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The Different Platin (II) Complexes of Thiocarbon Acids

Asmat Azizova, Smid Gasimov, Khudayar Gasanov, Manaf Manafov

Azerbaijan National Academy of Sciences, Institute of Catalysis and Inorganic Chemistry named after acad. M.Nagiyevev,
Baku, Azerbaijan

Azerbaijan Medical University, Baku, Azerbaijan.

Azerbaijan Medical University, Baku, Azerbaijan.

Azerbaijan National Academy of Sciences, Institute of Catalysis and Inorganic Chemistry named after acad. M.Nagiyevev,
Baku, Azerbaijan

ABSTRACT: In this study, thiodipropionic acid have analytical purity was used as starting materials. Cis- $[(C_6H_5CN)_2PtCl_2]$, $K_2[PtCl_4]$, trans- $[Pt(NH_3)_2Cl_2]$ were synthesized by using the literature methods [1, 2]. Normal Na_2L and $NaHL$ salts of the ligands were prepared by potentiometric titration and the precipitating with organic solvents. Cis- $[Pt(H_2L)_2Cl_2]$ (I), Cis- $[Pt(H_2L)_2Br_2]$ (II), Trans- $[Pt(H_2L)_2Cl_2]$ (III), $[Pt(H_2L)(HL)Cl] \cdot 2H_2O$ (IV), Cis- $[Pt(HL)_2]$ (V), Trans- $[Pt(HL)_2]$ (VI), $K[PtLCl]$ (VII), $K[PtLBr]$ (VIII) and $[PtLNH_3]$ (IX) were synthesized from thiodipropionic acid by using appropriate Pt(II) complex in different reaction conditions. Purity degree of the starting materials and final products were elucidated by elemental analyses and IR spectroscopy. It has been proved that platinum complexes of potential tridentate thiodiacetic acid also are coordinated maximal bidentally. Depending on condition the five-membered chelate ring is formed as a result of deprotonation and protonation of thiodiacetic acid in platinum complexes. It has been proved that cis-complexes of platinum are more biologically active than its trans-analogues.

KEYWORDS: chelate ring, platinum, S-ligands, thiodiacetic acid, thiodipropionic acid.

I. INTRODUCTION

S-Donor ligands seem that they are simple biological models. Such kind of complexes having these ligands play a key role in the process of drug distribution in the body. The formation of the complexes of $-SH$ and $-COOH$ ligands with Pt(II) usually depend on the reaction conditions [1–3].

Thiodipropionic acid has sulfur and oxygen atoms that they act as mono-, di-, and tridentate ligands depending on the variation of times during the complex formation.

Characteristics of the complex formation and the related parameters have not been investigated yet. However, thiodiacetic acid $S(CH_2COOH)_2$ which is the simplest sample member of the group covering thiodipropionic acid was investigated by employing first transition elements (V, Cr, Mn, Fe, Co, Ni, Cu) [4–6], Pt(II) and Pd(II) [7–9] and Rh(III). Thiodiacetic acid behave as a tridentate ligand with the first transition elements and Rh(III). In the Pd(II) complexes, thiodiacetic acid behaves as monodentate ligand with only $-S-$ atom. In the Pt(II) complexes with the compound mentioned behaves as both monodentate with $-S-$ and bidentate with $-S-$ and $-O-$ which binding one of the carboxyl groups [10]. But tridentate coordination form of Pt(II) with thiodiacetic acid have not been synthesized yet.

The aim of this study is to examine the reaction conditions and find out the mechanism of the Pt(II) and thiodipropionic acid complexes varying time, temperature, species and proportion of solvent and proportion of the ligand.

II. EXPERIMENTAL SECTION

A. Materials and Apparatus: Analytical grade chemicals, solvents and double distilled water were used throughout this study. Cis- $[(C_6H_5CN)_2PtCl_2]$, $K_2[PtCl_4]$, trans- $[Pt(NH_3)_2Cl_2]$ were synthesized as reported earlier. Normal salts of the ligands as Na_2L and $NaHL$ were prepared by potentiometric titration and via precipitation with organic solvents. Purity of the precursor materials was examined by elemental analyses and IR spectroscopy a model of IR- 435 IR (200–4000 cm^{-1}) spectrophotometer (Shimadzu). Melting points of the synthesised ligands and complexes were determined by using a Gallenkamp apparatus and are uncorrected.

