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Synthesis of some new organotellurium compounds based on 1-substituted tetrazole

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Abstract: New organotellurium compounds are derived from 1-butyl-5H-tetrazole (**1**). 1-butyl tetrazole-5-yl mercury (II) chloride (**2**) was synthesized from the reaction of compound **1** with mercury acetate and sodium chloride. The 1:1 and 1:2 ratio reactions of tellurium tetrabromide with compound **2** gave 1-butyl tetrazole-5-yl tellurium tribromide (**3**) and di (1-butyl tetrazole-5-yl) tellurium dibromide (**4**), respectively. The reduction of compounds **3** and **4** by the alcoholic solution of aqueous hydrazine gave di (1-butyl tetrazole-5-yl) ditelluride (**5**) and di (1-butyl tetrazole-5-yl) telluride (**6**), respectively. The reaction of compound **5** with iodine and thionyl chloride gave 1-butyl tetrazole-5-yl tellurium triiodide (**7**) and 1-butyl tetrazole-5-yl tellurium trichloride (**8**), respectively. The reaction of compound **6** with iodine and thionyl chloride gave di (1-butyl tetrazole-5-yl) tellurium diiodide (**9**) and di (1-butyl tetrazole-5-yl) tellurium dichloride (**10**), respectively. The prepared compounds were characterized and the molar conductivities proved that the compounds **2–3** and **7–10** behaved as electrolytes (1:1).

Keywords: cycloaddition reaction, ditelluride, transmetalation reaction, telluride, tetrazole,

1. Introduction

The tetrazole is a heterocyclic compound of a five-membered ring containing four nitrogen atoms and one carbon atom [1]. The tetrazole and N-substituted tetrazole have the advantage of having a carbon-hydrogen bond with an acidic character (similar to other C-H acids) with $pK_a=23$ [2]. This property makes the N-substituted tetrazoles in high activity to suffer the mercuration reaction with mercury salts such as mercuric chloride and acetate [3, 4]. This reaction opened a wide door in the field of synthesis of organometallic compounds such as organotellurium compounds. The tetrazoles and their derivatives are one of the most popular organic compounds because of their wide range of applications and different uses [5-9].

Usually, the best attractive procedure for the synthesis of N-substituted tetrazole is (2+3) cycloaddition involves isonitriles and hydrazoic acid HN_3 and H_2SO_4 as a catalyst [10]. A variety of synthetic methods have been reported in the literature using new and conventional procedures included the reaction of primary amines with sodium azide and triethyl orthoformate in the presence of acetic acid as a solvent [11].

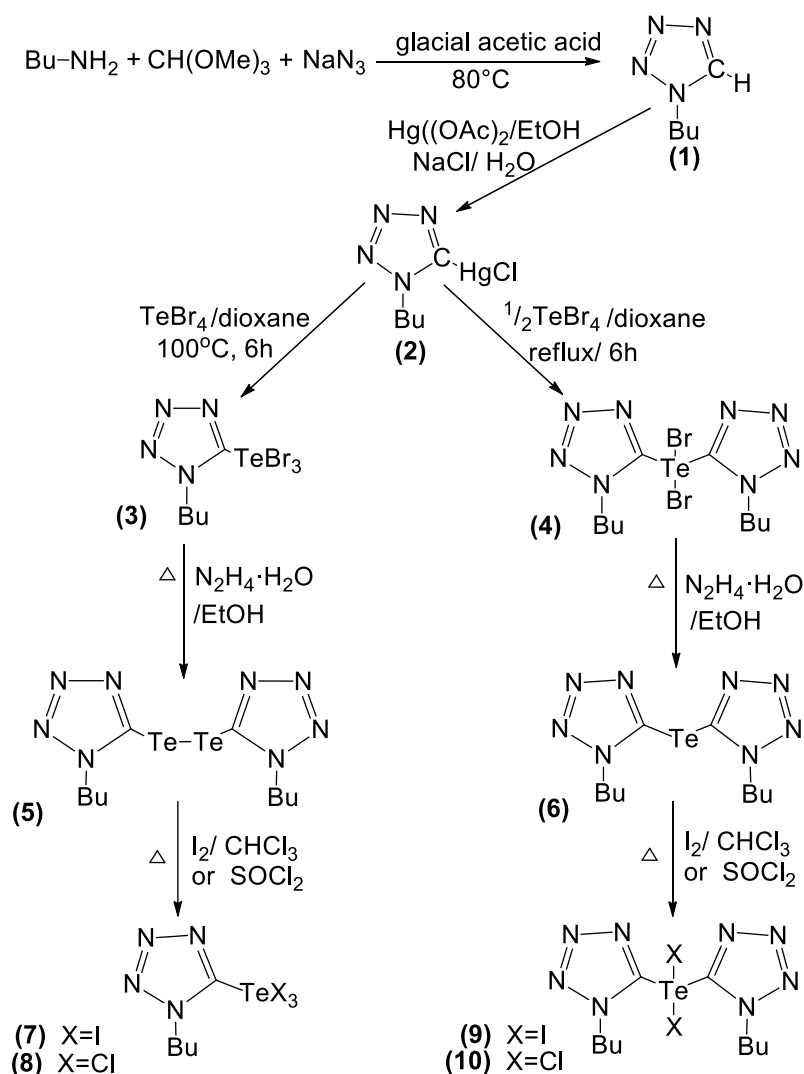
Also, there has been a growing interest in studying the organotellurium compounds due to their different synthetic methods and important applications [12-17].

Unfortunately, there are few research articles concerning the methods of tellurated derivatives that contain tetrazole moiety in the literature, so the present work described a satisfactory route to tellurated tetrazoles by transmetallation of organomercury derivatives containing tetrazole units with tellurium tetrabromide to obtain the corresponding organotellurium compounds.

2. Materials and methods



The starting materials for the synthesis of all of these new compounds are used without more purification and the methods are outlined in the Scheme.



Scheme 1. Synthesis of organotellurium compounds **3-10**.

2.1 Physical Measurements

The CHN analysis was done using the Eurovector EA-3000A Elemental Analyser (Analytical Service Unit, Al al-Bayt University, Al-Mafraq, Jordan). The FT-IR spectra were recorded as KBr discs with an FT-IR-8400s Shimadzu instrument in the range 4000-400 cm^{-1} . The ^1H NMR and ^{13}C NMR spectra were recorded with a Bruker (400 MHz) using DMSO- d_6 as a solvent and TMS as an internal standard (Central Laboratory, University of Tehran, Iran). The mass spectra were performed using a HAT-8200 analyzer at the ionizing potential of 70 eV (Central Laboratory, University of Tehran, Iran). The electronic absorption spectra were recorded on Spectroscan-80 D in the range of 200–800 nm using 1×10^{-4} M in DMSO. The molar conductivity was measured for 1×10^{-3} M in DMSO at room temperature using the Konduktorska model 365B conductivity bridge. The melting point was determined on a Thermo Fisher melting point apparatus and is uncorrected.

2.2 Synthesis of 1-butyl-1H-tetrazole (1)

Sodium azide (0.65 g, 10.00 mmol), butylamine (0.73 g, 10.00 mmol) and tertiary methyl orthoformate (1.59 g, 15.00 mmol) were mixed in 30 mL of glacial acetic acid and the mixture was ascended back for 6 h. After that, the mixture was left to cool for 20 min, then the solvent was separated in a vacuum in the rotary evaporator. Upon recycling with methanol, compound **1** was obtained as transparent crystals. The follow-up of the purification with the TLC technique was performed using methanol and chloroform. Pale yellow crystals of compound **1** were produced with a yield of 85%, m.p. 190-191 °C.

1-butyl tetrazole-5-yl mercury (II) chloride (2)

A solution of mercuric acetate (0.31 g, 10.00 mmol) was added dropwise to compound **1** in ethanol as a solvent and the produced mixture was refluxed for 12 h. The mixture was filtered and the filtrate was treated with saturated sodium chloride (0.58 g, 10.00 mmol) in 25 mL of distilled water at room temperature for 2 h and then washed with cold distilled water several times. The white powder of compound **2** was produced with a yield of 75%, m.p. 200–202 °C.

1-butyl tetrazole-5-yl tellurium tribromide (3)

This compound was prepared by escalating the reaction of the mixture consisting of tellurium tetrabromide (0.44 g, 1.00 mmol) and compound **2** (0.36 g, 1.00 mmol) in a dry dioxane solvent (30 mL). The reaction mixture was refluxed with stirring for 6 h in an inert atmosphere of argon. After the reaction was completed, the mixture was filtered when hot and then the filtrate was cooled to room temperature to form a white precipitate of the HgBrCl₂ (dioxane) complex. The filtrate was poured into 200 mL of ice-water to form a brown precipitate, which was recrystallized by a mixture of methanol and methane dichloride (2:1) to give orange crystals of compound **3** with a yield of 70%, m.p. 175-176 °C.

di (1-butyl tetrazole-5-yl) tellurium dibromide (4)

This compound was prepared and reported in our previous work [18], and recently was used to prepare other compounds.

di (1-butyl tetrazole-5-yl) ditelluride (5)

An ethanolic solution of hydrazine hydrate (0.26 g, 8.00 mmol) in 15 mL of ethanol was added drop-by-drop to the elevator solution and back to the prepared compound **3** (3.94 g, 8.00 mmol) in 20 mL of ethanol until completion of reduction, which we inferred when the release of nitrogen gas stopped. The mixture was filtered when hot and the resulting leachate was poured into 50 mL of ice-water. After that, the extraction process was performed using dimethyl ether (3 x 20 mL) and the organic layers were collected and dried using anhydrous calcium chloride. The solvent was evaporated using the rotary evaporator, creating a red color precipitate. The resulting steel was recrystallized with ethanol to form compound **5** as dark red crystals with a yield of 63%, m.p. 138-140 °C.

di (1-butyl tetrazole-5-yl) telluride (6)

An ethanolic solution of hydrazine hydrate (0.16 g, 5.00 mmol) in 15 mL of ethanol was added drop-by-drop to the elevated solution of compound **4** (2.68 g, 5 mmol) in 20 mL of ethanol until the nitrogen gas was released. The reaction mixture was filtered when hot and the filtrate was poured into 100 mL of distilled iced-water and immediately formed a yellow precipitate. The precipitate was separated by filtration and reconstituted using a mixture of ethanol and chloroform (2:3) to give compound **6** as pale-yellow crystals with a yield of 60%, m.p. 189–190 °C.

1-butyl tetrazole-5-yl tellurium triiodide (7)

The iodine (0.44 g, 2.00 mmol) that dissolved in 15 mL of chloroform solvent was added to the elevator solution and retroactively to compound **5** (0.51 g, 1.00 mmol) in 20 mL of chloroform for 1 h until a light brown precipitate was formed. The mixture was filtered and the precipitate was

subsequently recrystallized with a mixture of methanol and chloroform in a ratio of (2:1), to obtain compound **7** as brown crystals with a yield of 65%, m.p. 168-170 °C.

1-butyl tetrazole-5-yl tellurium trichloride (8)

The thionyl chloride was added dropwise (0.35 g, 3.00 mmol) to the elevator solution and retroactively to compound **5** (0.51 g, 1.00 mmol) in 20 mL chloroform for 1 h which formed an orange-coloured precipitate. The mixture was filtered and recrystallized using a mixture of ethanol and dichloromethane in a ratio of 3:1 to obtain compound **8** as yellow crystals with a yield of 62%, m.p. 186–188 °C.

di (1-butyl tetrazole-5-yl) tellurium diiodide (9)

The iodine was slowly added (0.44 g, 2.00 mmol) and dissolved in 15 mL of chloroform to the elevator solution of compound **6** (0.37 g, 1.00 mmol) in 20 mL of chloroform and formed a brown precipitate. The mixture was filtered and the precipitate was recrystallized using a mixture of methanol and dichloromethane in a ratio of 1:1 to obtain compound **9** as light brown crystals with a yield of 68%, m.p. 143–145 °C.

di (1-butyl tetrazole-5-yl) tellurium dichloride (10)

The thionyl chloride (0.23 g, 2.00 mmol) of dry ether was added dropwise to an etheric solution of compound **6** (0.37 g, 1.00 mmol) in 20 mL of chloroform and gave a yellow precipitate. The mixture was filtered and the precipitate was recrystallized using a mixture of ethanol and chloroform in a ratio of 1:3 to obtain compound **10** as yellow crystals with a yield of 64%, m.p. 180–182 °C.

3 Results and Discussion

The physical results of the prepared compounds are obtained as follows:

Compound **1**, IR (KBr) cm^{-1} : 3171w, 2962w, 2939w, 2330w, 1558s, 1408s, 1269m, 1026w, 929m; UV-Vis (λ_{max} , nm (ϵ L mol⁻¹ cm⁻¹)): 290 (24270); molar conductance (ohm⁻¹ cm² mol⁻¹): 4.0; and R_f : 0.72. The ¹H NMR (400 MHz, DMSO-d₆, δ , ppm) was found to be as follows: 9.230 (s, 1H, **C-H**); 2.829 (t, 2H, **N-CH₂**); 1.508 (quintet, 2H, **CH₂-CH₂-CH₃**); 1.301 (sextet, 2H, **CH₂-CH₃**); 0.899 (t, 3H, **CH₃**). The ¹³C NMR (DMSO-d₆, δ , ppm) was found to be as follows: 62.662 (**C-H**); 38.522 (**N-CH₂**); 28.917 (**CH₂-CH₂-CH₃**); 18.942 (**CH₂-CH₃**); 13.620 (**CH₃**). The MS calculated for C₅H₁₀N₄ (126.16) was found to be as follows: M⁺+1(127); MS/MS (m/z): 113.2, 99, 84, 71, 60, 57, 45, 43. The Elemental Analysis calculated for C (47.60), H (7.99) and N (44.41) found C (47.69), H (8.05) and N (44.50).

