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RESEARCH ARTICLE

Synthesis, Characterization and Molar Conductivity Study of Some New Palladium (II) and Platinum(II) Complexes Containing Heterocyclic Tellurium - Dicarboxylato Ligands

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Abstract

A novel complexes of the type [M(o o L_2] (where M = Pd and Pt; (o o) = oxalate , malonate and 1,1- cyclobutanedicarboxylate ; L = 1,3-dihydro-2-telluraindene (C_8H_8Te) and 5,6-dimethyl-1,3-dihydro-2-telluraindene ($C_{10}H_{12}Te$) have been prepared. All the prepared complexes was characterized by elemental analysis (CHN), conductivity measurements and ^1H - and ^{13}C –NMR, FT IR and U.V-visible spectroscopic data. The molar conductivity study indicate that all the prepared complexes are neutral and behave as non electrolytes in two different solvents CH_2Cl_2 and DMSO in the range 10^{-5} -10^{-3} M at room temperature.

INTRODUCTION

Heterocyclic tellurium compounds have, until recently, been rather neglected in the renaissance of metal coordination chemistry.(1) In last decades, a few papers have been reported describing the ability of heterocyclic tellurium compounds as coordinating ligands with some transition metals. (2-4) Al-Rubaie and Al-Luaibi prepared two complexes for platinum(II) which contain formula cis-[PtL_2Cl_2](L=(C_8H_8Te) 1,3-dihydro-2-telluraindene and ($C_{10}H_{12}Te$) 5,6-dimethyl-1,3-dihydro-2-telluraindene) by reaction K_2PtCl_4 with 2 equilimoles of the corresponding heterocyclic tellurium compounds respectively. (5) On the other hand, complexes of platinum (II) containing dicarboxylate ligands are well known(6-8). Al-Fregi prepared several complexes of platinum(II) complexes which contain formula [$Pt(Am)_2L_2$] (where Am = cyclohexyl amine, pipridine, 2- amino norbornane and 3-azabicyclic[3.2.2]nonane) ; L = oxalate and 1,2- cyclohexyldicarboxylate) in two procedures. (9) The first method consist reacting [$PtI_2(Am)_2$] with silver sulfate followed with the corresponding barium salt of dicarboxylate ligand . The second method by reacting [$PtI_2(Am)_2$] with the corresponding silver salt of dicarboxylate ligands. In this paper, we have been studying the ability of preparation of some new complexes for palladium (II) platinum (II) containing heterocyclic tellurium ligands together with dicarboxylate ligands.

2. Experimental Section

a) Chemicals and Physical Measurements

1,1-cyclobutanedicarboxylic acid (CBDC), malonic acid (mal), potassium oxalate (ox), tellurium metal and silver sulfate were purchase from British Drug House (BDH) chemical company.

Potassium tetrachloroplatinate(II) was purchase from Johnson Matty (Seabrook, N. H.)

All chemicals that were obtained for commercial supplier and used as received. Dicarboxylic acids were converted to their barium salts by treated with 1 equivalent of $Ba(OH)_2.8H_2O$ in 95% methanol. (10)

All tellurium ligands 1,3-dihydro-2-telluriuindene (11) and 5,6-dimethyl-1,3-dihydro-2-tellurinidene (12) were prepared by reported methods in argon atmosphere. Complexes cis-bis(1,3-dihydro-2-telluraindene)dichloropalladium(II) , cis-bis(1,3-dihydro-2-telluraindene)dichloroplatinum(II) cis-bis(5,6-dimethyl-1,3-dihydro-2-telluraindene)dichloropalladium(II) and cis-bis(5,6-dimethyl-1,3-dihydro-2-telluraindene)dichloroplatinum(II) were prepared according to literature method.(5)

