Synthesis and characterization of some new organotellurium compounds based on quinoline

Article · September 2017

DOI: 10.5155/eurjchem.8.3.218-223.1578

Adil Al-Fregi
University of Basrah, College of Science, Department of Chemistry

European Journal of Chemistry 8 (3) (2017) 218-223

European Journal of Chemistry

Journal webpage: www.eurjchem.com

Synthesis and characterization of some new organotellurium compounds based on quinoline

Adil Ali Al-Fregi *, Haider Abdul-Sattar Jaid and Hassan Thamir Abdulsahib

Department of Chemistry, College of Science, University of Basrah, 61001, Basrah, Iraq

* *Corresponding author at: Department of Chemistry, College of Science, University of Basrah, 61001, Basrah, Iraq.*
Tel.: +964.40.7707377383. Fax: +964.40.7707377383. E-mail address: dr.adilalfregi@yahoo.com (Adil A. Al-Fregi).

ARTICLE INFORMATION

DOI: 10.5155/eurjchem.8.3.218-223.1578

Received: 30 April 2017
Received in revised form: 21 May 2017
Accepted: 06 June 2017
Published online: 30 September 2017
Printed: 30 September 2017

KEYWORDS
Quinoline derivatives
Platinum(II) complexes
Rhodium(III) complexes
Palladium(II) complexes
Transmetallation reaction
Organotellurium compounds

ABSTRACT

A new series of organotellurium compounds based on quinoline were prepared by the reaction of 8-(quinolyl)mercuric chloride (1) with tellurium tetrabromide in 1:1 and 1:2 mole ratio in dry dioxane to obtain 8-(quinolyl)tellurium tribromide (2) and *bis*[8-(quinolyl)]tellurium dibromide (3), respectively, in good yields. Reaction of compounds 2 and 3 by ethanolic hydrazine hydrate gave *bis*[8-(quinolyl)]ditelluride (4) and *bis*[8-(quinolyl)]telluride (5), respectively, in moderate yields. Furthermore, the ligand properties of *bis*[8-(quinolyl)] telluride (5) will be carried out with K_2PtCl_4, Na_2PdCl_4 and $RhCl_3.3H_2O$. All compounds were characterized by spectroscopic data and elemental analysis.

Cite this: *Eur. J. Chem.* **2017**, *8(3)*, 218-223

1. Introduction

There are few examples of tellurated derivatives of quinoline in literatures, although the first example was prepared in 1943 by Reichel and Ilberg by treating 2-phenyl-4-quinoline carboxylic acid with tellurium(IV) chloride in dry carbon tetrachloride to obtain 4-(4'-carboxyquinol-2-yl)-benzenetellurinyl chloride [1]. On the other hand, transmetallation is a well-known synthetic tool for the synthesis of main group organometallic compounds, especially with tellurium element [2]. *Tris*(8-quinolinyl)telluronium chloride was prepared by transmetallation of 8-lithio-quinoline with tellurium tetrachloride with low yield of *bis*(8-quinolinyl) telluride [3]. Al-Assadi prepared a new series of organotellurium compounds containing quinoline namely: 2-(8-hydroxyquinolinazo)-1-naphthyl tellurium(IV) tribromide and *bis*[2-(8-hydroxyquinolineazo)-1-naphthyl] tellurium(VI) dibromide by reacting of 2-(8-hydroxyquinolineazo)-1-naphthyl mercury(II) chloride with tellurium tetrabromide in 1:1 and 1:2 mole ratio, respectively [4]. Furthermore, *bis*[2-(8-hydroxyquinolineazo)-1-naphthalenyl]ditelluride and *bis*[2-(8-hydroxyquino lineazo)naphthyl] telluride were prepared by action of hydrazine hydrate with the corresponding tribromide and dichloride, respectively. Kumar *et al.* [5] reported the preparation of *bis*[2,2,4-tri methyl-6-(ethyltelluro)-1,2-dihydroquinoline] ditelluride from the reaction of 6-bromo-2,2,4-trimethyl-1,2-dihydroquinoline with *tert*-butyllithium at -78 °C in dry diethyl ether, followed by insertion of tellurium into carbon-lithium bond and finally air oxidation of the resulting product.

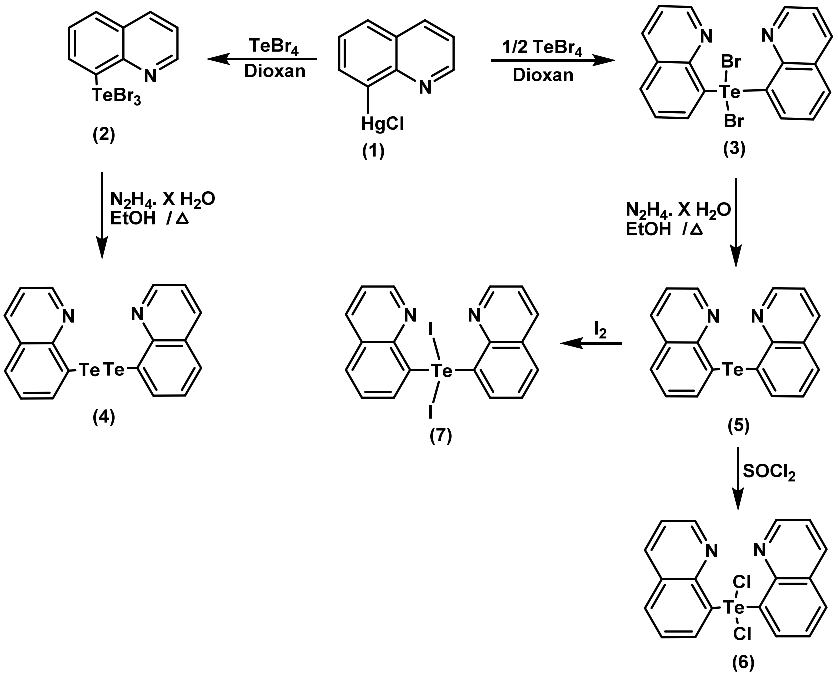
In the present work, we demonstrate, transmetallation as a route to prepare a series of new organotellurium compounds based on quinoline via transmetallation reaction of 8-(quinolyl)mercuric chloride with tellurium tetrachloride in 1:1 and 1:2 mole ratio, respectively. Furthermore, the ligand properties of *bis*[8-(quinolyl)] telluride will be carried out with K_2PtCl_4, Na_2PdCl_4 and $RhCl_3.3H_2O$.