Compound **2**, IR (KBr) cm^{-1} : 2985w, 2928w, 2320w, 1597s, 1411m, 1265w, 1087s, 1014w; UV-Vis (λ_{max} , nm (ϵ L mol⁻¹ cm⁻¹)): 280 (5890); molar conductance (ohm⁻¹ cm² mol⁻¹): 30; and R_f : 0.70. The ¹H NMR (400 MHz, DMSO-d₆, δ , ppm) was as follows: 2.734 (t, 2H, **N-CH₂**); 1.460 (quintet, 2H, **CH₂-CH₂-CH₃**); 1.297 (sextet, 2H, **CH₂-CH₃**); 0.895 (t, 3H, **CH₃**). The ¹³C NMR (DMSO-d₆, δ , ppm) was as follows: 69.354 (C-Hg); 37.915 (**N-CH₂**); 27.915 (**CH₂-CH₂-CH₃**); 19.215 (**CH₂-CH₃**); 13.620 (**CH₃**). The MS calculated for C₅H₉N₄ClHg (361.2) was found to be as follows: M⁺+1 (362); MS/MS (m/z): 316, 272, 236, 202, 127, 97, 71, 57, 45, 43. The Elemental Analysis calculated for C (16.63), H (2.51) and N (15.51) found C (17.01), H (2.55) and N (15.61).

Compound **3**, IR (KBr) cm^{-1} : 2931w, 2881w, 2330w, 1608sh, 1450br, 1273br, 1126w, 1033br; UV-Vis (λ_{max} , nm (ϵ L mol⁻¹ cm⁻¹)): 285 (10750); molar conductance (ohm⁻¹ cm² mol⁻¹): 25; and R_f : 0.75. The ¹H NMR (400 MHz, DMSO-d₆, δ , ppm) was as follows: 2.729 (t, 2H, **N-CH₂**); 1.368 (quintet, 2H, **CH₂-CH₂-CH₃**); 1.280 (sextet, 2H, **CH₂-CH₃**); 0.865 (t, 3H, **CH₃**). The ¹³C NMR (DMSO-d₆, δ , ppm) was as follows: 66.383 (C-Te); 38.172 (**N-CH₂**); 28.342 (**CH₂-CH₂-CH₃**); 18.603 (**CH₂-CH₃**); 13.562 (**CH₃**). The MS calculated for C₅H₉Br₃N₄Te (492.47) was found to be as follows: M⁺+3 (495.6); MS/MS (m/z): 467, 439, 411, 383, 199, 362, 128, 81, 57, 43. The Elemental Analysis calculated for C₅H₁₀N₄ where C (12.19), H (1.84) and N (11.38) found C (12.20), H (1.89) and N (11.42).

Compound **4**, this compound was previously well characterized and discussed [18].

Compound **5**, IR (KBr) cm^{-1} : 2946w, 2857w, 2350w, 1604w, 1496sh, 1211w, 937s; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 295 (17620); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 3.0; and R_f : 0.77. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was as follows: 2.726 (t, 2H, N-**CH** $_2$); 1.464 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.284 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.843 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm) was as follows: 62.660 (C-Te); 38.546 (N-**CH** $_2$); 28.954 (**CH** $_2$ -**CH** $_2$ -**CH** $_3$); 18.968 (**CH** $_2$ -**CH** $_3$); 13.467 (**CH** $_3$). The MS calculated for $\text{C}_{10}\text{H}_{18}\text{N}_8\text{Te}_2$ (505.51) was found to be as follows: M^{+4} (509.6); MS/MS (m/z): 495, 480, 467, 452, 439, 423, 409, 395, 202, 128, 111, 80, 72, 57, 43. The Elemental Analysis calculated for C (23.76), H (3.59) and N (22.17) found C (23.84), H (3.65) and N (22.20).

Compound **6**, IR (KBr) cm^{-1} : 2962m, 2897m, 1604m, 1410w, 1220w, 1103sh, 1080s; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 280 (3880); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 2.8; and R_f : 0.71. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was found to be as follows: 2.663 (t, 2H, N-**CH** $_2$); 1.474 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.242 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.832 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm) was as follows: 62.659 (C-Te); 38.573 (N-**CH** $_2$); 28.946 (**CH** $_2$ -**CH** $_2$ -**CH** $_3$); 18.9678 (**CH** $_2$ -**CH** $_3$); 13.455 (**CH** $_3$). The MS calculated for $\text{C}_{10}\text{H}_{18}\text{N}_8\text{Te}$ (377.91) was found to be as follows: M^{+4} (382); MS/MS (m/z): 361, 281, 261, 199, 127, 81, 72, 57, 43. The Elemental Analysis calculated for C (31.78), H (4.8) and N (29.65) found C (31.8), H (4.81) and N (29.65).

Compound **7**, IR (KBr) cm^{-1} : 2916m, 2889m, 2325w, 1570sh, 1404m, 1240br, 1095w; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 310 (21270); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 20.0; and R_f : 0.80. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was as follows: 2.762 (t, 2H, N-**CH** $_2$); 1.473 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.297 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.848 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm) was as follows: 62.672 (C-Te); 38.583 (N-**CH** $_2$); 28.959 (**CH** $_2$ -**CH** $_2$ -**CH** $_3$); 18.987 (**CH** $_2$ -**CH** $_3$); 13.473 (**CH** $_3$). The MS calculated for $\text{C}_5\text{H}_9\text{I}_3\text{N}_4\text{Te}$ (633.47) was found to be as follows: M^{+2} (636); MS/MS (m/z): 606, 592, 578, 564, 451, 351, 365, 336, 321, 254, 202, 128, 69, 59, 43. The Elemental Analysis calculated for C (9.48), H (1.43) and N (8.84) found C (9.51), H (1.50) and N (8.89).

Compound **8**, IR (KBr) cm^{-1} : 2924m, 2889w, 2320w, 1612m, 1400w, 1240br, 1220br, 1095w; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 295 (10180); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 27.0; R_f : 0.83. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was found to be as follows: 2.711 (t, 2H, N-**CH** $_2$); 1.169 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.057 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.849 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm) was as follows: 66.363 (C-Te); 38.582 (N-**CH** $_2$); 28.956 (**CH** $_2$ -**CH** $_2$ -**CH** $_3$); 18.966 (**CH** $_2$ -**CH** $_3$); 13.463 (**CH** $_3$). The MS calculated for $\text{C}_5\text{H}_9\text{Cl}_3\text{N}_4\text{Te}$ (359.11) was found to be as follows: M^{+3} (362); MS/MS (m/z): 341, 288, 257, 128, 111, 97, 81, 69, 57, 43. The Elemental Analysis calculated for C (16.72), H (2.53) and N (15.60) found C (16.81), H (2.58) and N (15.56).

Compound **9**, IR (KBr) cm^{-1} : 2901m, 2350w, 1570sh, 1404w, 1230br, 1076s; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 305 (17850); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 18.30; and R_f : 0.65. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was as follows: 2.832 (t, 2H, N-**CH** $_2$); 1.499 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.288 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.844 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm) was as follows: 62.647 (C-Te); 38.534 (N-**CH** $_2$); 28.956 (**CH** $_2$ -**CH** $_2$ -**CH** $_3$); 18.912 (**CH** $_2$ -**CH** $_3$); 13.429 (**CH** $_3$). The MS calculated for $\text{C}_{10}\text{H}_{18}\text{N}_8\text{TeI}_2$ (631.72) was found to be as follows: M^{+3} (634.7); MS/MS (m/z): 620, 606, 587, 576, 564, 551, 537, 523, 439, 395, 356, 229, 202, 128, 97, 81, 69, 57, 43. The Elemental Analysis calculated for C (19.08), H (2.87) and N (17.74) found C (19.08), H (2.91) and N (17.80).

Compound **10**, IR (KBr) cm^{-1} : 2980m, 2891w, 2350w, 1604m, 1404w, 1235br, 1103s, 1068s; UV-Vis (λ_{max} , nm (ϵ L mol $^{-1}$ cm $^{-1}$)): 285 (10660); molar conductance (ohm $^{-1}$ cm 2 mol $^{-1}$): 24; and R_f : 0.68. The ^1H NMR (400 MHz, DMSO- d_6 , δ , ppm) was as follows: 2.752 (t, 2H, N-**CH** $_2$); 1.463 (quintet, 2H, **CH** $_2$ -**CH** $_2$ -**CH** $_3$); 1.252 (sextet, 2H, **CH** $_2$ -**CH** $_3$); 0.856 (t, 3H, **CH** $_3$). The ^{13}C NMR (DMSO- d_6 , δ , ppm)

was as follows: 62.660 (C-Te); 38.572 (N-CH₂); 28.978 (CH₂-CH₂-CH₃); 18.959 (CH₂-CH₃); 13.461 (CH₃). The MS calculated for C₁₀H₁₈N₈TeCl₂ (448.81) was found to be as follows: M⁺⁺⁴ (452.6); MS/MS (m/z): 430, 341, 286, 202, 128, 111, 96, 81, 72, 57, 43. The Elemental Analysis calculated for C (26.76), H (4.04) and N (24.97) found C (26.82), H (4.08) and N (25.01).

The FT-IR spectra confirmed the presence of the tetrazole groups in the structures of all of the compounds **1–10**. The vibration frequency of the N-N=N- group appears at 1289–1236 cm⁻¹ [19-20]. Furthermore, the FT-IR spectra of the compounds showed bands at 1640-1560 cm⁻¹ which are due to the amplitude fluctuation of the C=N bond [11, 21, 22], while those spectra which showed bands at 1120-1080 cm⁻¹ are due to the amplitude oscillation of the C-N bond [20, 23]. The band at 1100-900 cm⁻¹ was due to the cyclic structure of the tetrazole [19]. The bands in the range 2360-2340 cm⁻¹ can be attributed to the stretching vibration of the N-CH₂ bond [20]. On the other hand, the bands at 2960-2933 cm⁻¹ and 2960-2870 cm⁻¹ can be attributed to the asymmetrical and symmetrical stretching vibration of the aliphatic C-H bond, respectively. The weak bands at the range 1480-1350 cm⁻¹ can be attributed to the bending vibration of the aliphatic C-H bond [24]. The medium-to-low-bands which appeared at the range 1300-929 cm⁻¹ are due to the C-C bonds [25, 26].

The UV-Vis spectra were recorded for 10⁻⁴ M of prepared compounds in Dimethyl sulfoxide (DMSO). Generally, they showed two absorption regions within the range of 280-460 nm [19, 23, 27, 28].

The ¹H NMR spectra of the compounds showed signals for the aliphatic butyl group which was substituted on the tetrazole located at the range 0.826-2.739 ppm, except for compound **1** and an indication of the aromatic proton of the tetrazole ring which appeared at 9.23 ppm. The ¹³C NMR spectra are illustrated in the experimental section.

The obtained mass spectra of the compounds showed diagnostic features that corresponded to the proposed molecular formula through the appearance of peaks with medium to good abundance at m/z 97, 84, 72, 57 and 43 due to the molecular ions [C₃H₆N₄]⁺, [C₂H₄N₄]⁺, [CH₂N₄]⁺, [C₄H₉]⁺ and [C₃H₇]⁺, respectively and of the compounds **3, 5-10** showed peaks of medium abundance at m/z 199 and 128 belonging to the molecular ions [CHN₄Te]⁺ and [Te]⁺ [29-31].

The results of CHN analysis are agreed well with the calculated values for these new compounds and the molar conductivity measurements proved that the compounds **2-3** and **7-10** behaved as electrolytes (1:1).

4 Conclusion

A new series of organotellurium compounds based on substituted tetrazole are prepared and characterized by using CHN, UV-Vis, FT-IR, ¹H NMR and ¹³C NMR techniques which their results are confirmed the chemical structures of the prepared compounds and the molar conductivity measurements proved that the compounds **2-3** and **7-10** behave as electrolytes (1:1).