B. Synthesis**Cis-[Pt(H₂L)₂Cl₂] (I):**

Method 1: Cis-[(C₆H₅CN)₂PtCl₂] (0.6452 mmol, 0.3047 g) was dissolved in chloroform (20 ml) and filtered. Thiodipropionic acid (1.2901 mmol, 0.2298 g) was added on the starting material by stirring. This heterogenic mixture was stirred 8 hr at room temperature in the tightly closed balloon. Then, the mixture was refluxed 15 hr in 50°C. Light yellow residue was formed. After cooling 10°C, these residue was filtered, washed with chloroform and ether, dried in air and kept in a desiccators' over P₂O₅ until stationary weight (Yield 93.7%). The results of the elemental analyses of the complex C₁₂H₂₀S₂Cl₂O₈Pt: C, 23.23; H, 3.21; S, 10.29, Cl, 11.39; Pt, 31.31. Found : C 21.41; H 3.5; S 10.63; Cl 11.72; Pt, 31.56.

Method 2: K₂PtCl₄ (0.3672g, 0.8846 mmol) was dissolved in 10 ml distilled water and filtered. It was added drop by drop onto the solution of thiodipropionic acid (0.3151g, 1.7692 mmol) at 60°C within 3 hours. During this reaction, color of the mixture turned to light yellow from red. It was evaporated at 70°C. The residue was dissolved in acetone to separate KCl which was formed during the stoichiometric reaction. This purification process was repeated 3–4 times. The resulting material was dried in vacuum to stationary weight. Thus a yellow solid material was obtained (0.5038g, 91.3%). Anal. Calc. for C₁₂H₂₀S₂Cl₂O₈Pt : C, 23.23; H, 3.21; S, 10.29; Cl, 11.39; Pt, 31.31. Found : C, 23.37; H, 3.46; S, 10.51; Cl, 11.66; Pt, 31.43.

Method 3: [Pt(HL)₂] (VI) was stirred in the cold water (8 ml). After this suspension was completely solved in the concentrated HCl, it was evaporated at 70°C. The resulting precipitate was filtered off, washed several times with diethylether and dried in value by KOH to stationary weight. (0.2508g, 95.8%). Anal. Calc. for C₁₂H₂₀S₂Cl₂O₈Pt : C 23.23; H 3.21; S 10.29; Cl 11.39; Pt 31.31. Found : C 23.11; H 3.09; S 10.48; Cl 11.39; Pt 31.31.

Cis-[Pt(H₂L)₂Br₂] (II). The cis-[Pt(H₂L)₂Cl] (I) (0.3672g, 0.8846mmol) was solved in H₂O (7 ml). KBr (1:20) was added to mixture and stirred. For protonization of the carboxyl group, HBr (1 ml) was added to mixture. The solution was stirred at 80°C for 6 h. Color of the mixture was changed to orange. The reaction mixture was evaporated at 70°C to dried precipitate. The resulting precipitate was solved in the acetone and filtered for 5–6 times to separation of KCl. After then, the reaction mixture was heated slowly, and orange precipitate was obtained. It was filtered, and washed several times with alcohol, diethyl ether, dried in vacuum to stationary weight (0.3647g, 76.4%). Anal. Calc. for C₁₂H₂₀S₂Br₂O₈Pt : C, 20.26; H, 2.81; S, 9.01; Br, 22.49; Pt, 27.42. Found: C, 20.12; H, 2.57; S, 9.29, Br, 22.71; Pt, 27.66.

Trans-(Pt(H₂L)₂Cl₂) (III):[Pt(NH₃)₂Cl₂](0.3251g, 1.0833 mmol) was solved in H₂O (15 ml), and H₂L (0.3859g, 2.1665 mmol) and concentrated HCl (1 ml) was added to this suspension. The reaction mixture was stirred at 50°C for 4 hr. The homogenous mixture was filtered and evaporated at 40°C to 5 ml. It was cooled and kept in the room temperature for 3 days. The yellowish -white precipitate as cotton was obtained. It was filtered and washed several times with diethyl ether, and dried in value (0.5595g, 83%).

Anal. Calc. for C₁₂H₂₀S₂Cl₂O₈Pt : C 23.23; H 3.21; S 10.29; Cl 11.39; Pt 31.31.
Found : C 23.52; H 3.37; S 10.36; Cl 11.50; Pt 31.17.