2. Experimental

2.1. Instrumentation

Analysis for C, H, and N was done by the Analytical Service Unit at Al-al Bayt University, Jordan. FT-IR spectra were recorded as KBr disks using a FT-IR spectrophotometer Shimadzu (Japan) model 8400S in range 4000-400 cm^{-1} at General Company for Petrochemical Industries of Basrah. ^1H NMR spectra were recorded at University of Isfahan Isfahan, Islamic Republic of Iran by using a Bruker 400 MHz (Germany).

ISSN 2153-2249 (Print) / ISSN 2153-2257 (Online)
http://dx.doi.org/10.5155/eurjchem.8.3.218-223.1578



Scheme 1

Chemical shifts of all ^{1}H NMR spectra were recorded in δ (ppm) unit downfield from the internal reference tetramethyl silane (TMS), using DMSO-d_6 solvents, *J* values are given in Hz. Mass spectra were recorded at University of Isfahan, Isfahan, Islamic Republic of Iran, by using a MS model 5975C VL MSD. UV-Vis spectrum were recorded at Department of Chemistry, College of Science, University of Basrah by using Scan 80D (England) at range 200-800 nm using *N*,*N*-dimethylformamide as a solvents and 1 cm^3 pathway quartz cells. The molar conductivity for some synthesized compounds were measured in 1×10^{-3}-1×10^{-5} M solutions of dimethylsulfoxide solvent at room temperature using a Konduktoskop model 365B using standard conductivity cell with constant equal to 0.81 cm^{-1}. Melting points were determined on a Gallenkamp melting point apparatus and are uncorrected.

2.2. Synthesis

2.2.1. Synthesis of 8-(quinolyl)mercuric chloride (1)

8-(Quinolyl)mercuric chloride (**1**) was synthesized by method given in the literature (Caution ! mercuric acetate is highly toxic) [6].

2.2.2. Synthesis of 8-(quinolyl)tellurium tribromide (2)

A mixture of tellurium tetrabromide (1.00 g, 2.24 mmol) in 35 mL of dry dioxane and 8-(quinolyl)mercuric chloride (**1**) (0.82 g, 2.24 mmol) in 30 mL of dry dioxane was refluxed with stirring for 6 h under argon atmosphere. The resulting solution was filtered hot and on cooling deposited 2:1 complex of dioxane and mercuric halides as white plates, which was filtered off. The filtrate was evaporated by a rotary evaporator to give a yellow precipitate. Recrystallization of the crude product from a mixture of chloroform and methanol (7:3, *v*:*v*) gave a yellow solid of 8-(quinolyl)tellurium tribromide (**2**) (Scheme 1). Color: Yellow. Yield: 73%. M.p.: 108-110 °C. FT-IR (KBr, ν, cm^{-1}): 3471, 2925, 2856, 1649, 1616, 1527, 1436, 788, 729, 653, 462. ^{1}H NMR (400 MHz, DMSO-d_6, δ, ppm): 9.415 (d, 1H, H$_2$, *J* = 4 Hz), 9.280 (d, 1H, H$_4$, *J* = 8 Hz), 8.460 (d, 1H, H$_5$, *J* = 8 Hz), 8.350 (d, 1H, H$_7$, *J* = 8 Hz), 8.230 (t, 1H, H$_6$, *J* = 8 Hz), 8.030 (t, 1H, H$_3$, *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 268 (70000), 314 (10000).Anal. calcd. for $C_9H_6Br_3NTe$: C, 21.82; H, 1.22; N, 2.82. Found: C, 21.86; H, 1.24; N, 2.79%. MS (EI, *m/z* (%)): 494.71 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 29.50.