Infrared spectra were measured as KBr disk on an FT-IR spectrophotometer model Shimadzu 8400S in the range 4000-200 cm^{-1} . U.V-visible spectra were recorded on a thermospectronic Helios α V4.60 using CH_3Cl as solvent in the range 200-600 nm. Elemental analysis for carbon and hydrogen were performed at University of Al al-Bayt, Jordan using a Euro vector EA 3000A Elemental Analysis. ^1H- and ^{13}C- NMR spectra were recorded at University of Al al-Bayt, Jordan using a Bruker 300 MHz. Chemical shift of all ^1H- and ^{13}C NMR spectra recorded in δ(ppm) unit downfield from the internal reference trimethylsilane (TMS), using DMSO solvent. Conductivity measurements were made with a honduktoskop model 365B . The cell fitted with platinum electrode was calibrated with 1 mmol $.dm^{-3}$ aqueous KCl solution . The cell constant was found to be 0.785 cm^{-1}.The solutions of prepared complexes were studied in a concentration range 10^{-5} -10^{-3} $mol.dm^{-3}$ at room temperature . The solvents used CH_2Cl_2 and DMSO were used as received without any more purification.
Typical backgrounds conductivities for CH_2Cl_2 and DMSO were 1.5 and 1.1 M ohm^{-1} cm^2 mol^{-1} respectively . Melting points were determined on a Gallenkamp melting points apparatus and are uncorrected .

b) Synthesis

$Pt(C_8H_8Te)_2$ (o o OX) [**I**]

To a stirred suspended solution of cis-bis(1,3-dihydro-2-telluraindene)dichloroplatinum(II) (1.45 g, 2.00 mmole) in absolute ethanol (20 mL) was added an equilimole solution of silver sulfate (0.62 g, 2.00 mmole) in distilled water (25 mL) at room temperature under an atmosphere of argon . The resulting mixture was stirred for 3h, then the resulting inorganic precipitate of AgCl was removed by filtration. To the resultant filtrate of $(C_8H_8Te)_2PtSO_4$ was added barium oxalate (0.45 g, 2.00 mmole) in distilled water (20 mL) and was stirred for 6h. After barium sulfate was filtered off, the filtrate was reduced to 5 mL approximately by rotary evaporator an yellow solid product was obtained. The crude product was recrystallized from a mixture of chloroform / methanol (3:2) to give yellow crystals of complex [**I**] in 77% yield.

$Pt(C_8H_8Te)_2$ (o o mal) [**II**] and $Pt(C_8H_8Te)_2$ (o o CBDC) [**III**] complexes were prepared by the same procedure of complex [**I**] by reacting $Pt(C_8H_8Te)_2Cl_2$ (1.45 g, 2 mmole) in 25 mL of absolute ethanol with silver sulfate (0.62 g, 2.00 mmole) followed with barium malonate (0.47 g, 2.00 mmole) and barium 1,1-cyclobutanedicarboxylate(0.55 g, 2.00 mmole) respectively.
The yield and some physical properties are listed in *Table* **1**.

$Pt(C_{10}H_{12}Te)_2$ (o o OX) [**IV**]

To a well stirred solution of $Pt(C_{10}H_{12}Te)_2Cl_2$ (0.78 g, 1.00 mmole) in absolute ethanol (30 mL) was added silver sulfate (0.31 g, 1.00 mmole) in distilled water (20 mL) . The mixture was stirred for 3h under an atmosphere of argon. After silver chloride was filtered off, barium oxalate (0.22 g, 1.00 mmole) in distilled water was added to the resultant filtrate of $Pt(C_{10}H_{12}Te)_2SO_4$. After stirring for 6h at room temperature, the mixture reaction was poured in 100 mL distilled water and extracted with chloroform (4 X 25 mL). The extracted portions were combined and the solvent was evaporated to obtain an yellow solid. The crude solid was recrystallized from a mixture of chloroform / methanol (3:2) to give yellow crystals of complex [**IV**] in 88% yield.

$Pt(C_{10}H_{12}Te)_2$ (o o mal) [**V**] and $Pt(C_{10}H_{12}Te)_2$ (o o CBDC) [**VI**] complexes were prepared by the same procedure of complex [**IV**] by reacting $Pt(C_{10}H_{12}Te)_2Cl_2$ (0.78 g, 1.00 mmole) in 25 mL of absolute ethanol with silver sulfate (0.31 g, 1.00 mmole) followed with barium malonate (0.23 g, 1.00 mmole) and barium 1,1-cyclobutanedicarboxylate(0.27 g, 1.00 mmole) respectively.
The yield and some physical properties are listed in *Table* **1**.