[Pt(H₂L)(HL)Cl].2H₂O (IV) :

Method 1: Over the salt solution (15 ml) of K₂PtCl₄ (0.3542 g, 0.8530 mmol) which was filtered and heated to it's boiling point, the thiodipropionic acid solution (0.3042 g, 1.7078 mmol) in H₂O(5 ml) which was filtered at the same temperature, was added. After this solution was stirred, the light yellow, bright mixture was obtained. When this mixture was evaporated to 8 ml, and cooled to +4°C, the white precipitate was obtained in the greenish solution. The precipitate was filtered and washed with cold water and only a little alcohol and diethyl ether. (0.4935g, 93%). Anal. Calc. for C₁₂H₂₀S₂Cl₂O₈Pt : C 23.23; H 3.21; S 10.29; Cl 11.39; Pt 31.31. Found : C 23.52; H 3.37; S 10.36; Cl 11.50; Pt 31.17.

Method 2: (IV) can be obtained too from aqueous solution of cis-[Pt(H₂L)₂Cl₂] (I) by heating and cooling. The complex which obtained by both of the methods have the same structure. It was proved with IR spectroscopy and elemental analyses.

Cis-[Pt(HL)₂] (V):

Method 1: K₂[PtCl₄] (0.3218g, 0.7752 mmol) was solved in H₂O (10 ml) and filtered. The solution was heated to 70°C. Acidic natrium salt of the thiodipropionic acid (0.3102 g, 1.5504 mmol) was solved in H₂O (7 ml) and filtered, it was heated to 70°C too. The heated solutions were mixed and had been colorless. This mixture evaporated at 70°C in the water-bath to 8 ml, and it was cooled. The white precipitate was obtained. After the Cl ions were controlled by

AgNO₃, the precipitate was recrystallized from hot-water, filtered and washed with the cold-water and only a little alcohol and diethyl ether. The product was dried in vacuum to stationary weight (0.3789g 89%).

Anal. Calc. for C₁₂H₁₈S₂O₈Pt: C 26.23; H 3.27; S 11.67; Pt 35.51.

Found : C 26.41; H 3.39; S 11.39; Pt 35.48.

Method 2: [Pt(H₂L)₂Cl₂] (I) (0.3066g) was solved in H₂O (15 ml) and evaporated to 7 ml in the water-bath at 80°C. When the solution was cooled, the white precipitate was obtained and it was recrystallized 4–5 times from hot-water. Exchanging of the Cl ions was controlled with AgNO₃. After the product was washed with cold water and alcohol, it was dried in vacuum to stationary weight (0.1556g, 61.3%).

Anal. Calc. for C₁₂H₁₈S₂O₈Pt : C 26.23; H, 3.27 S, 11.67; Pt 35.51.

Found : C 26.48; H 3.55; S 11.83; Pt 35.59.

Trans-[Pt(HL)₂] (VI): Trans[Pt(H₂L)₂] (III) (0.4183 g) was solved in water (25 ml). This solution was heated in the tightly closed balloon to 2 h. The reaction mixture had been colorless. The mixture was transferred to the porcelain bowl and it was evaporated at 70°C in water-bath to 5 ml. When the mixture was cooled, the white precipitate as cotton was obtained. This product was recrystallized from hot-water 3–4 times. After the Cl ions were controlled with AgNO₃ solution, it was filtered and washed with cold water, alcohol and diethyl ether. The final product was dried in vacuum to stationary weight (0.3123g, 84.6%).

Anal. Calc. for C₁₂H₁₈S₂O₈Pt: C 26.23; H 3.27; S 11.67; Pt 35.51.

Found : C 26.60; H 3.44; S 10.59; Pt 35.72.

K[PtLCl] (VII): K₂[PtCl₄] (0.3744 g, 0.9019 mmol) was solved in H₂O (10 ml) and filtered. It was heated to 70°C. The thiodipropionic acid's disodium salt (0.2021g, 0.9019 mmol) was solved in H₂O (10 ml) and heated to 70°C too. The solutions were stirred and the color of the mixture changed to greenish yellow. pH of the media was turned to basic with 0.5M KOH (pH=8.5) (4 ml). This basic mixture was evaporated at 80°C in the water-bath to 5-6 ml. After 3 days, greenish-yellow small crystalline precipitate was obtained. The precipitate was filtered, washed with the cold water, alcohol and diethyl ether, and dried in vacuum to stationary weight (0.3087g 76.8%).

Anal. Calc. for C₆H₈SO₄KPtCl: C 16.16; H 1.79; S 7.19; Cl 7.96; Pt 43.77. Found : C 16.03; H 1.32; S 7.39; Cl 7.48; Pt 43.94.