Acknowledgments

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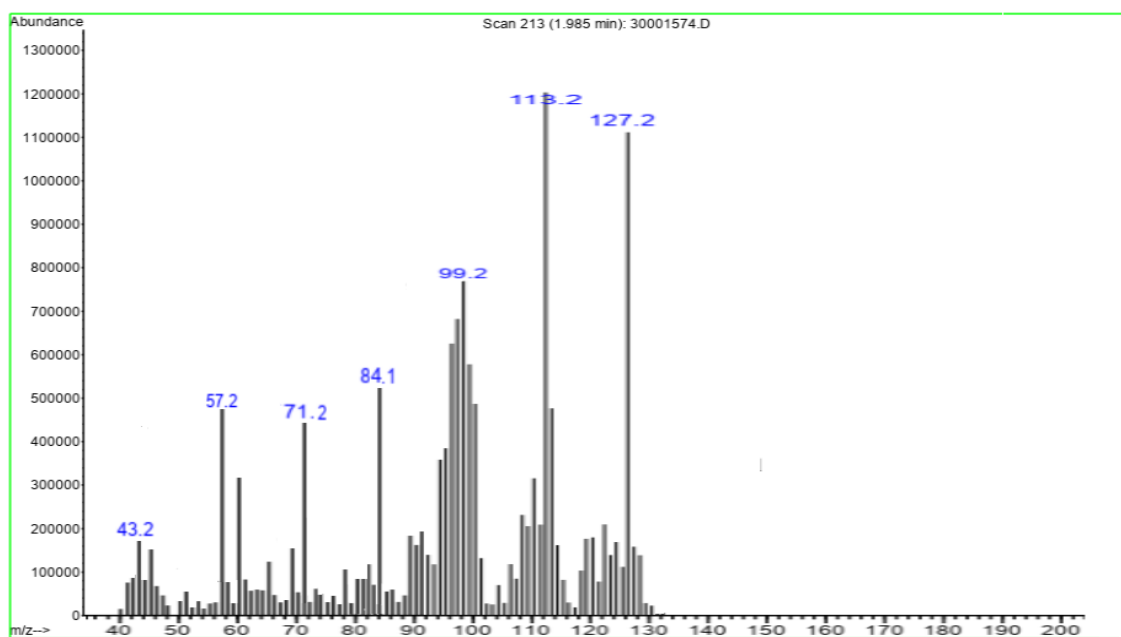
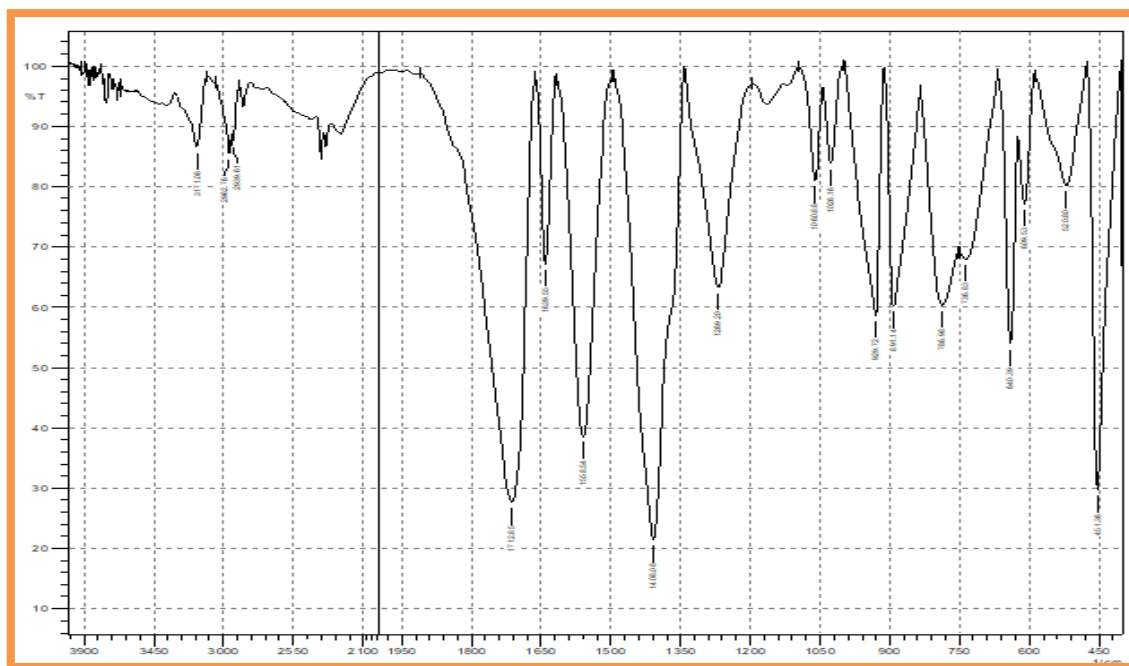
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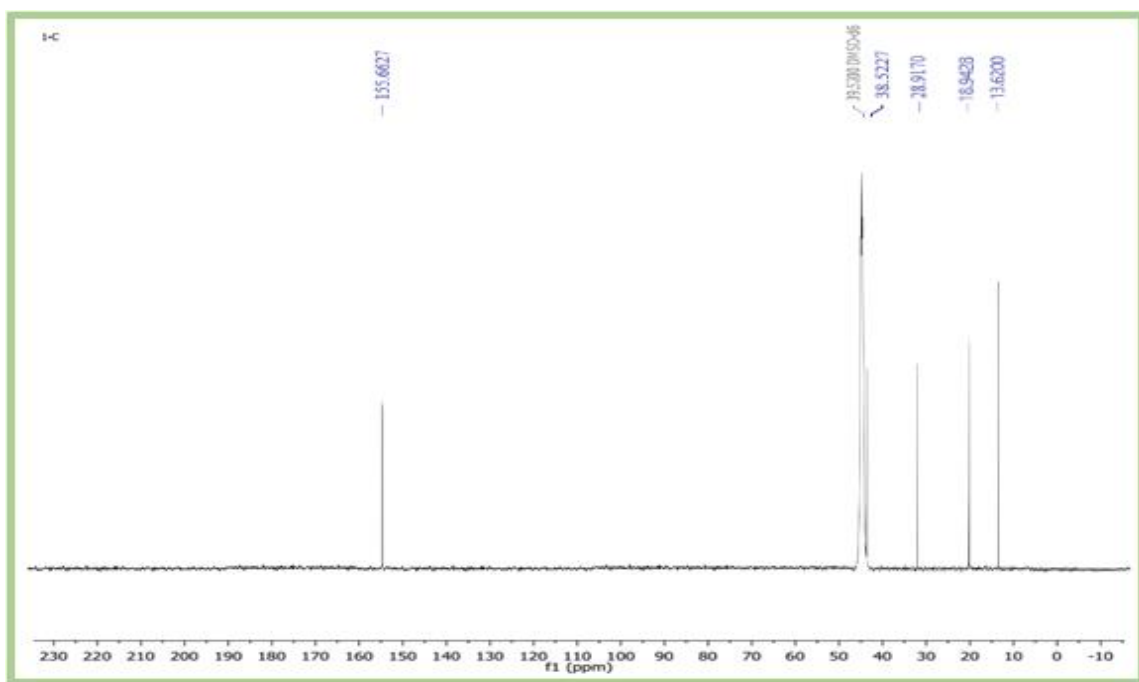
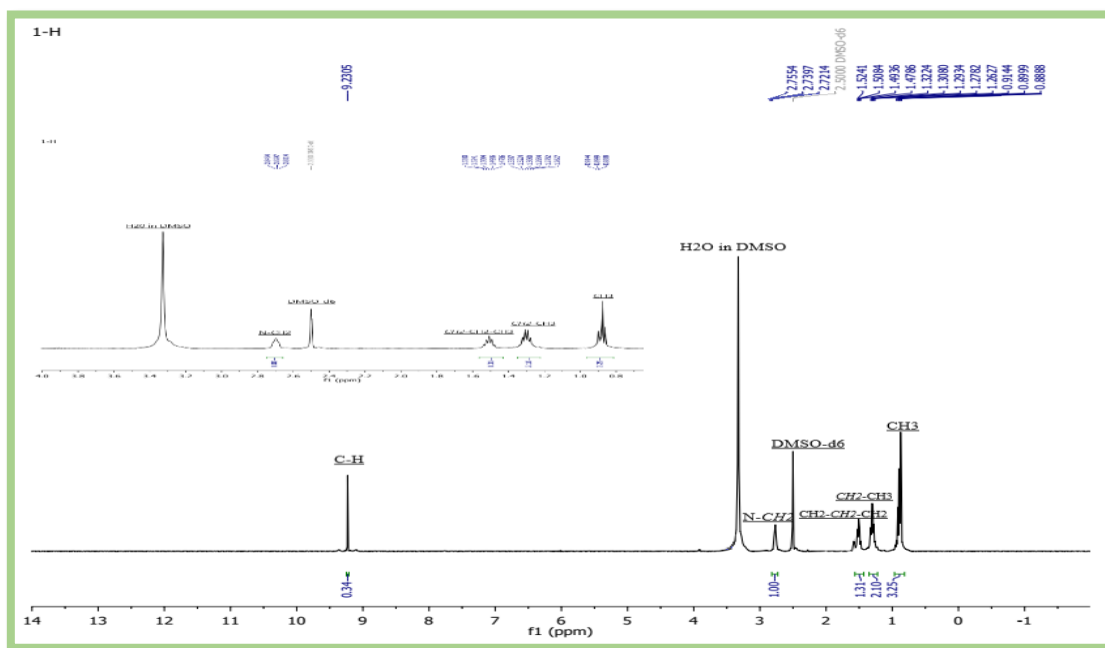
Appendix

Supplementary data

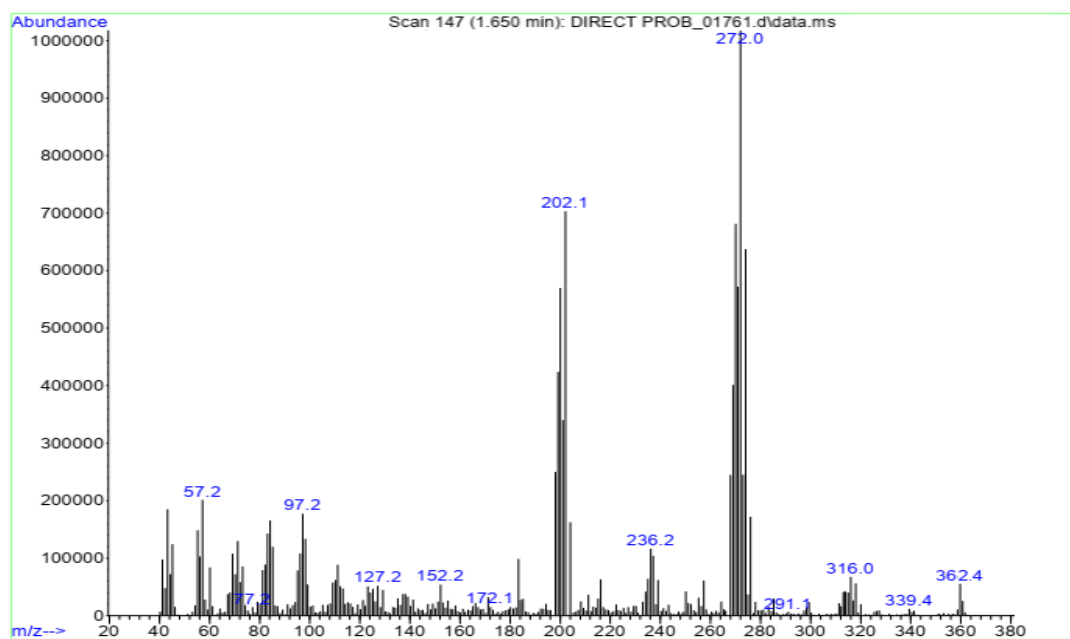
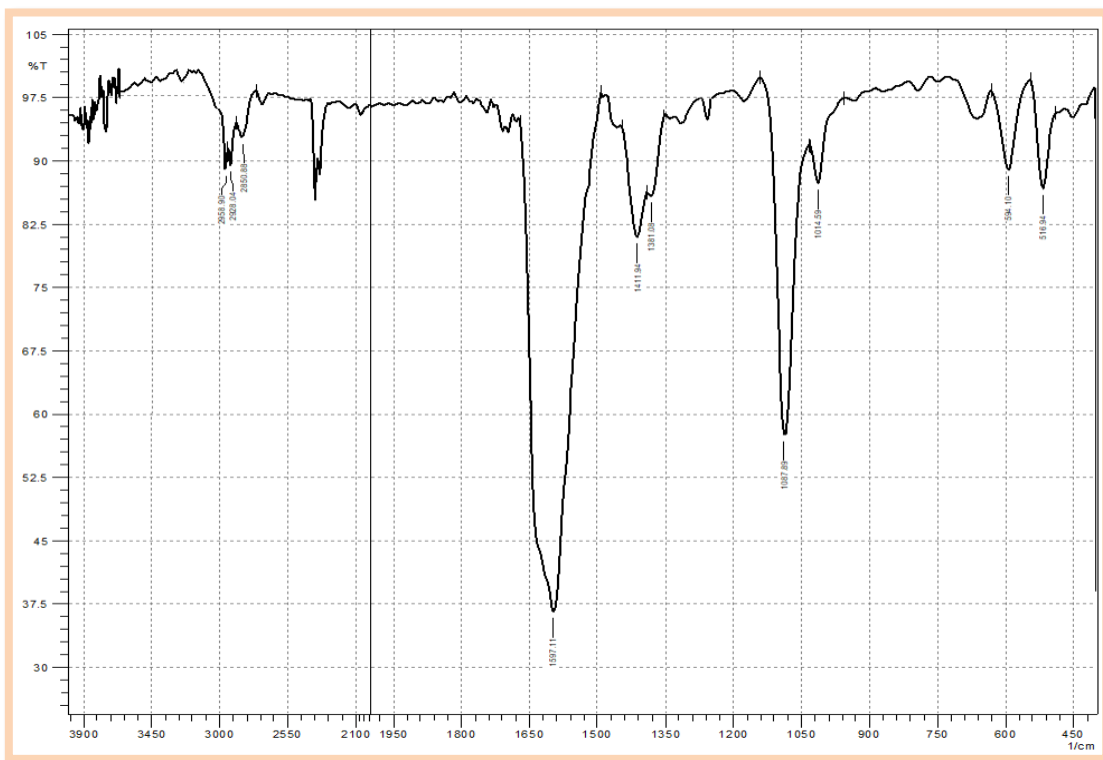
The spectra details (FT-IR, MS, ^1H NMR and ^{13}C NMR respectively) of the prepared organotellurium compounds.