2.2.3. Synthesis of bis[8-(quinolyl)]tellurium dibromide (3)

A mixture of tellurium tetrabromide (1.00 g, 2.70 mmol) and 8-(quinolyl)mercuric chloride (**1**) (0.41 g, 1.12 mmol) in 35 mL of dry dioxane was refluxed with stirring for 6 h under argon gas atmosphere. The resulting solution was filtered hot and cooled to room temperature. On cooling, a 2:1 complex of dioxane and mercuric halides was separated as white plates. This complex was filtered off. The filtrate solution was poured into 300 mL of distilled ice-water to obtain brown to orang solid immediately. The resulting precipitate was collected by filtration. Recrystallization of the product from a mixture of methanol and chloroform (4:1) gave an orange powder (Scheme 1). Color: Orange. Yield: 77%. M.p.: 250-252 °C. FT-IR (KBr, ν, cm^{-1}): 3490, 2923, 2856, 1647, 1614, 1529, 1471, 800, 707, 694, 460. ^{1}H NMR (400 MHz, DMSO-d_6, δ, ppm): 9.045 (d, 2H, H2&H2', *J* = 4 Hz), 8.640 (d, 2H, H4&H4', *J* = 8 Hz), 8.350 (d, 2H, H5&H5', *J* = 8 Hz), 8.120 (d, 2H, H7&H7', *J* = 8 Hz), 7.900 (t, 2H, H6&H6', *J* = 8 Hz), 7.750 (t, 2H, H3&H3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 274 (14500), 314 (8500). Anal. calcd. for $C_{18}H_{12}Br_2N_2Te$: C, 39.76; H, 2.22; N, 5.15. Found: C, 39.70; H, 2.13; N, 5.11%. MS (EI, *m/z* (%)): 543.86 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 20.40.

2.2.4. Synthesis of bis[8-(quinolyl)] ditelluride (4)

8-(Quinolyl)tellurium tribromide (**2**) (1.00 g, 2.00 mmol) was refluxed in 25 mL of ethanol. An ethanolic solution of hydrazine hydrate was added drop by drop to the refluxing solution until the evolution of nitrogen was ceased. The resulting solution was cooled to room temperature and poured into 100 mL of distilled water and extract with diethyl ether (4 × 30 mL). The etheric extracts were dried over an anhydrous calcium chloride. Evaporation of solvent afforded a dark red solid. The crude product was recrystallized from a mixture of methanol and dichloromethane (1:4) to obtain dark red crystals (Scheme 1). Color: Dark red. Yield: 56%. M.p.: 118-120 °C. FT-IR (KBr, ν, cm^{-1}): 3508, 3076, 2925, 2856, 1629, 1548, 1521, 796, 759, 675, 464. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.420 (d, 2H, H_2&H_2', *J* = 4 Hz), 9.280 (d, 2H, H_4&H_4', *J* = 8 Hz), 8.460 (d, 2H, H_5&H_5', *J* = 8 Hz), 8.350 (d, 2H, H_7&H_7', *J* = 8 Hz), 8.230 (t, 2H, H_6&H_6', *J* = 8 Hz), 8.040 (t, 2H, H_3&H_3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 270 (17500), 314 (4000). Anal. calcd. for $C_{18}H_{12}N_2Te_2$: C, 42.27; H, 2.36; N, 5.48. Found: C, 42.18; H, 2.33; N, 5.41%. MS (EI, *m/z* (%)): 514.91 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 6.30.

2.2.5. Synthesis of bis[8-(quinolyl)] telluride (5)

Bis[8-(quinolinyl)]tellurium dibromide (**3**) (1 g, 2.60 mole) was dissolved in 25 mL of ethanol and refluxed. A solution of hydrazine hydrate in ethanol was added drop wisely to the refluxed solution until nitrogen evolution was ceased. The resulting solution was poured into 500 mL of distilled ice-water to afford a green solid. The crude product was twice recrystallized from a mixture of methanol and chloroform (1:3) to obtain green crystal (Scheme 1). Color: Green. Yield: 63%. M.p.: 202-204 °C. FT-IR (KBr, ν, cm^{-1}): 3506, 3068, 2925, 2856, 1623, 1556, 1471, 798, 649, 466. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.225 (d, 2H, H_2&H_2', *J* = 4 Hz), 8.930 (d, 2H, H_4&H_4', *J* = 8 Hz), 8.300 (d, 2H, H_5&H5', *J* = 8 Hz), 8.240 (d, 2H, H_7&H_7', *J* = 8 Hz), 8.060 (t, 2H, H_6&H_6', *J* = 8 Hz), 7.880 (t, 2H, H_3&H_3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 276 (22000), 314 (5000). Anal. calcd. for $C_{18}H_{12}N_2Te$: C, 56.31; H, 3.15; N, 7.30. Found: C, 56.28; H, 3.30; N, 7.28%. MS (EI, *m/z* (%)): 385.01 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 5.50.

2.2.6. Synthesis of bis[8-(quinolyl)tellurium dichloride (6)

Thionyl chloride (0.12 g, 1.00 mmol) in 15 mL of dry ether was added drop wisely to an etheric solution of *bis*[8-(quinolineyl)telluride (**5**) (0.38 g, 1.00 mmol) with stirring at room temperature for 30 minutes. A yellow precipitate was formed immediately. Recrystallization from a mixture of methanol and chloroform (1:4) gave yellow crystals of compound **6** (Scheme 1). Color: Yellow. Yield: 85%. M.p.: 216-218 °C. FT-IR (KBr, ν, cm^{-1}): 3442, 3072, 2923, 2854, 1649, 1548, 1461, 800, 675, 611, 459. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.050 (d, 2H, H_2&H_2', *J* = 4 Hz), 8.649 (d, 2H, H_4&H_4', *J* = 8 Hz), 8.350 (d, 2H, H_5&H_5', *J* = 8 Hz) , 8.150 (d, 2H, H7&H7', *J* = 8 Hz), 7.900 (t, 2H, H6&H6', *J* = 8 Hz), 7.741 (t, 2H, H3&H3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 272 (18500), 314 (4000). Anal. calcd. for $C_{18}H_{12}Cl_2N_2Te$: C, 47.54; H, 2.66; N, 6.16. Found: C, 47.50; H, 2.63; N, 6.11%. MS(EI, *m/z* (%)): 453 .81 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 29.65.