[**VII**] Pd$(C_8H_8Te)_2$ (o oOX):

To a stirred suspended solution of cis-bis(1,3-dihydro-2-telluraindene)dichloropalladium(II) (2.18 g, 3.00 mmole) in absolute ethanol (20 mL) was added an equilimole solution of silver sulfate (0.93 g, 3.00 mmole) in distilled water (25 mL) at room temperature under an atmosphere of argon . The resulting mixture was stirred for 3h, then the resulting inorganic precipitate of AgCl was removed by filtration. Then, to the resultant filtrate of $(C_8H_8Te)_2PdSO_4$ was added barium oxalate (0.67 g, 3.00 mmole) in distilled water (20 mL) and was stirred for 6h. After barium sulfate was filtered off, the filtrate was reduced to 5 mL approximately by rotary evaporator an yellow solid product was obtained. The crude product was recrystallized from a mixture of dichloromethane / ethanol (3:2) to give pale yellow crystals of complex [**VII**]in 81% yield.

Pd$(C_8H_8Te)_2$ (o o mal) [**VIII**] and Pd$(C_8H_8Te)_2$ (o o CBDC) [**IX**] complexes were prepared by the same procedure of complex [**VII**] by reacting Pd$(C_8H_8Te)_2Cl_2$ (2.18 g, 3.00 mmole) in 25 mL of absolute ethanol with silver sulfate (0.93 g, 3.00 mmole) followed with barium malonate (0.71 g, 3.00 mmole) and barium 1,1-cyclobutanedicarboxylate (0.83 g, 3.00 mmole) respectively.
The yield and some physical properties are listed in *Table* **1**.

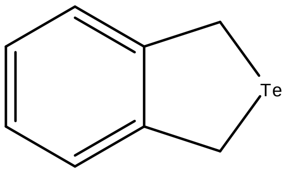
Pd$(C_{10}H_{12}Te)_2$ (o oOX) [**X**]

To a well stirred solution of Pd$(C_{10}H_{12}Te)_2Cl_2$ (1.39 g, 2.00 mmole) in absolute ethanol (30 mL) was added silver sulfate (0.62 g, 2.00 mmole) in distilled water (20 mL) . The mixture was stirred for 3h under an atmosphere of argon. After silver chloride was filtered off, barium oxalate (0.45 g, 2.00 mmole) in distilled water was added to the resultant filtrate of Pt$(C_{10}H_{12}Te)_2SO_4$. After stirring for 6h at room temperature, the mixture reaction was poured in 100 mL distilled water and extracted with chloroform (4 X 25). The extracted portions were combined and the solvent was evaporated to obtain an yellow solid. The crude solid was recrystallized from a mixture of dichloromethane / ethanol (3:2) to give yellow crystals of complex [**X**] in 79% yield.

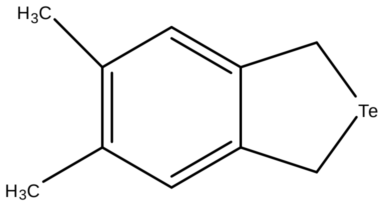
Pd$(C_{10}H_{12}Te)_2$ (o o mal) [**XI**] and Pt$(C_{10}H_{12}Te)_2$ (o o CBDC) [**XII**] complexes were prepared by the same procedure of complex [**X**] by reacting Pd$(C_{10}H_{12}Te)_2Cl_2$ (1.39 g, 2.00 mmole) in 25 mL of absolute ethanol with silver sulfate (0.62 g, 2.00 mmole) followed with barium malonate (0.47 g, 2.00 mmole) and barium 1,1-cyclobutanedicarboxylate(0.55 g, 2.00 mmole) respectively.
The yield and some physical properties are listed in *Table* **1**.