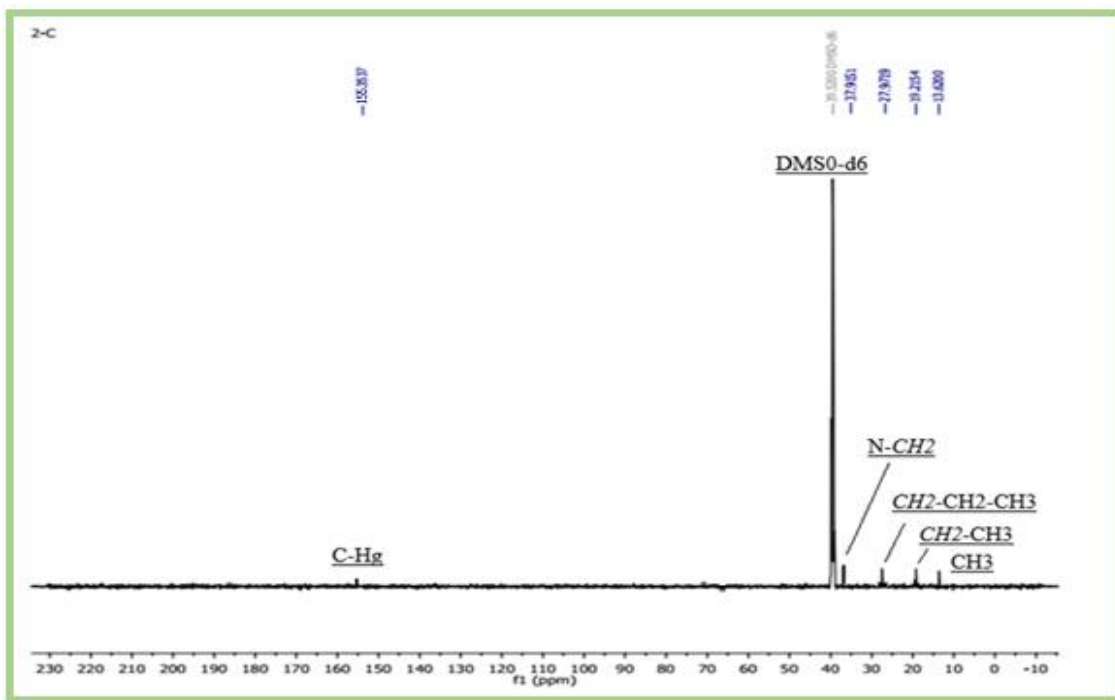
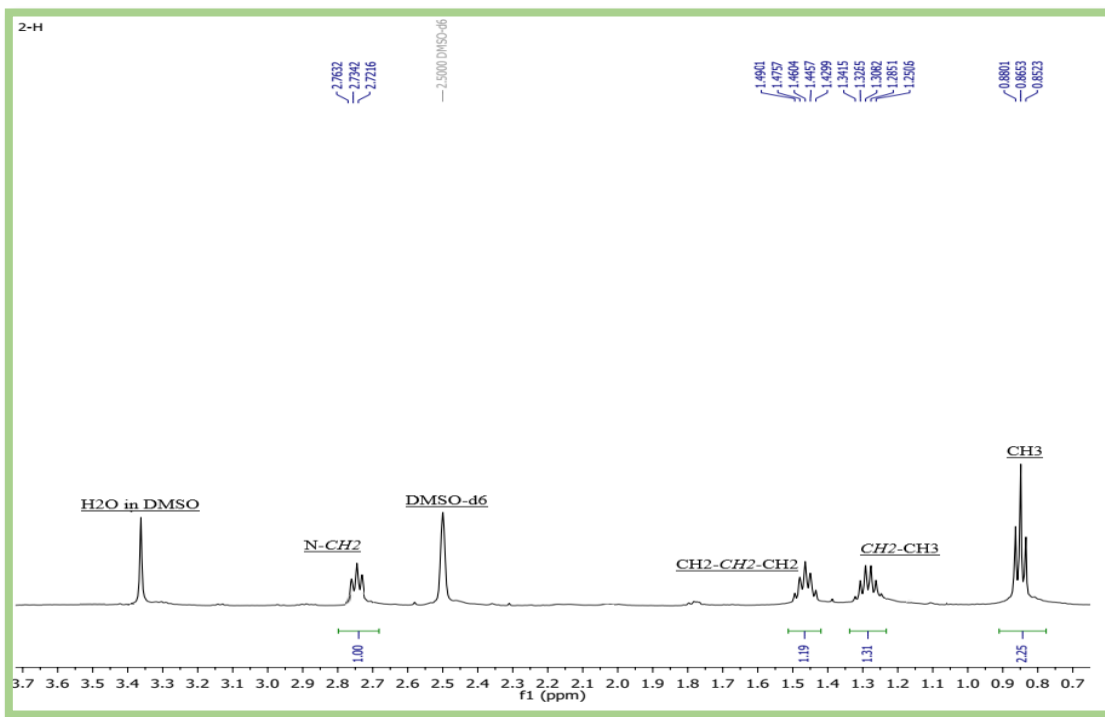
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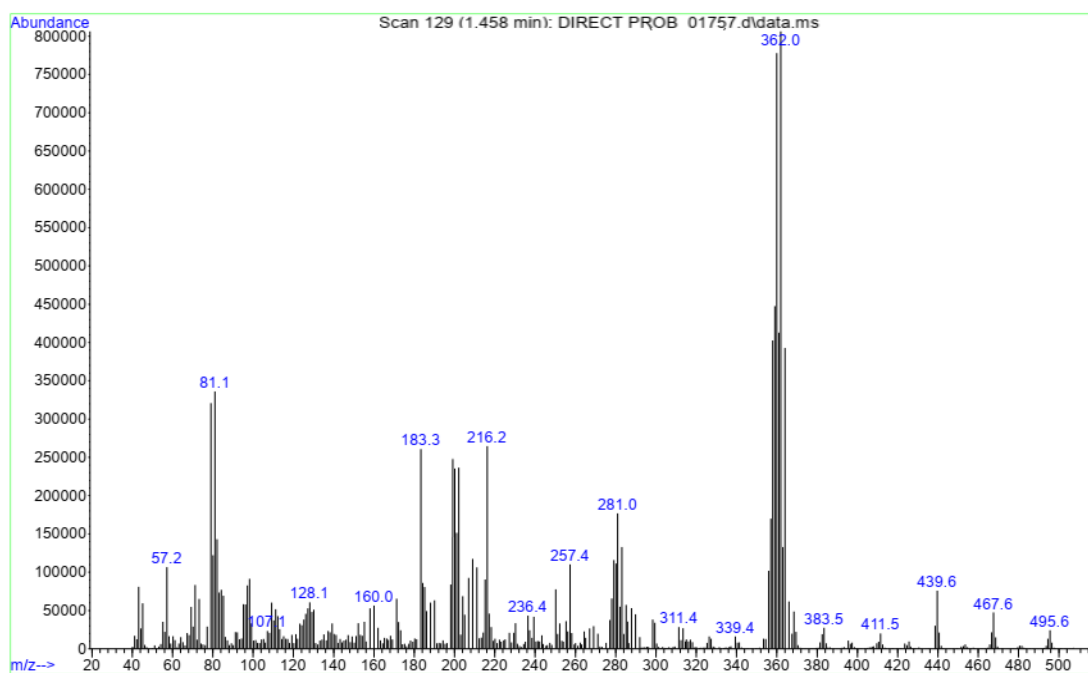
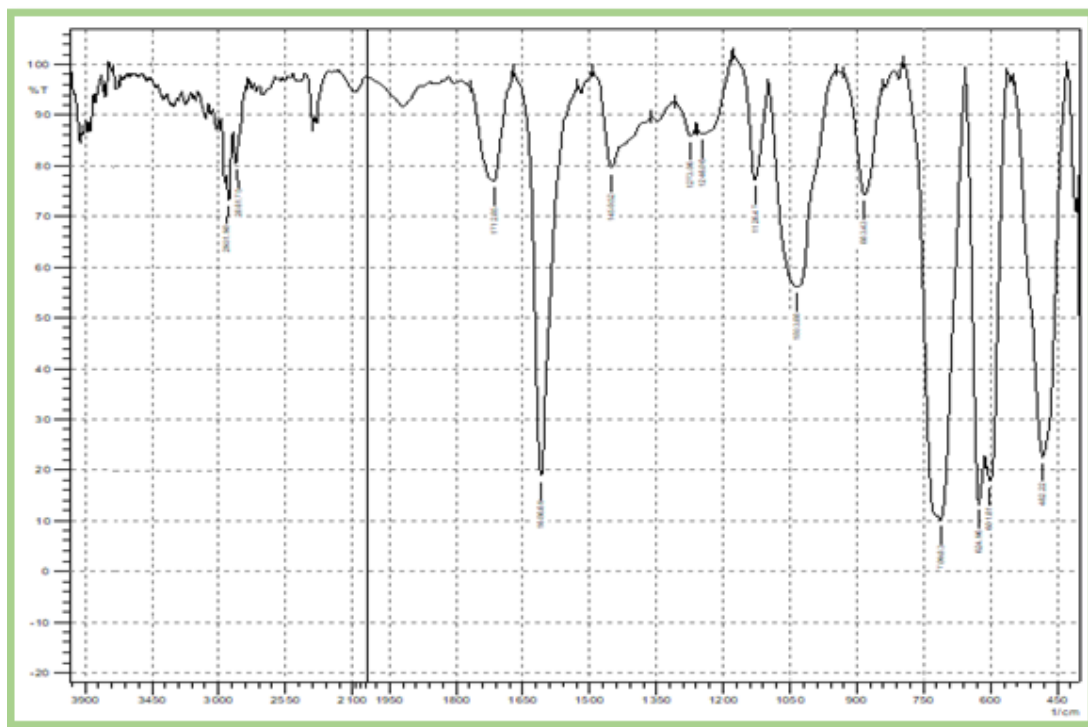


1-butyl tetrazole-5-yl mercury (II) chloride (2)

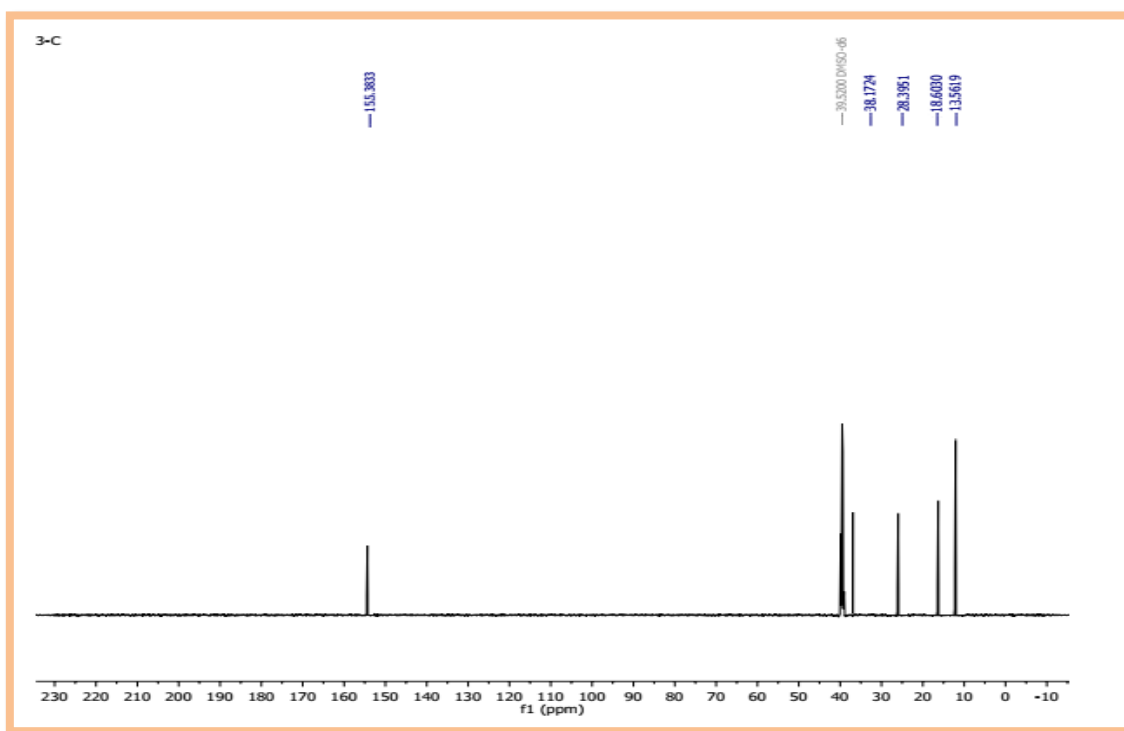
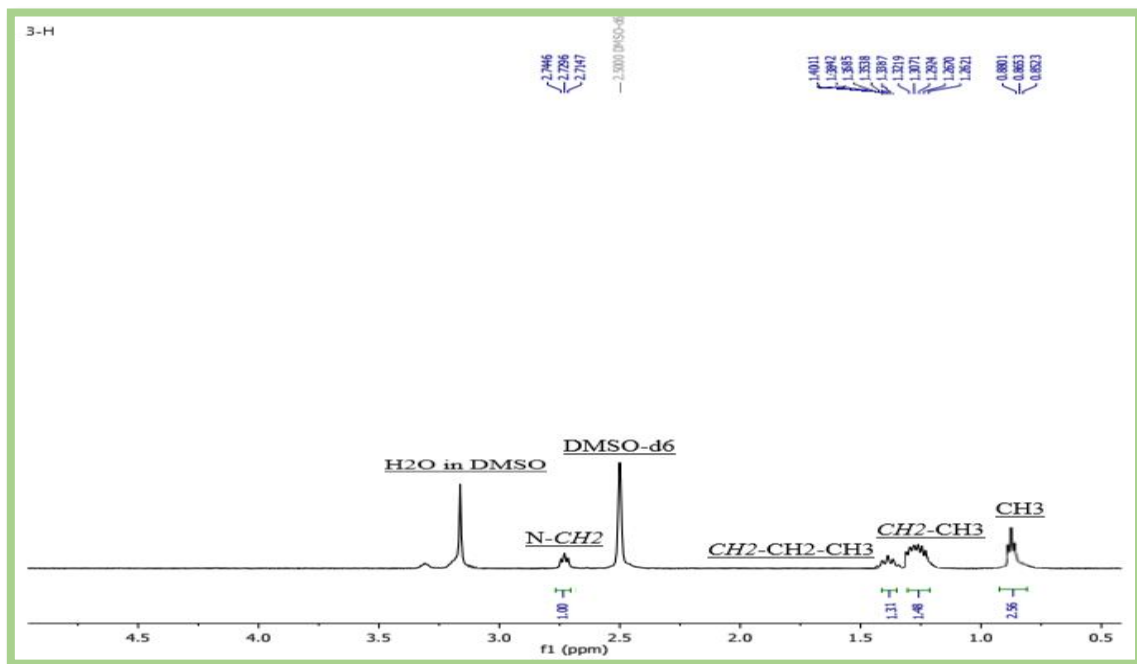