2.2.7. Synthesis of bis[8-(quinolyl)tellurium diiodide (7)

A solution of iodine (0.10 g, 0.78 mmol) in 10 mL of diethyl ether was added to a solution of *bis*-8-(quinolyl) telluride (**5**) (0.30 g, 0.78 mmol) in diethyl ether 20 mL with stirring at room temperature for 30 minutes gave brown solid. The crude product was recrystallized by a mixture of methanol and chloroform (3:1) to afford brown crystals of compound **7**. (Scheme 1) Color: Brown. Yield: 88%. M.p.: 180-182 °C. FT-IR (KBr, ν, cm^{-1}): 3072, 1649, 1546, 1514, 802, 673, 459. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.051 (d, 2H, H_2&H_2', *J* = 4 Hz), 8.649 (d, 2H, H_4&H_4', *J* = 8 Hz), 8.348 (d, 2H, H_5&H_5', *J* = 8 Hz), 8.150 (d, 2H, H_7&H_7', *J* = 8 Hz), 7.902 (t, 2H, H_6&H_6', *J* = 8 Hz), 7.740 (t, 2H, H_3&H_3', *J* = 8 Hz). UV UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 274 (21000), 314 (5600). Anal. calcd. for $C_{18}H_{12}I_2N_2Te$: C, 33.90; H, 1.90; N, 4.39. Found: C, 33.87; H, 1.83; N, 4.31%. MS (EI, *m/z* (%)): 636.71 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 32.00.

2.2.8. Synthesis of bis{bis[8-(quinolyl)]telluride} palladium(II) chloride (8)

To a stirring solution of sodium tetrachloro palladinate(II), Na_2PdCl_4, (0.10 g, 0.34 mmol) in distilled water (30 mL) a solution of telluride (**5**) (0.26 g, 0.68 mmol) in 25 mL of ethanol. The mixture was stirred at room temperature for 6 h to give a brown solid which was collected by filtration. The crude solid was recrystallized (twice) from a methanol to afford yellowish brown crystals (Scheme 2). Color: Brown. Yield: 74%. M.p.: 228-230 °C (Dec.). FT-IR (KBr, ν, cm^{-1}): 3446, 3062, 2921, 2856, 1691, 1552, 1514, 885, 802, 752, 457. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.225 (d, 4H, 2H_2&2H_2', *J* = 4 Hz), 8.890 (d, 4H, 2H_4&2H_4', *J* = 8 Hz), 8.280 (d, 4H, 2H_5 &2H_5', *J* = 8 Hz), 8.240 (d, 4H, 2H_7&2H_7', *J* = 8 Hz), 8.060 (t, 4H, 2H_6&2H_6', *J* = 8 Hz), 7.890 (t, 4H, 2H_3&2H_3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 262 (18353), 302 (10450). Anal. calcd. for $C_{36}H_{24}Cl_2N_4PdTe_2$: C, 45.75; H, 2.56; N, 5.93. Found: C, 45.67; H, 2.53; N, 5.91%. MS (EI, *m/z* (%)): 944.13 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 48.00.

2.2.9. Synthesis of bis{bis[8-(quinolyl)]telluride} platinum(II) chloride (9)

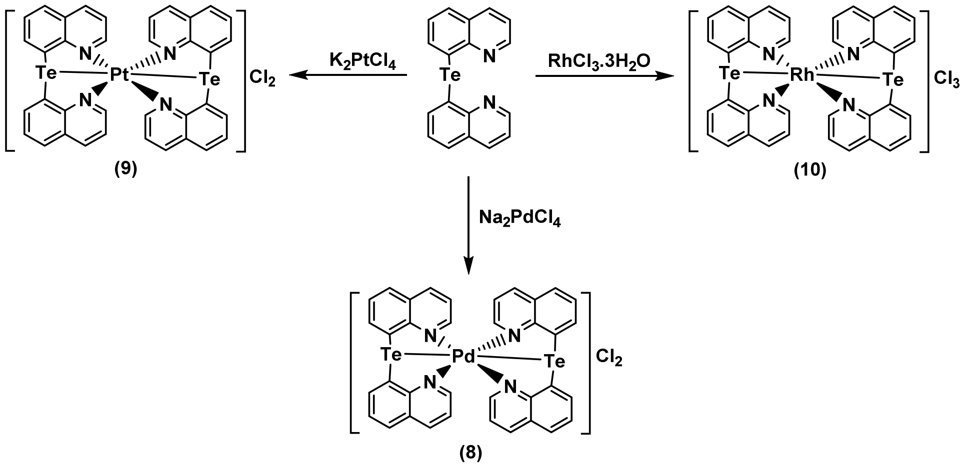
This complex was prepared by the same method of complex **8** by reacting telluride (**5**) (0.18 g, 0.48 mmol) and potassium tetrachloroplatinate(II), K_2PtCl_4, (0.10 g, 0.24 mmol). Compound **9** was obtained as yellow crystals (Scheme 2). Color: Yellow. Yield: 68%. M.p.: 255-257 °C (Dec.). FT-IR (KBr, ν, cm^{-1}): 3058, 1697, 1552, 1512, 871, 806, 624, 459. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.155 (d, 4H, 2H_2&2H_2', *J* = 4 Hz), 8.785 (d, 4H, 2H_4&2H_4', *J* = 12 Hz), 8.220 (d, 4H, 2H_5 &2H_5', *J* = 8 Hz), 8.190 (d, 4H, 2H_7&2H_7', *J* = 8 Hz), 8.000 (t, 4H, 2H_6&2H_6', *J* = 8 Hz), 7.830 (t, 4H, 2H_3&2H_3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 260 (11290), 300 (9900). Anal. calcd. for $C_{36}H_{24}Cl_2N_4PtTe_2$: C, 41.83; H, 2.34; N, 5.42. Found: C, 41.79; H, 2.33; N, 5.38%. MS (EI, *m/z* (%)): 1032.92 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 54.00.

