub> F <sub>8</sub> HgN <sub>6</sub> O <sub>4</sub> ] <sup>+</sup>	
1149	[C <sub>40</sub> H <sub>25</sub> Br <sub>2</sub> F <sub>8</sub> HgN <sub>6</sub> O <sub>3</sub> ] <sup>+</sup>	
979	[C <sub>36</sub> H <sub>27</sub> Br <sub>2</sub> F <sub>4</sub> HgN <sub>6</sub> ] <sup>+</sup>	
957	[C <sub>34</sub> H <sub>28</sub> Br <sub>2</sub> F <sub>4</sub> HgN <sub>6</sub> ] <sup>+</sup>	
809	[C <sub>24</sub> H <sub>15</sub> Br <sub>2</sub> F <sub>4</sub> HgN <sub>5</sub> ] <sup>+</sup>	
711	[C <sub>21</sub> H <sub>13</sub> BrF <sub>4</sub> HgN <sub>3</sub> O <sub>3</sub> ] <sup>+</sup>	
683	[C <sub>22</sub> H <sub>20</sub> BrF <sub>4</sub> HgN <sub>3</sub> ] <sup>+</sup>	
575	[C <sub>17</sub> H <sub>13</sub> BrF <sub>2</sub> N <sub>3</sub> ] <sup>+</sup>	
423	[C <sub>12</sub> H <sub>12</sub> F <sub>2</sub> HgN <sub>2</sub> ] <sup>+</sup>	
381	[C <sub>9</sub> H <sub>7</sub> F <sub>2</sub> HgN <sub>2</sub> ] <sup>+</sup>	
353	[C <sub>8</sub> H <sub>6</sub> F <sub>2</sub> HgN] <sup>+</sup>	
316	[C <sub>14</sub> H <sub>10</sub> BrFN <sub>3</sub> ] <sup>+</sup>	
288	[C <sub>11</sub> H <sub>11</sub> BrFN <sub>2</sub> ] <sup>+</sup>	

**Table 13**  
Lc- Mass spectra of H<sub>6</sub>.

Mass / Charge: m/z	Fragmentation	Complex
1357	M+ = [C <sub>42</sub> H <sub>30</sub> Br <sub>6</sub> HgN <sub>6</sub> O <sub>4</sub> ] <sup>+</sup>	<b>H<sub>6</sub></b>
1239	[C <sub>38</sub> H <sub>24</sub> Br <sub>6</sub> HgN <sub>6</sub> ] <sup>+</sup>	
1127	[C <sub>35</sub> H <sub>27</sub> Br <sub>5</sub> HgN <sub>6</sub> ] <sup>+</sup>	
1036	[C <sub>34</sub> H <sub>29</sub> Br <sub>4</sub> HgN <sub>6</sub> ] <sup>+</sup>	
977	[C <sub>29</sub> H <sub>24</sub> Br <sub>4</sub> HgN <sub>6</sub> ] <sup>+</sup>	
907	[C <sub>24</sub> H <sub>18</sub> Br <sub>4</sub> HgN <sub>6</sub> ] <sup>+</sup>	
837	[C <sub>21</sub> H <sub>21</sub> Br <sub>4</sub> HgN <sub>3</sub> ] <sup>+</sup>	
782	[C <sub>22</sub> H <sub>21</sub> Br <sub>3</sub> HgN <sub>4</sub> ] <sup>+</sup>	
711	[C <sub>18</sub> H <sub>14</sub> Br <sub>3</sub> HgN <sub>3</sub> ] <sup>+</sup>	
666	[C <sub>19</sub> H <sub>20</sub> Br <sub>2</sub> HgN <sub>2</sub> ] <sup>+</sup>	
604	[C <sub>16</sub> H <sub>12</sub> Br <sub>2</sub> N <sub>3</sub> ] <sup>+</sup>	
574	[C <sub>14</sub> H <sub>10</sub> Br <sub>2</sub> HgN <sub>3</sub> ] <sup>+</sup>	
535	[C <sub>12</sub> H <sub>7</sub> Br <sub>2</sub> HgN <sub>2</sub> ] <sup>+</sup>	
430	[C <sub>18</sub> H <sub>15</sub> Br <sub>2</sub> N <sub>3</sub> ] <sup>+</sup>	
422	[C <sub>37</sub> H <sub>14</sub> Br <sub>2</sub> N <sub>3</sub> ] <sup>+</sup>	

**Table 14**  
The Elemental analysis C.H.N.S. of prepared Mercury complexes.

Sample Name		C%	H%	N%	S%
H <sub>1</sub>	Theoretical	51.34	2.67	18.42	0.000
	Practically	54.809	3.639	17.077	0.000
Average		54.62	3.36	17.20	0.00
H <sub>2</sub>	Theoretical	42.57	2.55	7.09	0.000
	Practically	44.062	2.308	4.148	0.000
Average		44.03	2.25	4.01	0.00
H <sub>3</sub>	Theoretical	37.839	2.033	8.78	0.000
	Practically	37.183	2.206	9.516	0.000
Average		37.51	2.12	9.67	0.00
H <sub>4</sub>	Theoretical	45.44	2.60	4.82	0.000
	Practically	44.547	2.509	5.008	0.000
Average		44.68	2.44	5.11	0.00
H <sub>5</sub>	Theoretical	41.11	2.46	6.85	0.000
	Practically	42.734	2.328	7.351	0.000
Average		42.86	2.18	7.39	0.00
H <sub>6</sub>	Theoretical	37.02	2.23	6.17	0.000
	Practically	36.898	2.289	6.490	0.000
Average		36.63	2.32	6.35	0.00