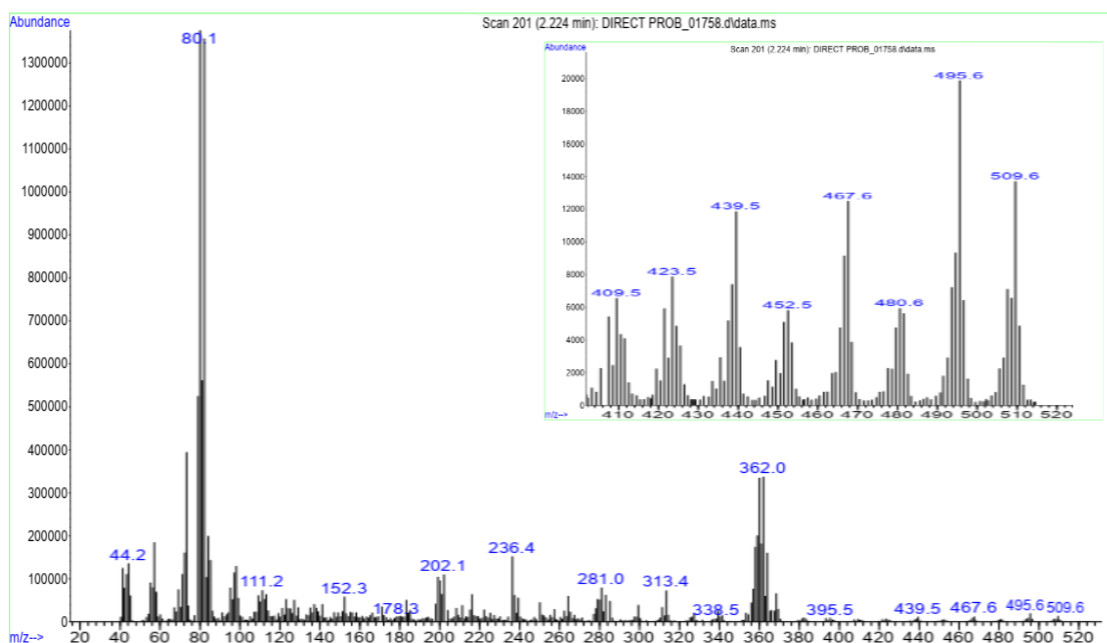
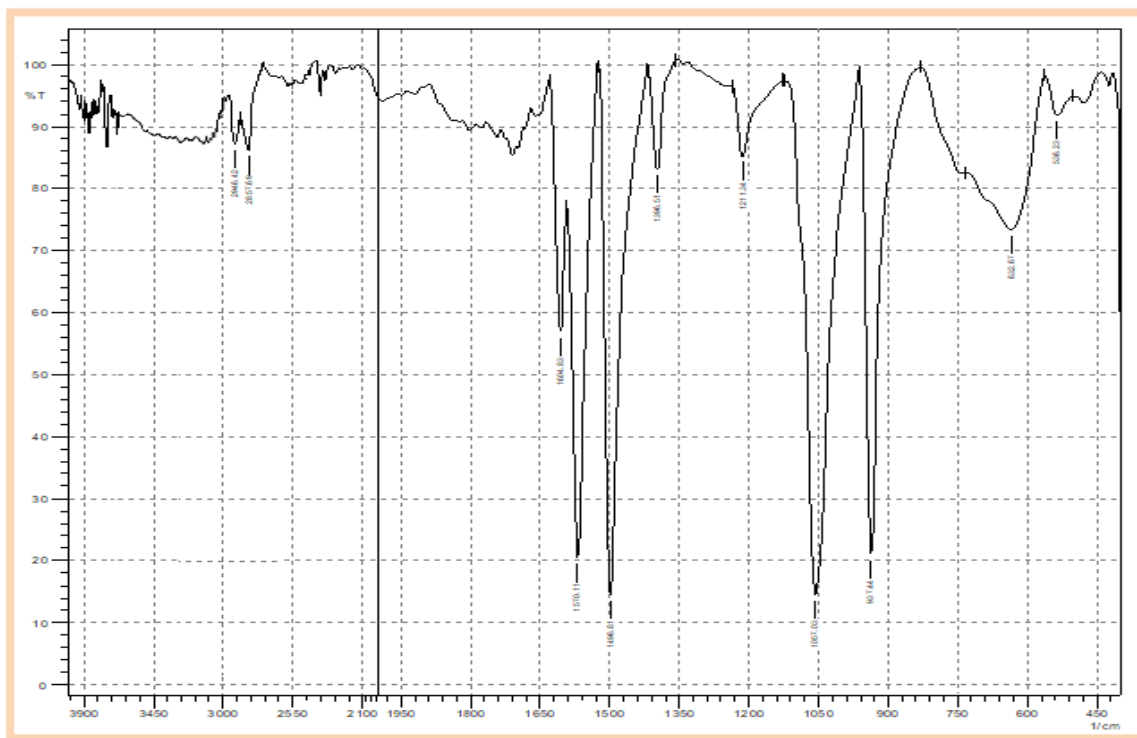
1-butyl tetrazole-5-yl tellurium tribromide (3)

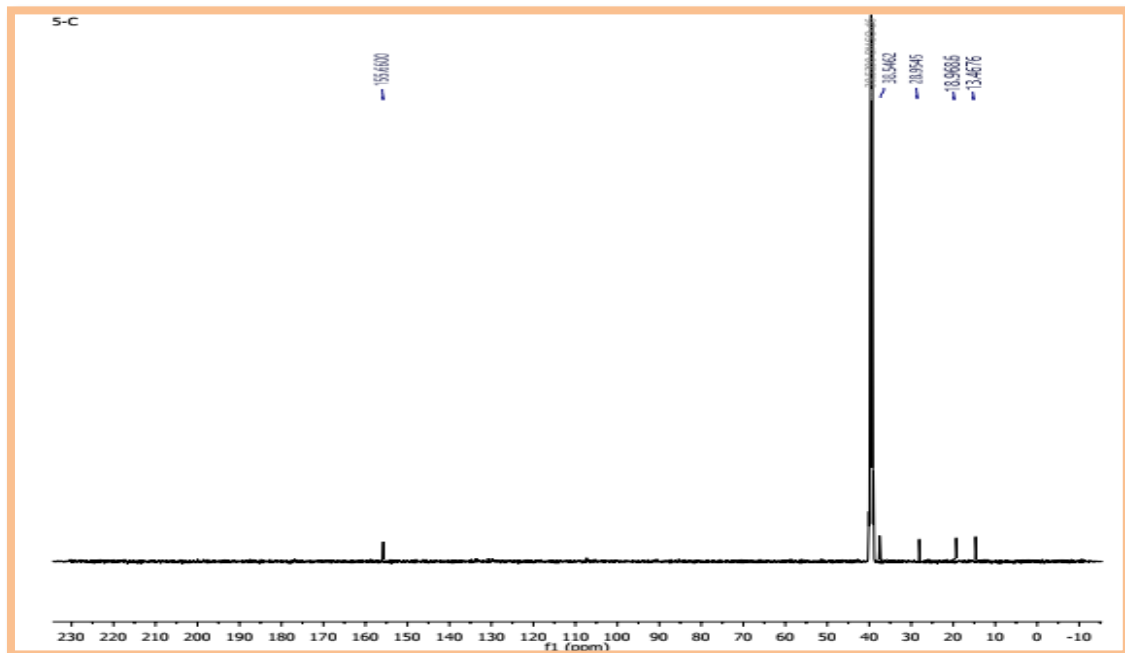
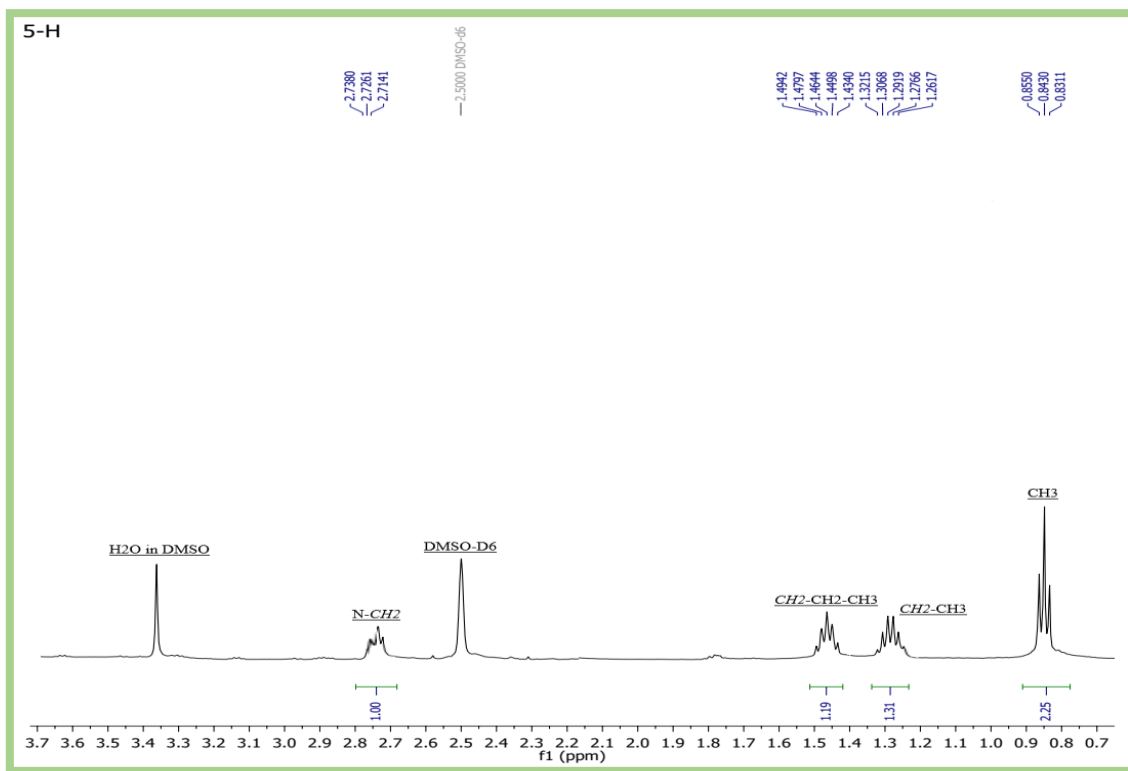