2.2.10. Synthesis of bis{bis[8-(quinolyl)]telluride} rhodium(III) chloride (10)

This complex was prepared by the same method of complex **8** by reacting telluride (**5**) (0.37 g, 0.95 mmol) and rhodium(III) chloride trihydrate, $RhCl_3.3H_2O$, (0.10 g, 0.48 mmol). Yellowish-brown crystals was obtained (Scheme 2). Color: Yellowish-brown. Yield: 77%. M.p.: 311-315 °C. FT-IR (KBr, ν, cm^{-1}): 3407, 3070, 2923, 2854, 1691, 1581, 1527, 802, 729, 680, 457. ^{1}H NMR (400 MHz, DMSO-*d*$_6$, δ, ppm): 9.152 (d, 4H, 2H_2&2H_2', *J* = 4 Hz), 8.799 (d, 4H, 2H_4&2H_4', *J* = 8 Hz), 8.254 (d, 4H, 2H_5 &2H_5', *J* = 8 Hz), 8.199 (d, 4H, 2H_7&2H_7', *J* = 8 Hz), 8.000 (t, 4H, 2H_6&2H_6', *J* = 8 Hz), 7.849 (t, 4H, 2H_3&2H_3', *J* = 8 Hz). UV/Vis (DMF, λ_{max}, nm, (ε, M^{-1}.cm^{-1})): 260 (14950), 300 (5550). Anal. calcd. for $C_{36}H_{24}Cl_3N_4RhTe_2$: C, 44.25; H, 2.48; N, 5.73. Found: C, 44.17; H, 2.40; N, 5.69%. MS (EI, *m/z* (%)): 978.82 (M$^+$, 100). Λ_m (S.m^2.mol^{-1}): 75.00.

3. Results and discussion

In the present study, reaction of quinoline with mercuric acetate gave the quaternary *N*-mercuriacetate at room temperature. At 160 °C further substitution occurs and treatment with sodium chloride, gives a mixture of 3- and 8-(quinolyl)mercuric chlorides. Then, the two mixtures were extracted by column chromatography using a mixture of methanol and chloroform (1:3) as an eluents.



Scheme 2

Reaction of 8-(quinolyl)mercuric chloride (**1**) with tellurium tetrabromide in 1:1 mole ratio gave the 8-(quinolyl)tellurium tribromide (**2**) as a yellow solid in 73% yield. When 8-(quinolyl)mercuric chloride (**1**) was reacted with tellurium tetrabromide in 2:1 mole ratio, *bis*[8-(quinolyl)]tellurium dibromide (**3**) was obtained as orange, in 77% yields. Reduction of 8-(quinolyl)tellurium tribromides (**2**) by ethanolic solution of hydrazine hydrate gave *bis*[8-(quinolyl)] ditelluride (**4**) as a dark red solid in 56% yield. Di-[8-(quinolyl)] telluride (**5**) was obtained as green dark solid in 63% yield by reduction of *bis*[8-(quinolyl)]tellurium dibromide (**3**) with hydrazine hydrate in ethanol. *Bis*[8-(quinolyl)] tellurium dichloride (**6**) and *bis*[8-(quinolyl)]tellurium diiodide (**7**) were prepared by reacting of *bis*[8-(quinolyl)] telluride (**5**) with thionyl chloride and iodine respectively. Compounds **6** and **7** were obtained as brown solids in 85 and 88% yields, respectively, Scheme 1.

In order to clarify the ligand properties of these new compounds to form complexes with metal salts, we selected *bis*[8-(quinolyl]telluride (**5**) as a ligand with Na_2PdCl_4, K_2PtCl_4, and $RhCl_3.3H_2O$. Reaction of two moles of *bis*[8-(quinolyl)] telluride (**1**) with one mole of Na_2PdCl_4, K_2PtCl_4 and $RhCl_3$. $3H_2O$, respectively, gave yellow to yellowish brown crystals of *bis*{*bis*[8-(quinolyl)]telluride} palladium(II) chloride (**8**), *bis* {*bis*[8-(quinolyl)]telluride} platinum(II) chloride (**9**), *bis*{*bis*[8-(quinolyl)]telluride} rhodium(III) chloride (**10**), respectively, in good yields, Scheme 2.

Generally, all the prepared compounds **1**-**10** are color, solids, stable in air, soluble in DMF and DMSO. The complexes **8**-**10** are soluble in water which can be as evidence to the ionic nature of these complexes. The elemental analysis CHN of all synthesized compounds are in good agreement with the calculated values which indicated the suggested structures are correct.