**Table 15**  
The molar conductivity values of the synthesized complexes.

Comp. code	Molar Conductivity $\Lambda_m(\text{Ohm}^{-1} \cdot \text{cm}^{-1} \cdot \text{mol}^{-1}) \times 10^{-6}$	Temperature °C	Concentration (molar)
H <sub>1</sub>	98.9	28	1x10 <sup>-3</sup>
H <sub>2</sub>	288.8	28	1x10 <sup>-3</sup>
H <sub>3</sub>	289.6	28	1x10 <sup>-3</sup>
H <sub>4</sub>	98.5	28	1x10 <sup>-3</sup>
H <sub>5</sub>	199.8	28	1x10 <sup>-3</sup>
H <sub>6</sub>	97.8	28	1x10 <sup>-3</sup>

ductivity values are all higher than 70 (Ohm<sup>-1</sup>. cm<sup>-1</sup>. mol<sup>-1</sup>) × 10<sup>6</sup>), this proves that the acetate root is outside the harmonic sphere and that the complex is equivalent to the existence of two negative charge of acetate ions (2CH<sub>3</sub>COO<sup>-</sup>) that are neutral with the two positive charge of mercury II (Hg<sup>+2</sup>). See Table 15.

4.1. Magnetic moment measurements

It is one of the important techniques to know the number of individual electrons and to find out if the complex has a high or low twirl and thus it is possible to know the spatial shapes of the complexes, if the complex contains one or more electrons, it will have magnetic properties, but if it does not contain the electrons

**Table 16**  
The magnetic moment measurements of Mercury complexes.

H <sub>6</sub>	H <sub>5</sub>	H <sub>4</sub>	H <sub>3</sub>	H <sub>2</sub>	H <sub>1</sub>	Compound No.
1244.65	1072.99	1018.82	1159.74	1024.83	1104.41	Molar mass (M)
25	25	25	25	25	25	Temperature °C (T)
0.8277	0.8277	0.8277	0.8277	0.8272	0.8277	mass of empty tube (g)
-33	-33	-33	-33	-32	-33	Balance reading with empty tube (R0)
0.9326	0.859	0.8523	0.864	0.9269	0.9536	Mass of tube + sample (g)
2.1	1.1	0.9	1.1	1.9	1.9	Length of sample in tube (cm) L
144	254	-40	-34	159	-54	Balance reading with filled tube (R)
0.0959	0.0313	0.0246	0.0363	0.0497	0.1259	Mass of sample (g) m
4.41E-06	1.15E-05	-2.9E-07	-3.4E-08	8.3E-06	-3.6E-07	$\chi_g$
0.005484	0.012303	-0.0003	-4E-05	0.008507	-0.0004	$\chi_M$

alone, it will have day properties. Magnetic measurements were made for the complexes at room temperature using the Faraday method. Table 16 shows the magnetic measurements ( $\mu_{\text{eff}}$ ) of the complexes after their calculation from the following relationship:

$$\mu_{\text{eff}} = 2.828(X_A \cdot T)^{1/2}, X_A = X_M - X_D \text{ and } X_M = X_g \cdot M. \text{ Wt.}$$

Whereas: X<sub>A</sub>: (Atomic sensitivity), X<sub>M</sub>: (Molar sensitivity), X<sub>g</sub>: (Gram sensitivity), X<sub>D</sub>: (Correction factor, Pascal constants), M. Wt.: (Molecular weight of complex), T: (Kelvin temperature)

5. Conclusions

Azomethine compounds were prepared by condensation and in varying product proportions. It was found through the results obtained from the study of the structural formula of the complexes that the synthesized ligands are double-chelated when coordinated with the central ion. From the results obtained from spectroscopy measurements on the prepared ligands, which included UV-Visible spectra, FT-IR, <sup>1</sup>H NMR spectra, and through spectroscopy of the prepared complexes, which included C.H.N.S., Uv-Visible, FT-IR, Lc-Maas, molar conductivity and the magnetic measurements proved that the extent of stability compared to the period in which the compounds were present and then sent for measurement until it was completed within a period of more than six months.

### CRediT authorship contribution statement

**Najdat Thamer Yas:** Conceptualization, Investigation, Visualization, Writing - review & editing. **Rasim Farraj Muslim:** Data curation, Investigation, Methodology, Supervision. **Mohammed Ahmed Awad:** Data curation, Investigation, Methodology, Supervision.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgment

Special thanks to Prof. dr. Abdullah Husain Kashash and everyone who helped to complete this research.

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