3.Results and Discussion

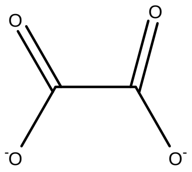
Twelve complexes of the type [Pt( )L_2] and [Pd( )L_2] , where ( ): dicarboxylate ligand = (oxalate ;malonate (mal) and (1,1-cyclobutanedicarboxylate) (CBDC) ; L =heterocyclic tellurium ligand : (C_8H_8Te) 1,3-dihydro-2-telluraindene and $(C_{10}H_{12}Te)$ 5, 6- dimethyl- 1,3-dihydro-2-telluraindene have been prepared. Complexes [**I**] – [**III**] and [**VII**]**- [IX]** were prepared by reacting complex cis-bis(1,3-dihydro-2-telluraindene)dichloroplatinum(II), $(C_8H_8Te)_2PtCl_2$ or cis-bis(1,3-dihydro-2-telluraindene)dichloropalladium(II), $(C_8H_8Te)_2PdCl_2$, with silver sulfate followed with barium oxalate, barium malonate and barium 1,1-cyclobutanedicarboxylate, respectively. Complexes [**IV**]-[**VI**] and [**X**]**- [XII]** were prepared by reacting cis-bis(5,6-dimethyl-1,3-dihydro-2-telluraindene)dichloroplatinum(II), Pt$(C_{10}H_{12}Te)_2Cl_2$ or cis-bis(5,6-dimethyl-1,3-dihydro-2-telluraindene)dichloropalladium(II), Pd$(C_{10}H_{12}Te)_2Cl_2$, with silver sulfate followed with barium oxalate, barium malonate and barium 1,1-cyclobutanedicarboxylate, respectively . *Fig.* **1** illustrate the two heterocyclic tellurium compounds and dicarboxylate ligands which used in this study and preparative methods of complexes [**I**]-[**XII**] were summarized in *Scheme* **1** .



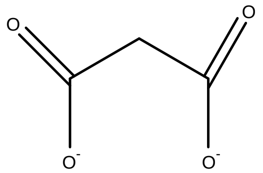
1,3-dihydro- 2-telluraindine



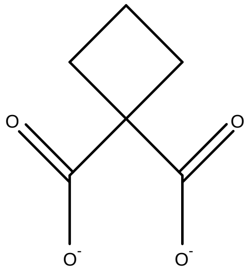
5,6-dimethyl-1,3-dihydro-2-telluraindine



oxalate



malonate



1,1-cyclobutanedicarboxylate

$C_8H_8Te)_2\ MCl_2 + Ag_2SO_4 \rightarrow (C_8H_8Te)_2MSO_4 + 2\ AgCl($

$(C_8H_8Te)_2\ MSO_4 + Ba\ (\overset{\frown}{O\quad O}) \rightarrow (C_8H_8Te)_2M(\overset{\frown}{O\quad O}) + BaSO_4$

$C_{10}H_{12}Te)_2MCl_2 + Ag_2SO_4 \rightarrow (C_8H_8Te)_2MSO_4 + 2\ AgCl($

$(C_{10}H_{12}Te)_2MSO_4 + Ba\ (\overset{\frown}{O\quad O}) \rightarrow (C_8H_8Te)_2M(\overset{\frown}{O\quad O}) + BaSO_4$

M = Pd , Pt ; $(\overset{\frown}{O\quad O})$ = oxalate (OX), malonate (Mal) and 1,1- cyclobutanedicarboxylate (CBDC)

*Scheme*1 : preparative methods of complexes [**I**] – [**XII**]

Recrystalization of complexes [**I**]-[**VI**] in a solvent mixture of chloroform and methanol (3:2) and complexes [**VII**] – [**XII**] in a solvent mixture of dichloromethane and ethanol (3:2) result yellow crystals products in yield (55-67%). All the new complexes [**I**]-[**XII**] are yellow solids and mostly insoluble in polar solvents such as water, ethanol and methanol but are soluble in non polar solvent such as chloroform, dichloromethane and tetrachloromethane and also, in DMF and DMSO which can be considered as an evidence to that all prepared complexes are neutral. The prepared complexes were decomposed in the temperature range (134-191 °C).

The CH analysis of complexes [**I**]-[**XII**] are in good agreement with calculated values. The elemental analysis, yield and some physical properties and elemental analysis of carbon and hydrogen for all new complexes are shown in *Table* **1**.