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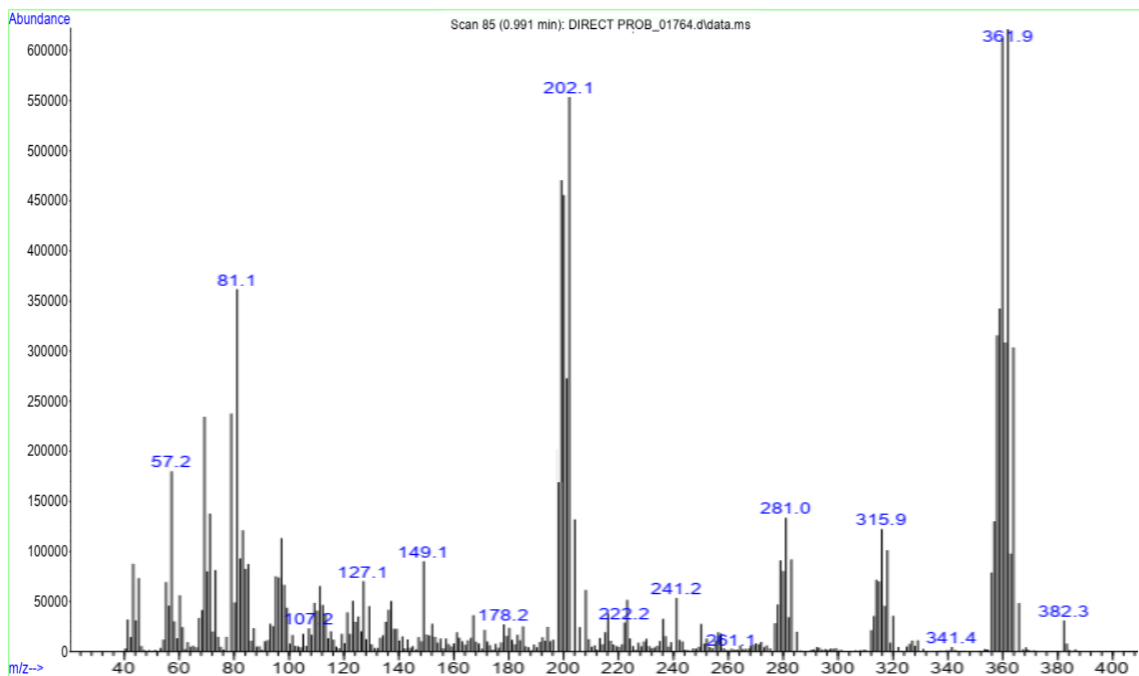
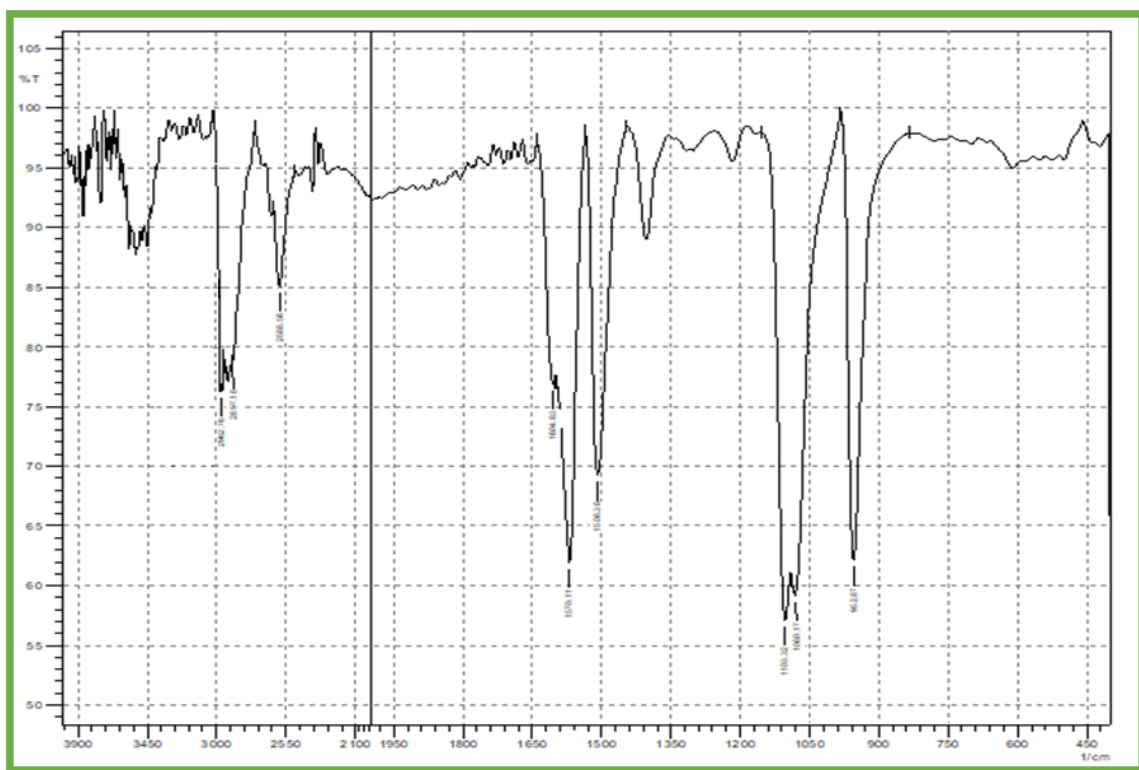


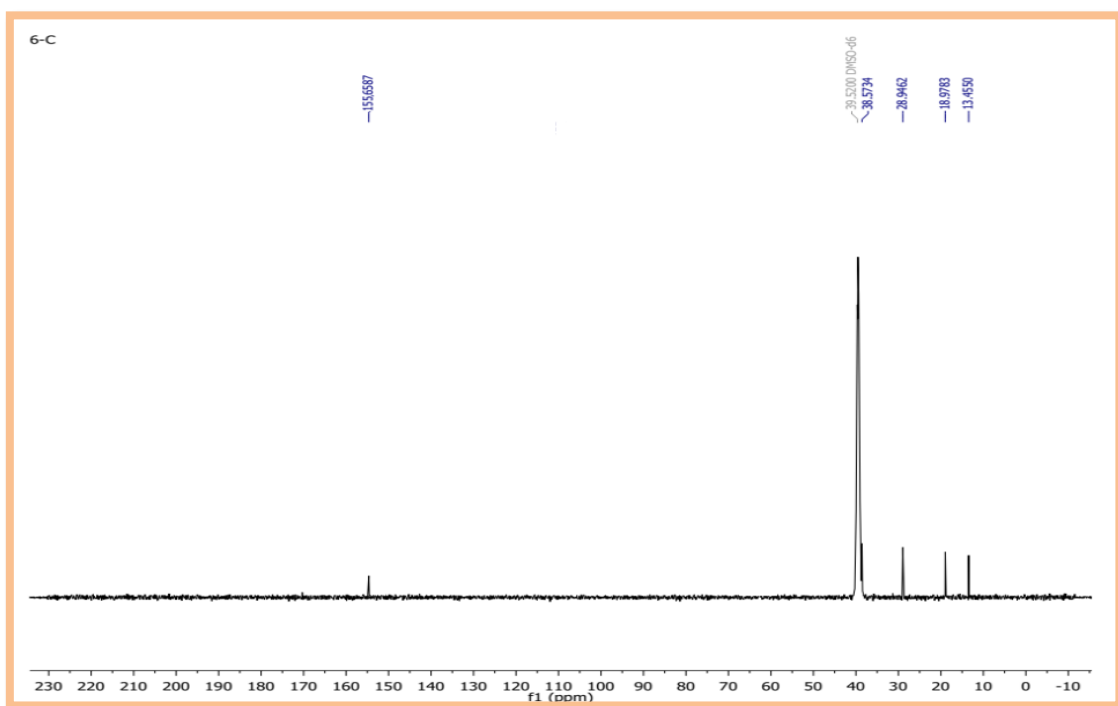
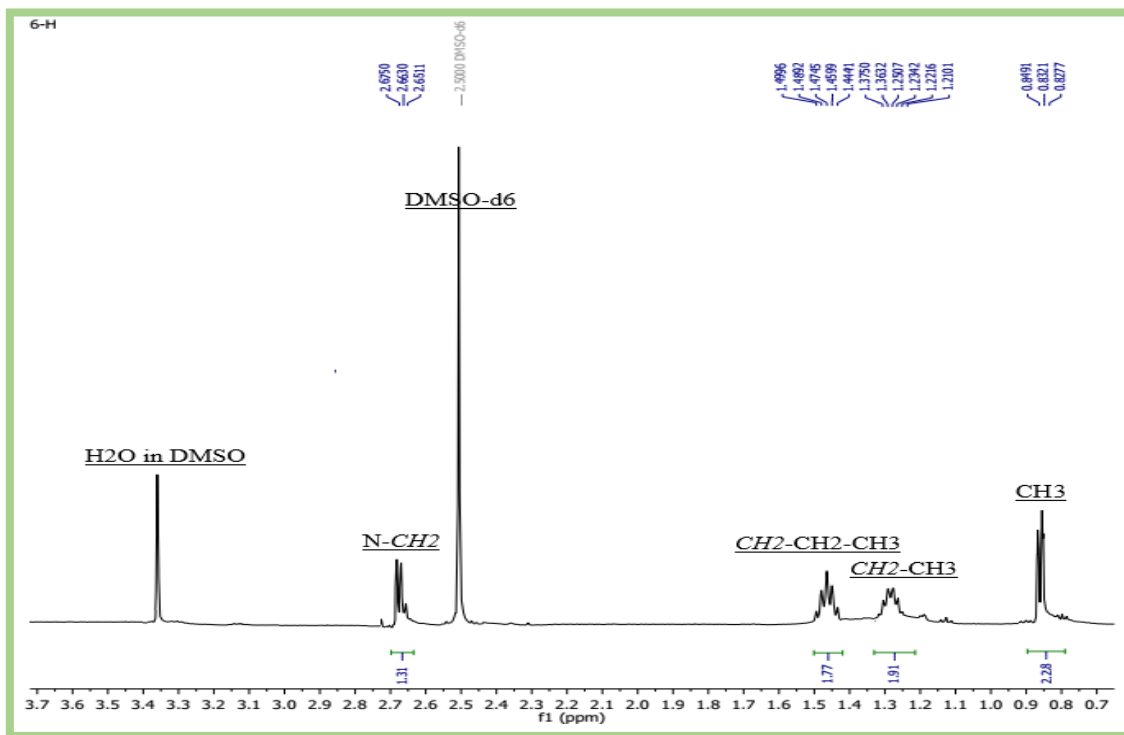
di (1-butyl tetrazole-5-yl) ditelluride (5)



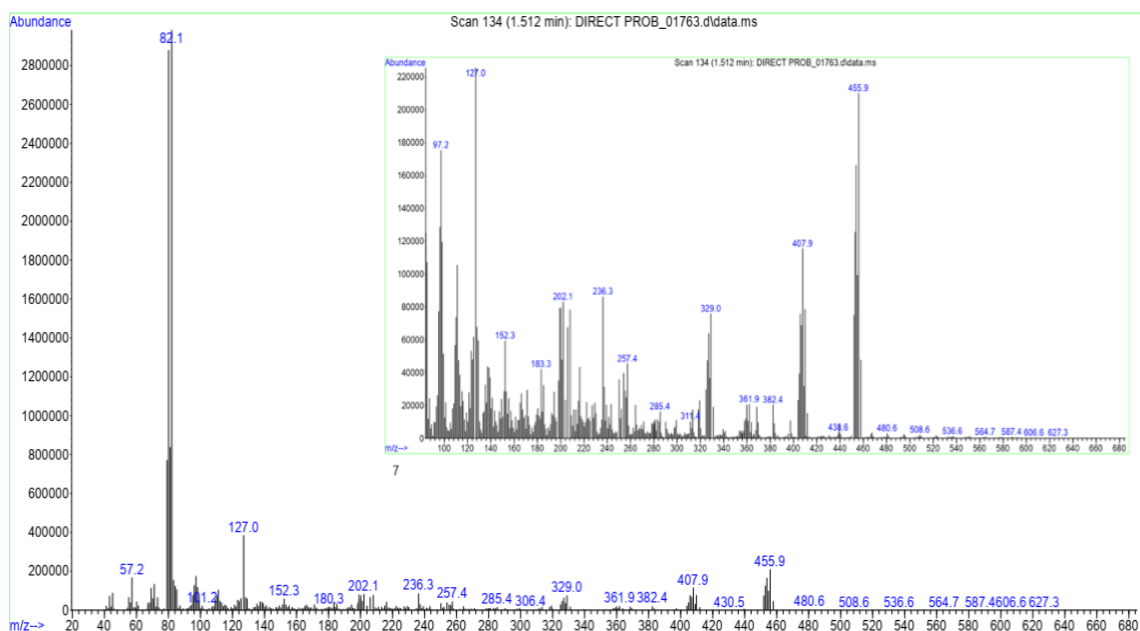
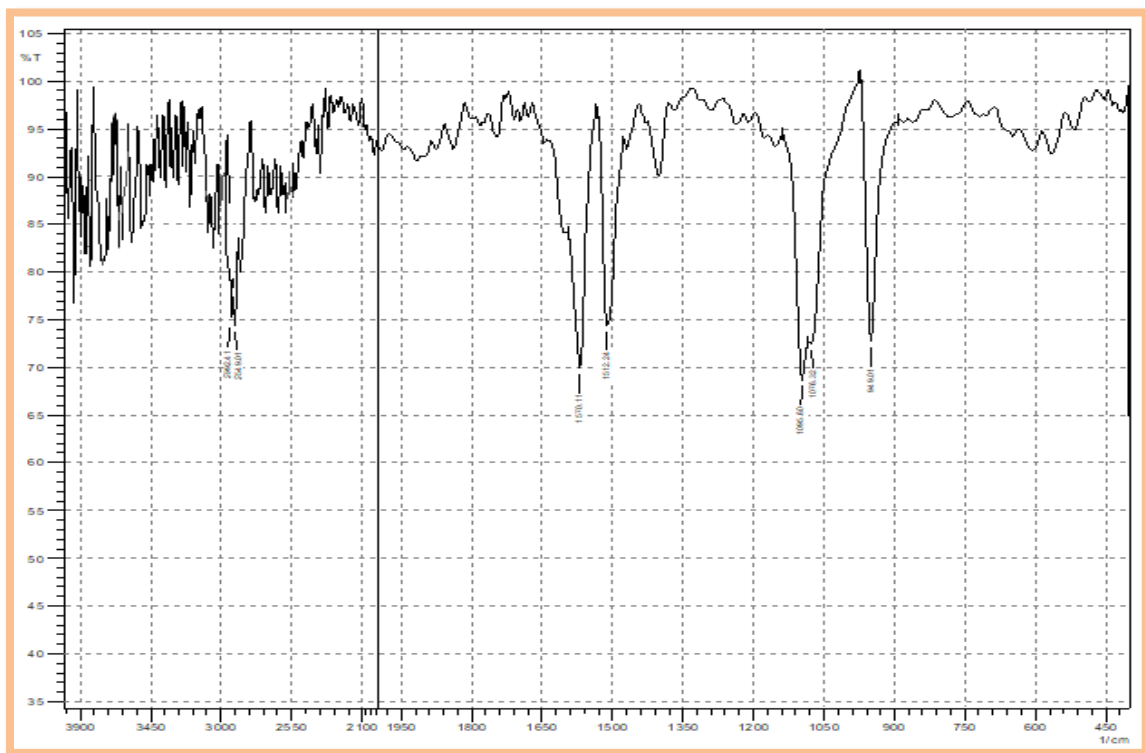