The molar conductivities were determined for all synthesized compounds **1**-**10** in 1×10^{-3} M of DMSO solvent at room temperature. The molar conductance of 8-(quinolyl) mercuric chloride (**1**), 8-(quinolyl)tellurium tribromide (**2**), *bis*[8-(quinolyl)]tellurium dibromide (**3**), *bis*[8-(quinolyl) tellurium dichloride (**6**) and *bis*[8-(quinolyl)tellurium iodide (**7**) were found at 26.10, 29.50, 20.40, 29.65 and 32.00 S.m^2/mol, respectively. These values confirm that these compounds behave as 1:1 electrolyte which are in agree well with previous work in DMSO solution [7,8]. These observations may be due to ionic character of Hg-Cl and one of Te-halide bonds in these compounds. The molar conductance of *bis*[8-(quinolyl)] ditelluride (**4**) and *bis*[8-(quinolyl)]telluride (**5**) were found at 6.30 and 5.50 S.m^2.mol^{-1}, respectively. This indicates that these compounds are nonelectrolytes. On the other hand, the molar conductance of complexes *bis*{*bis*[8-(quinolyl)]telluride} palladium(II) chloride (**8**), *bis*{*bis*[8-(quinolyl)] telluride} platinum(II) chloride (**9**) and *bis*{*bis*[8-(quinolyl)]telluride} rhodium(III) chloride (**10**) were found at 48.00, 54.00 and 75.00 S.m^2.mol^{-1}, respectively. These data indicate that complexes **8** and **9** behave as 1:2 electrolytes while complex **10** behave as a 1:3 electrolyte which are agreement with the suggested structure of complexes.

The IR spectra of all new synthesized compounds **1**-**10** display common feature in certain regions and characteristic bands in the fingerprint and other regions. Generally, the IR spectral analysis of compounds **1**-**10** are in good arrangement with the suggested structures. The IR spectra of all new prepared compounds **1**-**10** show strong absorption band around the region 1614-1691 cm^{-1} range is characteristic, originating from the stretching mode of the C=N bonds. These values are in good agreement with previous works [2,9-11]. The IR spectra of compounds **2**-**7** are quite similar to those of 8-(quinolyl)mercuric chloride (**1**). This means that telluration has occurred at the point of mercuration. The IR spectra of compounds **1**-**10** display weak bands in the region between 3051 and 3076 cm^{-1}, however at higher frequency, are assigned to C-H stretching vibrations of aromatic rings of quinolone [12,13]. Also, the IR spectra of compounds **1**-**10** show two bands in the range 1527-1583 and 1521-1436 cm^{-1} can be attributed to asymmetrical and symmetrical stretching of aromatic C=C, respectively [2,11-13]. Furthermore, several variable bands between 611 and 806 cm^{-1} range can be assigned to aromatic bending of C-H. A weak band was appeared in IR spectra of compounds **2**-**7** at range 457-466 cm^{-1} may be attributed to Te-C stretching [14]. It is worth noting, quinoline and its derivatives interact strongly with H_2O molecule due to the potentially capable of nitrogen in these compounds to form hydrogen bonding with H_2O and ROH molecules. Therefore, the IR spectra of all compounds, except compound **7** and **10**, showed a broadly band centered in the range 3452-3506 cm^{-1} may be due to ν(O-H) of methanol solvent as an adduct compound in crystalline lattice of these compounds [11,15]. Also, two weak stretching bands at 2921-2925 and 2854-2858 cm^{-1} can be assigned to aliphatic C-H stretching of methanol molecule in the crystalline lattice [11,15,16]. These observation well agreements with the elemental analysis (CHN) of these compounds. On the other hand, the IR spectra of complexes **8** -**10** show a similar pattern to the spectrum of compound **5** with some shifts and alteration of intensities. Comparison IR spectra of complexes **8**, **9** and **10** with compound **5**, a high frequency shift (68 cm^{-1}) was appeared can be attributed to coordinate of nitrogen atoms of compound **5** with palladium, platinum and rhodium ions, respectively. Also, IR spectra of complexes **8**, **9** and **10** show a weak band at 457, 459 and 57, respectively, with low frequency which indicate to coordinate tellurium atom of compound **5** with palladium, platinum and rhodium ions, respectively. The IR spectra of compound **5** show a weak band at 466 cm^{-1} assign to ν(C-Te). The same band was shifted toward low frequency (7-9 cm^{-1}) in complexes **8**-**10** which can be as evidence to coordinate compound **5** with palladium, platinum and rhodium ions, respectively [8,10,17,18].

The ^1H NMR spectra of compounds **1**-**10** were measured in DMSO-d_6 solvent. In general, ^1H NMR spectra of the recorded compounds show the expected signals in proper intensity ratio. The signal at δ 2.5 ppm in the spectra is due to methyl protons of DMSO-d_6 solvent, while the signal at δ 3.33 ppm is due to hydroxyl proton of the water [19]. The quinoline ring may be thought of as comprising a benzene and a pyridine ring. The H_2, H_3 and H_4 of pyridine are chemically and magnetically nonequivalent. The equivalent hydrogens of benzene become chemically and magnetically nonequivalent when joined with pyridine to give the quinoline ring system. The spectrum of quinoline thus shows signals corresponding to seven *spin-spin* coupled hydrogen atoms that can be divided into two groups. One set corresponds to the protons in the benzene ring (H_5-H_8) and the second set corresponds to the protons in the pyridine ring (H_2-H_4). The chemical shifts and coupling constant differences between the protons of benzene and pyridine rings of quinolone can found in reference [19-21]. The H_2 proton of compounds **1**-**10** has the highest chemical shift, owing to deshielding by the proximal electronegative nitrogen, whereas the H_3 has the lowest chemical shift. Thus, the ^1H NMR spectra of compounds **1**-**10** show a doublet signal centered at range δ 9.04-9.42 ppm with *J-J* coupling constant, $^3J_{2,3}$ equal to 4.00 Hz can be attributed to H_2, while the triplet signal which was centered at range δ 7.60-8.04 ppm with coupling constant equal to 8 Hz can be attributed to H_3 proton. The splitting patterns of H_2 and H_3 of quinolyl group provide further confirmation for the assignment of these protons in all the prepared compounds [10,19]. Assigning the remaining signals now requires analysis of their splitting patterns and coupling constants. Unfortunately, the splitting patterns of the various sets of protons are sometimes too complicated, owing to long range coupling, to distinguish the protons. Assignment of H_2 and H_3, leaves three doublet signals. So, the ^1H NMR spectra of compounds **1**-**10** show a doublet signal centered at δ 8.64-930 ppm range with *J-J* coupling constant ranged at 8 Hz (except **9** *J-J* constant = 12) can be attributed to H_4 proton while a doublet signal centered at δ 8.12- 8.49 ppm with *J-J* coupling = 8 Hz assign to H_5. The last doublet signal which appeared at the range δ 8.19-8.37 ppm with *J-J* coupling equal to 8 Hz can be attributed to H_7 proton [19,21]. Finally, a triplet signal centered at δ 7.90-8.23 ppm with *J-J* coupling = 8 *Hz* corresponds to H_6 [19-21].