*Table **1**: some physical properties and elemental analysis for complexes[**I**]-[**XII**]*

Com		**Physical properties**		**Elemental analysis (%)^b**

	Complexes	**Meltin Point (^{o}c)^{a}**	**Colour**	**Yield %**	**C**	**H**
[I]	$(C_8H_8Te)_2Pt(OX)$	165	yellow	77	28.76 (28.96)	2.09 (2.16)
[II]	$(C_8H_8Te)_2Pt(mal)$	191	yellow	69	30.11 (30.00)	2.62 (2.39)
[III]	$(C_8H_8Te)_2Pt(CBDCA)$	178	yellow	62	32.71 (33.00)	2.62 (2.77)
[IV]	$(C_{10}H_{12}Te)_2Pt(OX)$	180	yellow	88	32.60 (32.92)	2.98 (3.01)
[V]	$(C_{10}H_{12}Te)_2Pt(mal)$	148	yellow	67	33.84 (33.82)	3.19 (3.21)
[VI]	$(C_{10}H_{12}Te)_2Pt(CBDCA)$	134	yellow	75	36.20 (36.45)	3.28 (3.53)
[VII]	$(C_8H_8Te)_2Pd(OX)$	159	Pale yellow	81	32.91 (32.86)	2.51 (2.45)
[VIII]	$(C_8H_8Te)_2Pd(mal)$	201	Pale yellow	70	34.05 (33.96)	2.66 (2.70)
[IX]	$(C_8H_8Te)_2Pd(CBDCA)$	166	Pale yellow	81	37.07 (37.11)	3.15 (3.11)
[X]	$(C_{10}H_{12}Te)_2Pd(OX)$	174	Pale yellow	79	36.93 (37.01)	3.37 (3.39)
[XI]	$(C_{10}H_{12}Te)_2Pd(mal)$	171	Pale yellow	66	36.90 (37.94)	3.54 (3.60)
[XII]	$(C_{10}H_{12}Te)_2Pd(CBDCA)$	130	Pale yellow	78	40.71 (40.65)	3.95 (3.94)

[a] All complexes decomposed, [b] Calculated values are in parentheses

The infra red spectra were recorded for each of the complexes [**I**]-[**XII**] and all spectral data IR of complexes are listed in *Table* **2**.

In all cases the infra red spectra display patterns which are typical of dicarboxylate ligands bonded in a bidentate fashion to platinum (II) or palladium (II) center through the oxygen atom of two carboxylate groups. The carbonyl region appears two strong vibration absorption frequency bonds . The first attributed to the $\upsilon_{asy}COO^-$ band was observed in the region (1653 - 1556 cm^{-1}) and the other band in the region (1450 - 1309 cm^{-1}) can be attributed to $\upsilon_{sy}COO^-$.(13) The shift in frequencies of carbonyl band compared to free ligands (OX = 1735 ; mal = 1730

; CBDCA = 1717 cm^{-1}) indicates the binding of platinum (II) ion or palladium (II) with carboxylate group. (14) The difference between υ_{asy}(COO$^-$) - υ_{sy}(COO$^-$) of the same complex was larger than 200 cm^{-1} which indicate that the carboxylate groups of the dicarboxylate ligands bind to platinum (II) or palladium(II) center from oxygen atoms of these groups.(10, 14)

In the other hand, IR spectra of [**I**]-[**XII**], consist of two weak bands in the ranges 530 – 520 cm^{-1} and 426 – 419 cm^{-1} can be attributed to **υ_{asy} Te-C** and **υ_{sy} Te-C** respectively.(2, 5, 15) The low frequency shift of **υ_{asy} Te-C** and **υ_{sy} Te-C** (about 5 – 30 cm^{-1}) in comparison with the free (C_8H_8Te) and ($C_{10}H_{12}Te$) ligands indicates that the heterocyclic tellurium ligands coordinate with platinum (II) or palladium(II) ion through tellurium atom.(2, 5, 15)