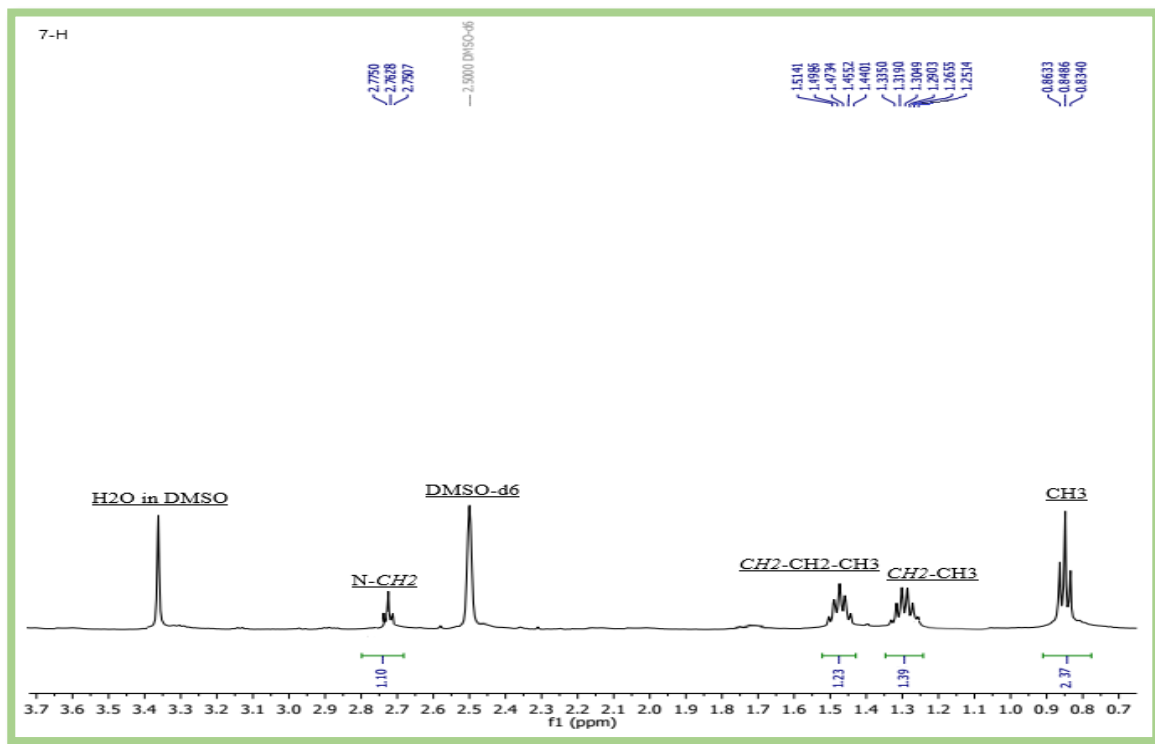
di (1-butyl tetrazole-5-yl) telluride (6)



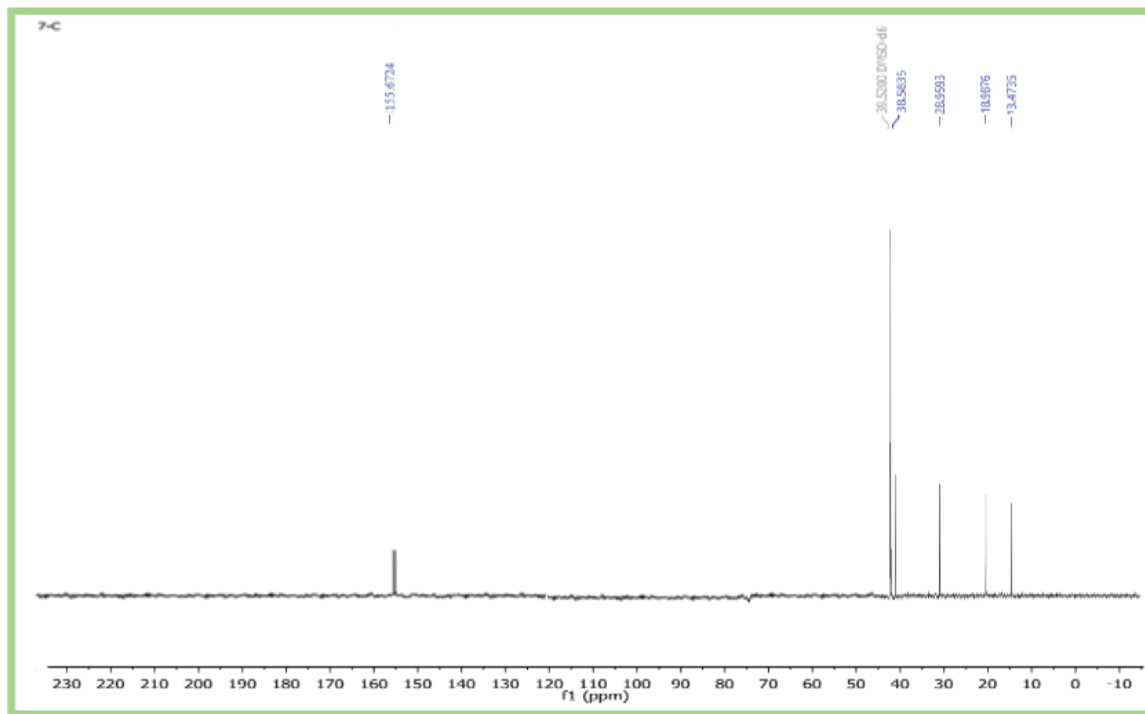


1-butyl tetrazole-5-yl tellurium triiodide (7)

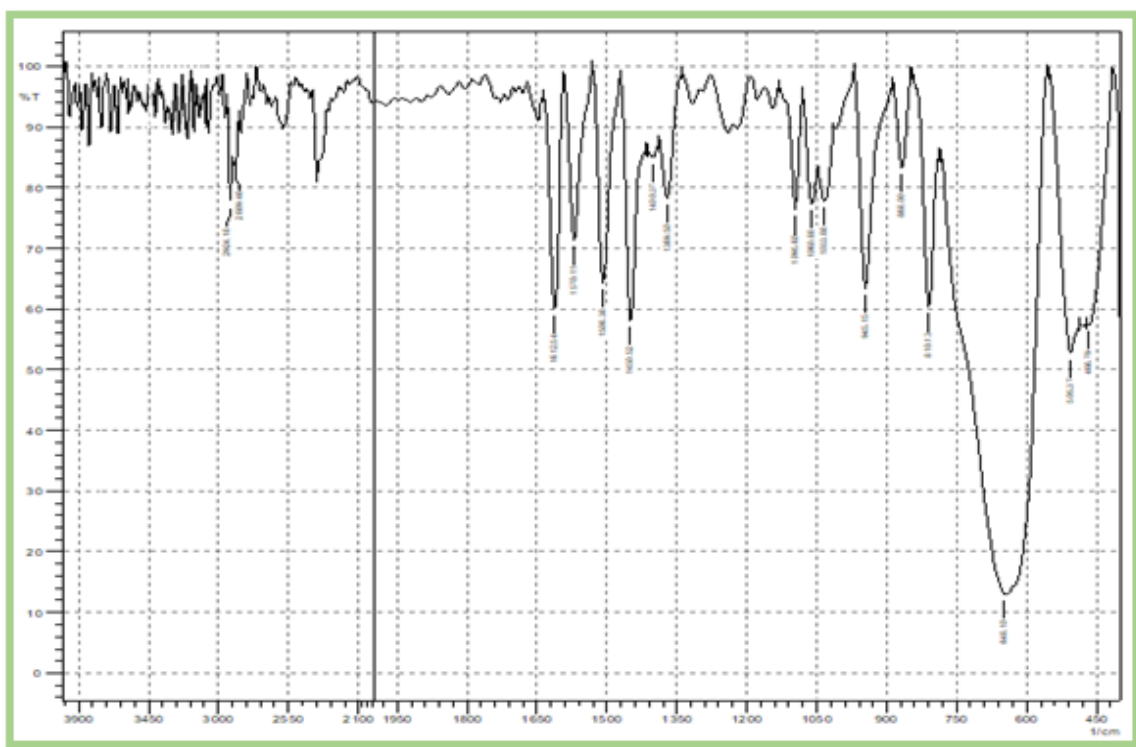




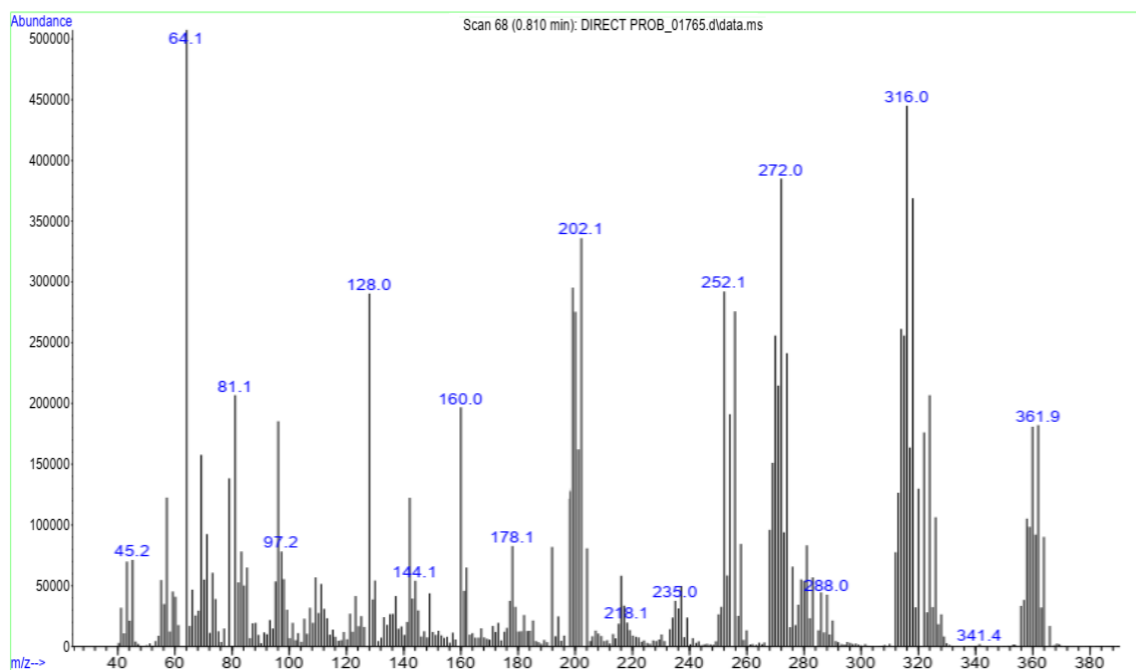
طيف $^1\text{H-NMR}$ للمركب 7



1-butyl tetrazole-5-yl tellurium trichloride (8)

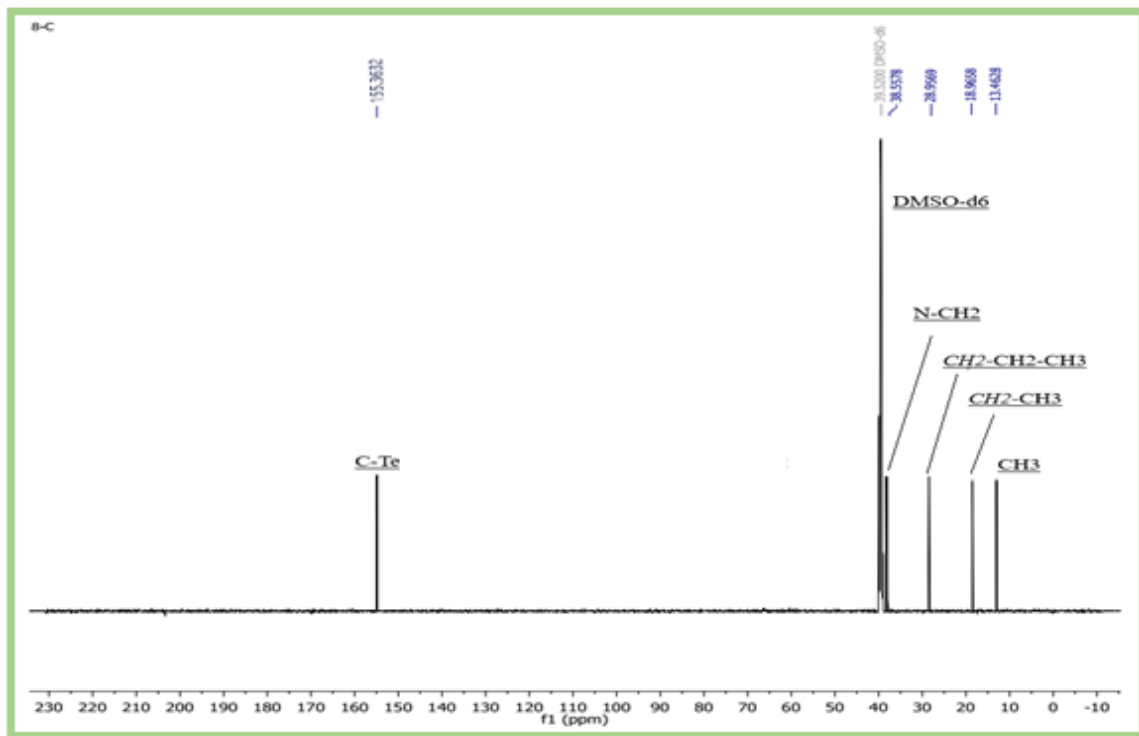
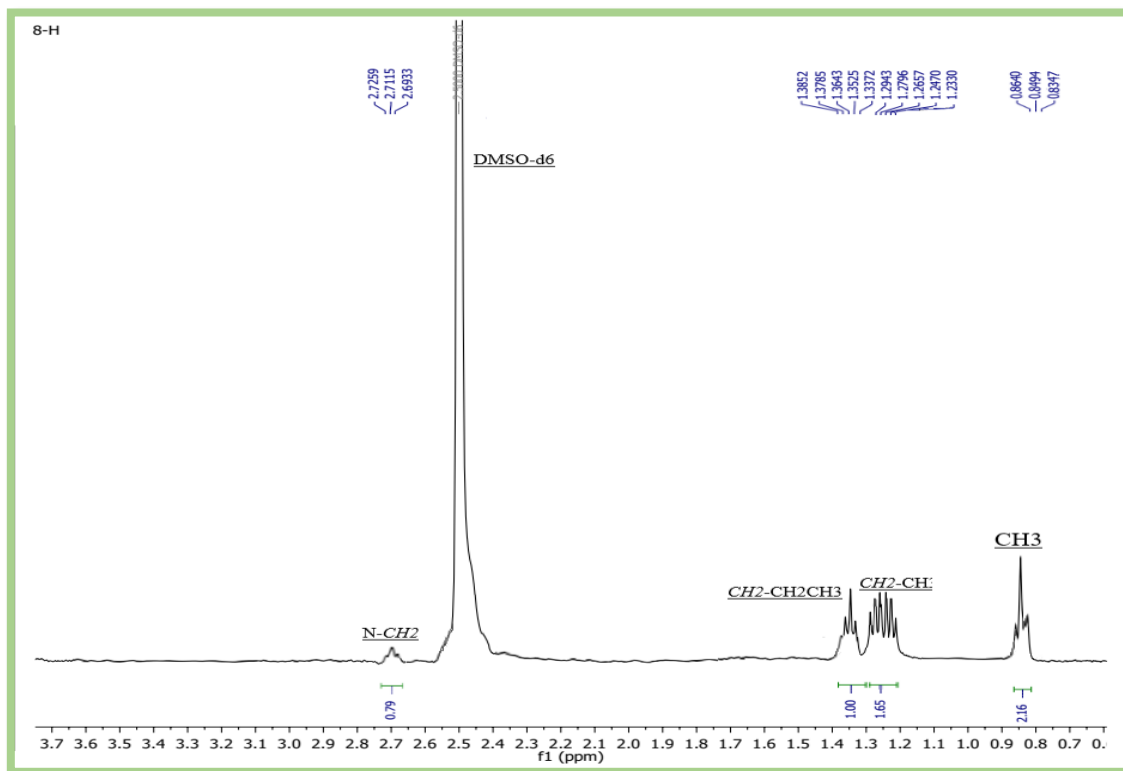