The mass spectrum of compound **2** shows a peak at *m/z* 526 which corresponding to molecular ion $[C_{10}H_{10}NTeOBr_3]^+$. A peak at *m/ z* 494.71 was also observed which correspond to $[C_9H_6NTeBr_2]^+$ ion, attributed to the loss of adduct molecule of methanol. The peak at *m/z* 287.8 is due to the loss of Br_2 molecule to give ion with formula $[C_9H_6NTeBr]^+$. The fragment at *m/z* 129.1 can be attributed to quinoline ion $[C_9H_7N]^+$. The mass spectrum of compound **3** exhibits molecular ion peak $[C_{19}H_{16}N_2TeOBr_2]^+$ at *m/z* 574.86. The peak at *m/z* 494.71 can be attributed to $[C_{18}H_{14}N_2TeBr_2]^+$ ion, due to the loss of adduct molecule of methanol. The fragment with *m/z* 361.02 attributed to $[C_{18}H_{14}Te]^+$ due to loss of CH_3CN from each quinolyl moiety. The peak at *m/z* 281.8 attributed to $[C_{12}H_{10}Te]^+$ ion while at *m/z* 209 due to $[C_6H_5Te]^+$ ion. The mass spectrum of compound **4** shows peak at *m/z* 287.97 attributed to $[C_{10}H_{10}NTeO]^+$ ion due to the breakage of Te-Te bond, while at *m/z* 258.97 attributed to quinolyl ion $[C_9H_7N]^+$. The mass spectrum of compound **5** exhibits the molecular peak of $[C_{19}H_{14}N_2TeO]^+$ at *m/z* 416. The peak at *m/z* 386.01 attributed to $[C_{18}H_{12}N_2Te]^+$ ion due to the loss of adduct methanol molecule. Also, the peak at *m/z* 361.01 attributed to $[C_{17}H_{13}NTe]^+$ due to the loss of CH_3CN. It is worth to note, all the mass spectra of compounds **2**, **3**, **4** and **5** exhibit peaks at *m/z* 102.05, 80.79 and 51.07 attributed to $[C_8H_6]^+$, $[C_6H_6]^+$ and $[C_4H_4]^+$, respectively. The mass spectra of complexes **8**-**10** exhibit the peak of molecular ion at *m/z* 949.85, 1032.92 and 979.82, respectively which are confirm the suggested structures for these complexes. The mass spectra of complexes **8**-**10** show a peak at *m/z* 491, 580 and 489, respectively, can be attributed to M^+ ($[C_{18}H_{12}N_2PdTe]^+$, $[C_{18}H_{12}N_2PtTe]^+$ and $[C_{18}H_{12}N_2RhTe]^+$, respectively). Also, the mass spectra of complexes **8**-**10** exhibit a peak at *m/z* 234 can be attributed to $[C_9H_6NTe]^+$ and a low intensity peak at *m/z* 127.6 due to lose of Te element (*m/z* 127.6). A peak was appeared at *m/z* 234, 324, and 232 attributed to $[C_9H_7NPd]^+$, $[C_9H_7NPt]^+$ and $[C_9H_7NRh]^+$ while *m/z* 129.1 attributed to $[C_9H_9N]^+$ ion due to lose of Pd (*m/z* 106), Pt (*m/z* 195) and Rh (*m/z* 102) elements respectively. Furthermore, there are several fragments exhibited at *m/z* 102.05, 80.79 and 51.07 can attributed to $[C_8H_6]^+$, $[C_6H_5]^+$ and $[C_4H_4]^+$, respectively.