Table 2: *The FT.IR and U.V. – Vis. data of complexes [**I**]-[**XII**]*

complex	**Infrared data** (cm-1)				**U.V- Vis. data (nm)**
	υ_{asy}(COO$^-$)	**υ_{sy}(COO$^-$)**	**υ_{asy} Te-C**	**υ_{sy} Te-C**	
[I]	1637	1446	526	419	245, 315
[II]	1652 1577	1434 1355	528	426	240, 320
[III]	1562	1342	530	424	255, 320
[IV]	1639 1604	1450	526	422	248, 315
[V]	1652 1596	1429 1355	526	420	245,320
[VI]	1585 1556	1342	522	421	255, 320
[VII]	1637	1446 1309	520	426	241, 315
[VIII]	1650 1589	1436 1355	520	423	240, 320
[IX]	1562	1342	522	424	252, 320
[X]	1641 1604	1446 1311	526	420	245, 318
[XI]	1649 1581	1434 1357	525	425	241, 320
[XII]	1585 1558	1342	521	426	254, 320
Free ligand (C_8H_8Te)	-	-	535	449	275, 335

Free ligand ($C_{10}H_{12}Te$)	-	-			380, 355

The U.V.-visible absorption spectra of complexes [**I**]-[**XII**] were recorded in (10^{-3} M) using $CHCl_3$ as solvent in the range (200-800 nm) and all U.V.-visible spectral data for all complexes are summarized in *Table* **2** . All spectra of the prepared complexes[**I**]-[**XII**] show two electronic transitions in the ranges (240- 255 nm) and (315 – 320 nm) respe (277 and 335 nm) which can be considered as an evidence to coordinate tellurium atom in these ligands with palladium(II) and platinum (II) ions.

The ^{1}H- NMR spectra of 1,3-dihydro- 2 -telluraindene (C_8H_8Te) and 5,6-dimethyl-1,3-dihydro-2 – telluraindene ($C_{10}H_{12}Te$) showed singlet for each methylene protons centered in 4.46 and 4.38 ppm respectively, *Table* 3 .(11, 12)
The ^{1}H NMR spectra for complexes [**I**]-[**XII**] were recorded in DMSO - d_6.
All ^{1}H- NMR spectra of complexes [**I**]-[**XII**] show that of each the methylene protons has a different chemical shifts and appeared as two doublets of a simple **AB** pattern, *Table* 3. Similar coupling pattern have been observed previously with some palladium(II) and platinum (II) complexes. (2, 5, 12)
It is now shown that methylene protons also become magnetically non - equivalent which can be considered as evidence to coordinate of heterocyclic tellurium ligands C_8H_8Te and $C_{10}H_{12}Te$ with palladium (II) and platinum (II) ion. (2, 5, 12)
The ^{1}H- NMR spectra of complexes which contain 1,3-dihydro- 2 -telluraindene (C_8H_8Te) ligand, *i.e* [**I**]-[**III**] and [**VII**] – [**IX**] show doublet or multiple signals at range (6.20 – 7.90 ppm) while ^{1}H- NMR spectra of complexes which contain 5,6-dimethyl-1,3-dihydro-2 – telluraindene ($C_{10}H_{12}Te$) ligand, *i.e* [**IV**]-[**VI**] and [**X**] – [**XII**] show a singlet signal in the range (6. 99 – 7. 08 ppm) due to aromatic protons, *Table* 3. (17) On the other hand, the ^{1}H- spectra of complexes [**II**], [**V**], [**VIII**], [**XI**] show a singlet signal at 3.06, 3.21, 3.05 and 3.05 ppm respectively can be due to malonate ligand protons.(17) The ^{1}H- spectra of complexes [**III**], [**VI**], [**IX**], [**XII**] show quintet signal centered at 1.23, 1.24, 1.59 and 1.58 ppm, respectively can be attributed to methylene group CH_2- ***CH_2***-CH_2 in 1,1-cyclobutanedicarboxylate (CBDC) ligand. Also, the ^{1}H- spectra of complexes [**II**], [**V**], [**VIII**], [**XI**] show triplet signals centered at 2.05 , 2.03, 2.16 and 2.09 respectively due to ***CH_2***- CH_2-***CH_2***.(16, 17)

Table 3: *^{1}H NMR data for complexes [**I**]-[**XII**] and free ligands C_8H_8Te and $C_{10}H_{12}Te$*