K[PtLBr] (VIII): K[PtLCl] (0.2118g) was solved in the hot water (20 ml). Concentrated KBr hot-solution (10 ml) was added over the K[PtLCl] solution the hot and concentrated KBr solution(10 ml) was added to hot solution of the K[PtLCl] (0.2118 g) in the hot water (20 ml). 0.5 M KOH solution (pH=8) (3 ml) was added to the reaction mixture and the reaction mixture was stirred at 80°C for 4 h. After then the solution was evaporated in the water bath at 80°C to 10 ml. When the solution was cooled, the red-yellow precipitate was obtained. It was filtered and washed 3-4 times with water, alcohol and diethyl ether. The precipitate was dried in vacuum to stationary weight (0.1481 g 63.6%).

Anal. Calcd. For C₆H₈SO₄KPtBr: C 14.69; H 1.63; S 6.54; Pt 39.79.

Found : C 14.60; H 1.49; S 6.31, Pt 39.36.

The potassium ion was controlled with NaHC₄H₄O₆ in the complex VII and complex VIII.

[PtLNH₃] (IX): The [Pt(NH₃)₄]Cl₂ (0.2917 g; 0.8731 mmol) solution in H₂O (10 ml) was filtered and heated to 50°C. The disodium salt of thiopropionic acid (0.1956 g, 0.8731 mmol) was solved in H₂O (10 ml), and filtered and heated to 60°C. These hot solutions were mixture by stirring. %25 NH₃H₂O (5 ml) was added to the reaction mixture. The reaction mixture was heated to 60°C for 3 h, and evaporated in water bath to 5 ml. The mixture was cooled to +6°C. After 5 days, when the mixture was stirred-by the glass rod, the precipitate begun to obtain (form). The precipitate was filtered, washed with cold water, alcohol and diethyl ether and dried in vacuum to stationary weight (0.2640 g, 77.9%).

Anal. Calc. For C₁₆H₁₁NSO₄Pt: C 18.23; H 2.83; N 3.60; S 8.25; Pt 50.25. Found : C 18.24; H 2.97; N 3.44; S 8.41; Pt 50.38.

III. RESULT AND DISCUSSION

Several solvent systems consisted of distilled water and organic solvents were used to examine the effect of reaction medium. Proportions and the structures of the same complexes which was obtained by the different methods, was elucidated by IR spectroscopy and the elemental analyses. Effect of the temperature, time, pH and the rate of the M:L to the synthesis of the Pt(II) complex of the thiodipropionic acid have been proved. The most important IR assignment in the spectrum of the free ligand as well as bonding sites have been determined by a careful comparison of the both the ligand and its metal complexes.

The IR band of the free group $-\text{COOH}-$ of the ligand appears at 1694 cm^{-1} . For the group mentioned above the bands were seen at 1696 cm^{-1} , 1700 cm^{-1} and 1697 cm^{-1} , for the **I**, **II**, **III** complexes, characteristically. With the consideration of the spectroscopic data, it may be concluded that no ionization is seen. That is, it does not bind with central atom however, a changing in the structures of **I**, **II** and **III** were observed.

In the IR spectra of **I** and **III** M-Cl valance bonds were observed at 344 cm^{-1} , 331 cm^{-1} (**I**) and 332 cm^{-1} (**III**) and M-S valance bonds were observed at 374 cm^{-1} , 362 cm^{-1} (**I**) and 370 cm^{-1} (**III**). Since M-Cl and M-S absorption bands' appear too close each other, in structure elucidation of the complexes, the IR spectrums of the brominated ligand were used. In brominated complexes, the absorption bands were obtained at 225 cm^{-1} , 253 cm^{-1} (**II**) separate from the region of absorption bands of M-Cl bonds, should be considered as the bands of M-Br valance bonds [8, 9]. For elucidation of the geometric structures of metal-halogen and metal-ligand, IR spectrums of the $[\text{ML}_2\text{X}_2]$ type flat-square complexes of Pt with **II** valance were used.

Absorption bands of M-X and M-S valance bonds points out that the structures are in cis-form for **I** and **II**, and trans form for in as elucidated in the reports [10, 13]. In the complexes named **I**, **II** and **III**, related ligands make a monodentate coordination with only S atom.

For the complex **IV**, the absorption bands at 1610 cm^{-1} and 1701 cm^{-1} belong to COO^- and COOH groups of the complexes. Absorption bands seen at 370 cm^{-1} and 349 cm^{-1} may belong to metal - sulphur bond of the ligand that is in the cis configuration to each other. Pt-Cl valance bond should be characterized with the strong absorption band at 328 cm^{-1} . Hydrate of the complex **IV** is characterized in the IR spectra with the absorption band at about $3564\text{--}3489\text{ cm}^{-1}$ region [16].