The UV-Vis spectra of compounds **1**-**10** were measured at 1×10^{-4} M using dimethylformamid (DMF) as a solvent. In general, the UV-Vis spectra of compounds **1**-**10** are result of absorptions due mainly to the quinolyl rings, which have changed in comparison with those of free quinoline. Quinoline is a hetero aromatic compound, so the $n \rightarrow \pi^*$ and the $\pi \rightarrow \pi^*$ transitions are expected to be shown, however the band due to the $n \rightarrow \pi^*$ transition is generally weak, while the bands associated with the $\pi \rightarrow \pi^*$ transitions do not present fine structure and are observed in two regions, which cover up the band owed to the $n \rightarrow \pi^*$ transition and showed two maximum absorption peaks at 330 and 263 nm. The absorption at the long wavelength is characterized to present vibrational fine structure dependent on the physical state and solvent polarity [2,21]. In comparison with the compounds **1**-**7** , it is possible to verify that the maximum peak at 261 nm for the free quinoline is red-shifted (about 5-13 nm), as 268 nm for compounds **1** and **2**; 274 nm for compounds **3** and **7**; 270 nm for compound **4**; 276 nm for compound **5**; and 272 nm for compound **6**. On the other hand, there are blue-shifted (about 16 nm) in the second band of UV-Vis spectra of compounds **1**-**7** compared with free quinolone (330 nm). Both shifted can be indicate as an evidence to telluration and mercuration of quinoline. The UV-Vis spectra of complexes **8**-**10** show two absorption bands at the range 260-262 nm (ε = 14950-11280 $M^{-1}.cm^{-1}$) and 300-302 nm (ε = 5550-9290 $M^{-1}.cm^{-1}$) due to $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, respectively of the quinolyl rings [11,19]. Generally, blue shifted was observed in the transition values of complexes **8**-**10** compared with the complex **5** which can be attributed to increase of electronic levels between (n and π*) and (π and π*) due to donate the lone pairs of nitrogen and tellurium atoms of quinolyl ligand. No *d-d* transitions were observed for complexes **8**-**10** may be masked by high intensity of $\pi \rightarrow \pi^*$ of quinoline moiety.

4. Conclusions

In summary, we have prepared nine compounds for organotellurium based on quinoline by transmetallation reaction of 8-(quinolyl)mercuric chloride (**1**) with tellurium tetrachloride in 1:1 and 1:2 mole ratio in dry dioxane gave the corresponding tribromide and dibromide, respectively, in good yields. Reaction of compounds tribromide and dibromide can be converted to the corresponding ditelluride and telluride, respectively, by action of ethanolic hydrazine hydrate. Furthermore, the ligand properties of *bis*[8-(quinolyl)] telluride with with Pt(II), Pd(II) and Rh(III) ions gave N-Te-N coordination type with octahedral geometry.

Acknowledgements

Authors are grateful for Department of Chemistry, College of Science, University of Basra for supporting this work.

Reference

[1]. Reichel, L.; Ilberg, K. *Ber.* **1943**, *76B*, 1108-1117.

[2]. Tamang, S. R.; Son, J. H.; Hoefelmeyer, J. D. *Dalton Trans.* **2014**, *43(19)*, 7139-7145.

[3]. Lin, T. P.; Gabbai, F. *Angew. Chem. Int. Ed.* **2013**, *52*, 3864-3870.

[4]. Al-Assadi, R. Ph. D. Thesis, University of Basrah, Iraq, 2013.

[5]. Kumar, S.; Engman, L.; Valgimigli, L.; Amorati, R.; Fumo, M. G; Pedulli, G. F. *J. Org. Chem.* **2007**, *72*, 6046-6055.

[6]. Ukai, I. T. *J. Pharma. Soc. Japan* **1927**, *548*, 873-879.

[7]. Al-Rubaie, A. Z.; Al-Najar, A. A.; Jassim, F. A. *Inorg. Chim. Acta* **1990**, *175*, 181-188.

[8]. Qseer, H. A. *Croatical Chem. Acta* **2005**, *78(1)*, 79-89.

[9]. Kumar, R.; Singh, A. K.; Butcher, R. J.; Shama P.; Toscano, *R. A. Eur. J. Inorg. Chem.* **2004**, *5*, 1107-1116.

[10]. Kumar, R.; Singh, A. K.; Drake, J. E.; Hursthouse, M. B.; Light, M. E. *Inorg. Chem. Commun.* **2004**, *7*, 502-511.

[11]. Silerstien, R. M.; Webster F. X.; Kiemle, D. J. , Spectrometric Identification of Organic Chemistry Compounds, 6th Ed., John Wiley and Sons, N. Y., 2005.

[12]. Al-Rubaie, A. Z.; Al-Fregi, A. A.; Al-Jadaan, S. A. *Phosphorus Sulfur Silicon* **2011**, *186*, 115-124.

[13]. Saadon, H. L.; Ali B.; Al-Fregi, A. A. *Optics Laser Tech.* **2014**, *58*, 33-44.

[14]. Al-Fregi, A. A. *Int. J. Adv. Res.* **2015**, *3(3)*, 637-647.

[15]. Al-Fregi, A. A.; Al-Asfoor A. F.; Jabar, S. F. *Int. J. Sci. Eng. Res.* **2015**, *6(3)*, 274-283.

[16]. Bernstein, M. P.; Mattioda, A.; Sandford, S. A.; Hudgins, D. *Astrophysical J.* **2005**, *626(2)*, 909-918.

[17]. Nakamoto, K., Infrared and Raman Spectra of Organic and Coordination Compounds, John Wiley and Sons Ltd., 7th Ed., N. Y., 2009.

[18]. Al-Salami, B. K.; Al-Fadhly, A. L.; Al-Fregi, A. A. *Der Pharma Chem.* **2016**, *8(19)*, 488-497.

[19]. Shriner, R. L.; Hermann, C. K.; Morrill, T. C.; Curtan D. Y.; Fuson, R. C., The systematic identification of Organic compounds, 8th Edition, John Wiley and Sons, N. Y., 2004.

[20]. Mitra, A.; Assarpour, A.; Seaton, P. J.; Williamson, R. T. *J. Chem. Ed.* **2002**, *79(1)*, 106-109.

[21]. Rouge, P. *Food Chem.* **2013**, *141*, 1888-1895.