Complex Number	Complex Formula	^{1}H NMR data (ppm vs. TMS)
[I]	$(C_8H_8Te)_2Pt(OX)$	4.37(CH_2, d, 4H) 4.57(CH_2, d, 4H) 7.21 – 7.31(Ar- H, d, 8H)
[II]	$(C_8H_8Te)_2Pt(mal)$	3.06(CH_2- mal, s, 2H) 3.22(CH_2, d, 4H) 4.16(CH_2, d, 4H) 6.55- 7.70(Ar- H, m, 8H)
[III]	$(C_8H_8Te)_2Pt(CBDCA)$	1.23(CH_2-*CH_2*-CH_2, q, 2H) 2.05(*CH_2*-CH_2-*CH_2*, t, 4H) 4.23(CH_2, d, 4H) 4.51(CH_2, d, 4H) 6.22 – 7.19(Ar- H, m, 8H)
[IV]	$(C_{10}H_{12}Te)_2Pt(OX)$	2.27(2 CH_3, s, 6H) 3.96(CH_2, d, 4H)

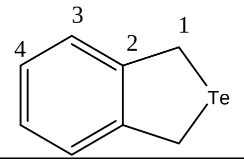
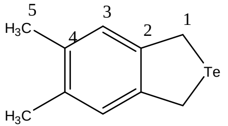
		4.04(CH_2, d, 4H) 7.04(Ar- H, s, 8H)
[V]	$(C_{10}H_{12}Te)_2Pt(mal)$	2.16(2 CH_3, s, 6H) 3.21(CH_2- mal, s, 2H) 4.37(2 CH_2, d, 8H) 7.08 (Ar- H, s, 8H)
[VI]	$(C_{10}H_{12}Te)_2Pt(CBDCA)$	2.17(2 CH_3, s, 6H) 1.24(CH_2-CH_2-CH_2, q, 2H) 2.03(CH_2-CH_2-CH_2, t, 4H) 4.54(CH_2, d, 4H) 4.76(CH_2, d, 4H) 7.03 (Ar-H, s, 8H)
[VII]	$(C_8H_8Te)_2Pd(OX)$	4.13(CH_2, d, 4H) 4.39(CH_2, d, 4H) 7.22 – 7.31(Ar- H, d, 8H)
[VIII]	$(C_8H_8Te)_2Pd(mal)$	3.05(CH_2- mal, s, 2H) 3.89(CH_2, d, 4H) 4.22(CH_2, d, 4H) 6.50- 7.77(Ar- H, m, 8H)
[IX]	$(C_8H_8Te)_2Pd(CBDCA)$	1.59(CH_2-CH_2-CH_2, q, 2H) 2.16(CH_2-CH_2-CH_2, t, 4H) 4.36(CH_2, d, 4H) 4.59(CH_2, d, 4H) 6.81 – 7.91 (Ar- H, m, 8H)
[X]	$(C_{10}H_{12}Te)_2Pd(OX)$	2.27(2 CH_3, s, 6H) 3.56(CH_2, d, 4H) 4.31(CH_2, d, 4H) 6.99(Ar- H, s, 8H)
[XI]	$(C_{10}H_{12}Te)_2Pd(mal)$	2.16(2 CH_3, s, 6H) 3.05(CH_2- mal, s, 2H) 4.23(2 CH_2, d, 8H) 7.00 (Ar- H, s, 8H)
[XII]	$(C_{10}H_{12}Te)_2Pd(CBDCA)$	2.17(2 CH_3, s, 6H) 1.58(CH_2-CH_2-CH_2, q, 2H) 2.09(CH_2-CH_2-CH_2, t, 4H) 3.53(CH_2, d, 4H) 4.01(CH_2, d, 4H) 7.07 (Ar- H, s, 8H)
Free ligand	C_8H_8Te	4.46(CH_2, s, 4H) 7.05 – 7.25(Ar-H, m, 4H)

Free ligand	$C_{10}H_{12}Te$	2.14(CH_3, s, 6H) 4.38(CH_2, s, 4H) 6.95 (Ar-H, s, 2H)

The ^{13}C NMR spectra for complexes [**I**]-[**XII**] were recorded in DMSO - d_6 and all ^{13}C NMR data were summarized in *Table* 4. ^{13}C NMR spectra of these complexes are undoubtedly of much importance in the study of ligand properties of heterocyclic tellurium ligands. The resonance signals of phenyl carbons and carbons atoms adjacent to tellurium atom (i.e. *CH_2*-Te) have clear changed toward downfield shift which can be attributed as an another evidence to coordinate of heterocyclic tellurium ligands C_8H_8Te and $C_{10}H_{12}Te$ with palladium (II) and platinum (II) ion, *Table* 4. (2, 5)