طيف تحت الحمراء للمركب 8

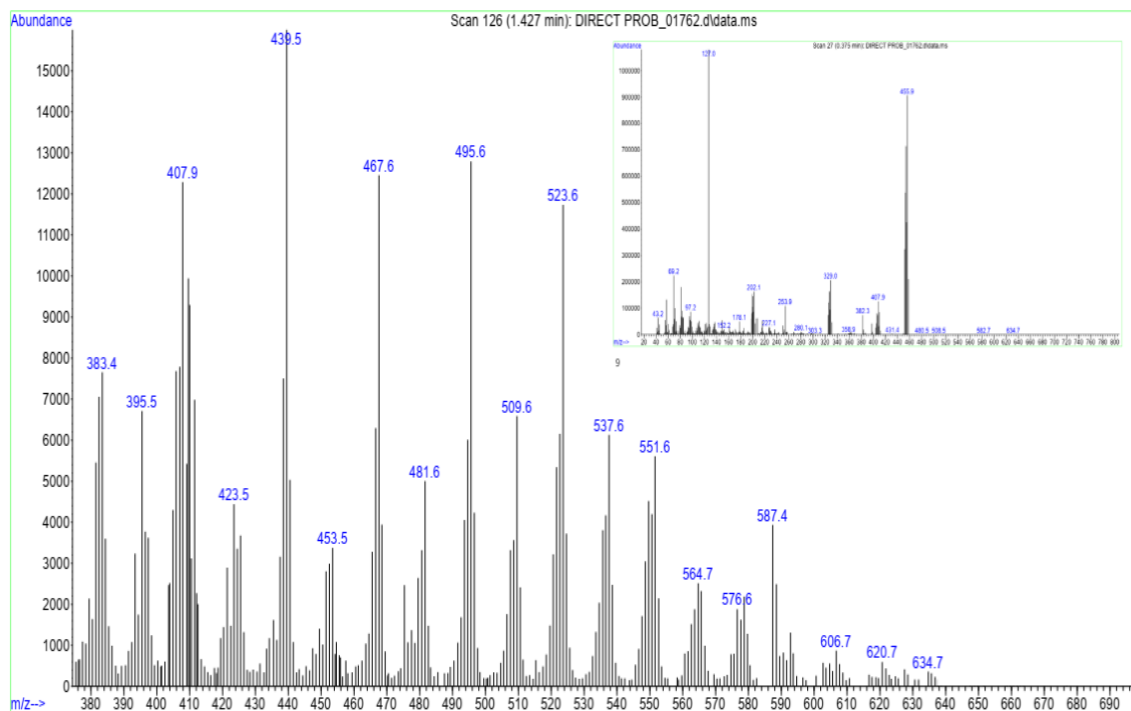
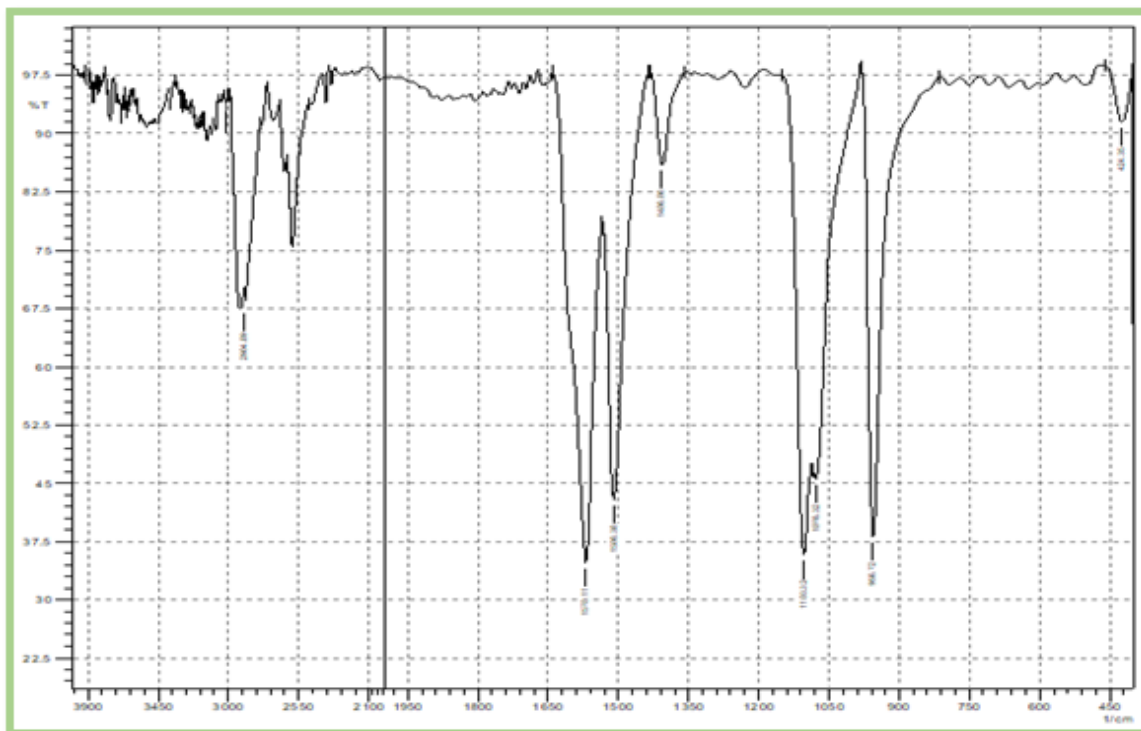


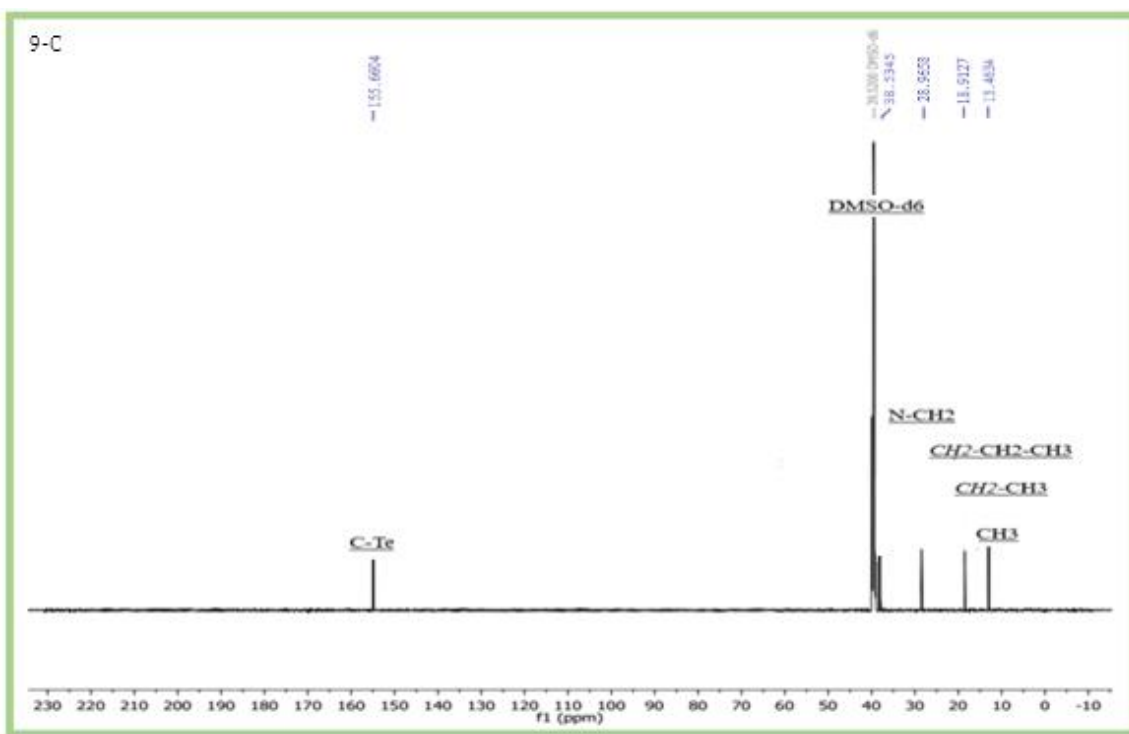
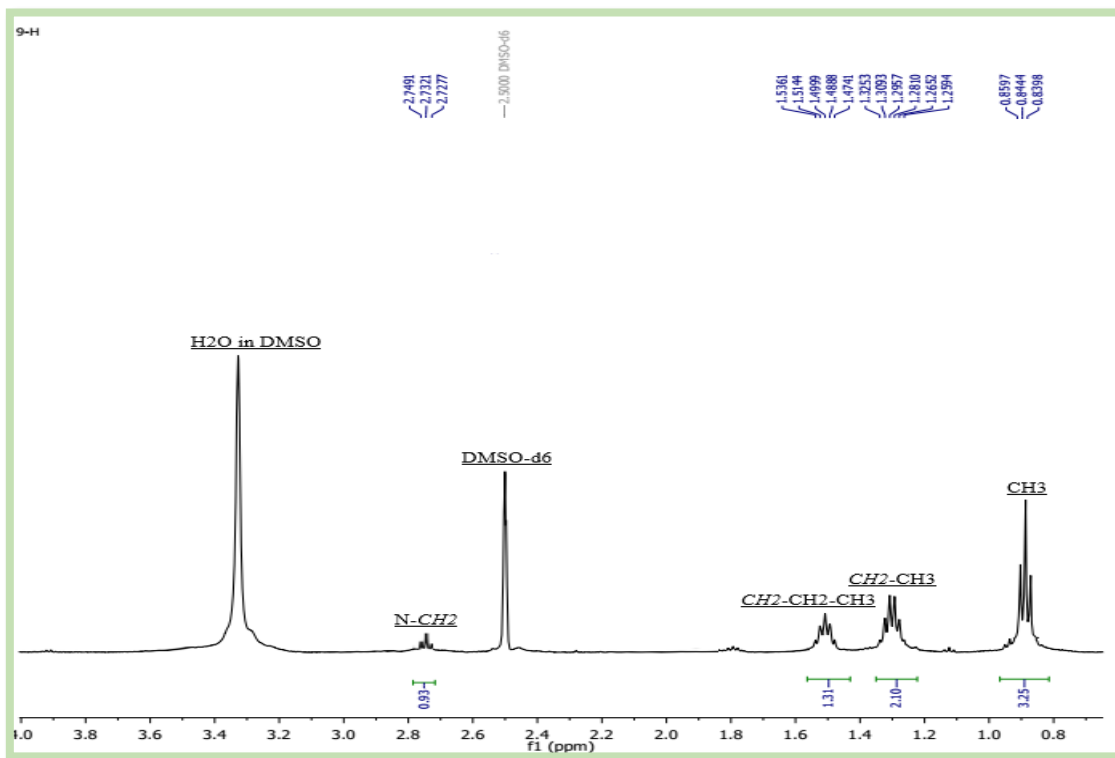
8

طيف الكتلة للمركب 5 عند 70eV



di (1-butyl tetrazole-5-yl) tellurium diiodide (9)





di (1-butyl tetrazole-5-yl) tellurium dichloride (10)