Table 4: *^{13}C NMR data for complexes [**I**]-[**XII**] and free ligands C_8H_8Te and $C_{10}H_{12}Te$*

Complex Number	Complex Formula	**^{13}C NMR data (ppm vs. TMS)^a**							
		C-1	**C-2**	**C-3**	**C-4**	**C-5**	**C=O^b**	***CH_2*COO^c**	**CH_2-*CH_2*CH_2^{c}**
[I]	$(C_8H_8Te)_2Pt(OX)$	21.03	155.69	119.22	140.24	-	169.12	-	-
[II]	$(C_8H_8Te)_2Pt(mal)$	21.39	155.54	119.43	139.15	-	170.24	41.56	-
[III]	$(C_8H_8Te)_2Pt(CBDC)$	21.68	155.62	119.54	138.82	-	172.74	28.80	15.59
[IV]	$(C_{10}H_{12}Te)_2Pt(OX)$	20.98	156.00	119.83	140.05	18.26	169.96	-	-
[V]	$(C_{10}H_{12} Te)_2Pt(mal)$	21.20	155.39	119.44	138.93	18.26	169.73	41.21	-
[VI]	$(C_{10}H_{12}Te)_2Pt(CBDCA)$	21.00	155.98	119.10	140.42	18.51	172.22	28.00	15.56
[VII]	$(C_8H_8Te)_2Pd(OX)$	20.82	155.68	119.53	140.24		169.43	-	-
[VIII]	$(C_8H_8Te)_2Pd(mal)$	21.43	155.62	119.55	140.27		170.25	41.83	-
[IX]	$(C_8H_8Te)_2Pd(CBDCA)$	21.43	155.71	119.82	140.04		173.83	29.45	19.99
[X]	$(C_{10}H_{12}Te)_2Pd(OX)$	20.80	156.35	119.87	140.27	18.04	169.99	-	-
[XI]	$(C_{10}H_{12} Te)_2Pd(mal)$	21.36	155.55	119.45	139.16	18.32	169.82	41.99	-
[XII]	$(C_{10}H_{12}Te)_2Pd(CBDCA)$	21.12	155.43	119.43	139.05	18.26	172.82	28.80	15.36

Free ligand		8.70	136.70	125.80	128.70	-	-	-	-
Free ligand		8.80	133.3	128.10	141.10	18.70	-	-	-

[a] carbon atoms assignments as illustrated for C_8H_8Te and $C_{10}H_{12}Te$
[b] carbon atoms of carbonyl groups for OX, mal and CBDC ligands
[c] carbon atoms for CBDC ligand

The molar conductivity measurements were carried out for all synthesized complexes [**I**]-[**XII**] in two different solvents dimethyl sulfoxide (DMSO) and methylene chloride (CH_2Cl_2) in 10^{-3} M at room temperature and summarized in *Table* **5**. The molar conductivity values were found in the range (2.5 – 8.7) ohm^{-1}cm^{2}mol^{-1} (less than 30 ohm^{-1}cm^{2}mol^{-1} for 10^{-3} MNH4Cl in DMSO and CH_2Cl_2 at r. t)which indicate that all complexes behave as non electrolyte in these solvents. This observations are confirm the suggested structure of complexes [**I**]-[**XII**] that all complexes are neutrals.(18)

Table 5 : molar conductivity data for complexes[**I**]-[**XII**] *in two solvents at room temperature .*

Complex Number	$\wedge_m^{a,b}$ in (DMSO)	$\wedge_m^{a,b}$ in (CH_2Cl_2)
[I]	3.6	2.5
[II]	5.3	8.7
[III]	6.5	5.8
[IV]	4.0	3.0
[V]	4.2	5.2
[VI]	5.1	7.0
[VII]	5.9	5.1
[VIII]	8.1	7.9
[IX]	6.7	6.8
[X]	4.4	4.2
	5.5	6.7

[XI]		
[XII]	8.6	6.0

a: unit of ohm^{-1}cm^{2}mol^{-1} b: measured at 10^{-3} M .

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