According to the thermogravimetric analyses results of the complex **IV**, the hydrate cleaves (breaks up) at about $110\text{--}140^\circ\text{C}$ and the complex decomposes at 215°C without melting. Due to the data, in complex **IV**, a molecule of thiodipropionic acid makes a monodentate coordination with sulphur atom. The second molecule makes bidentate coordination with the ionization of sulphur or $-\text{COOH}$ group. As a result, ligand and metal forms a hexagonal ring.

Absorption bands of complex **V** were observed at 355 cm^{-1} , 370 cm^{-1} where cis form of Pt-S valance bond gives some peaks there. Ionized and free (nonionized) $-\text{COOH}$ groups of complex **V** are characterized by absorption bands at 1706 cm^{-1} , 1700 cm^{-1} $-\text{COOH}$ and 1598 cm^{-1} $-\text{COO}^-$ [17]. In complexes with bidentate coordination of the both (**IV** and **V**) ligand, two hexagonal metal rings should be formed when the complex **V** was treated with concentrated HCl, the formed hexagonal ring cleaves at Pt-OCO bond and will form a $[\text{Pt}(\text{H}_2\text{L})_2\text{Cl}_2]$ complex **I**.

The absorption bands of complex **VI** at 1692 cm^{-1} $-\text{COOH}$ 1592 cm^{-1} $-\text{COO}^-$ 368 cm^{-1} $-\text{Pt-S}-$ shows that, in the compound of trans configured ligand is in bidentate coordination with sulphur and oxygen atoms [18].

The values of absorption bands of complex **VII**, **VIII** and **IX** were observed at 1616 cm^{-1} , 1600 cm^{-1} and 1606 cm^{-1} . The results were obtained here show an agreement those of the ligand doesn't differ from the values of the free ligand's deprotonated carboxyl groups. In complexes **VII-IX** this fact should express the bond formation of only one molecule ligand with two deprotonated carboxyl group at the same time.

Strong absorption bands at 348 cm^{-1} and 370 cm^{-1} show a formation of Pt-Cl and Pt-S, respectively. Complex **VIII** is a brominated derivative of complex **VII** and absorption band at 250 cm^{-1} M-Br and 368 cm^{-1} M-S are exhibit.

For the complex **IX**, absorption band obtained at 378 cm^{-1} shows that the ligand is in coordination with the sulphur atom. In this complex, the coordinated NH_3 molecule is characterized with a deformation vibrations absorbed at 1540 cm^{-1} and the metal-nitrogen bond vibrations are observed at 504 cm^{-1} for the form of Pt-N [19].

With the help of the information's obtained from elemental analysis and IR spectrum of complexes **VII-IX**, it is concluded that; thiodipropionic acid behaves as a three-dentate coordination with sulphur atom and each deprotonated carboxylic groups. In these compounds the position of the four-dentate should be formed by acido ligands or ammonia, which is a neutral molecule.

Measuring of the electronic conductivities of the solid complexes ($10^3\text{ mol}\cdot\text{l}^{-1}$) at 25°C were showed us the **I-IV** complexes aren't electrolyte, but **VII** and **VIII** complexes are electrolyte with 2 ions. Electronic conductivities of the complexes, dihedral coordinates for Cis- $[\text{Pt}(\text{H}_2\text{L})_2\text{Cl}_2]$ (**I**) and cartesian coordinates for Cis- $[\text{Pt}(\text{H}_2\text{L})_2\text{Cl}_2]$ (**I**) were given in the Table 1,2,3.

Table 1. The electronic conductivities of the complexes

No	Complexes	(μ) $\text{Om}^{-1}\text{cm}^2\text{mol}^{-1}$
I	Cis- $[\text{Pt}(\text{H}_2\text{L})_2\text{Cl}_2]$	29
II	Cis- $[\text{Pt}(\text{H}_2\text{L})_2\text{Br}_2]$	43
III	Trans- $[\text{Pt}(\text{H}_2\text{L})_2\text{Cl}_2]$	37.7



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IV	[Pt(H ₂ L)(HL)Cl]. 2H ₂ O	45.0
VII	K[PtLCl]	102
VIII	K[PtLBr]	106

Table 2. Dihedral coordinates for Cis-[Pt(H₂L)₂Cl₂] (I)

Atom	Bond Atom	Bond Length	Angle Atom	First Angle	Third Atom	Second Angle	Angle Type
S(1)							
S(8)	S(1)	2.106					
Cl(16)	S(1)	2.086	S(8)	90.000			
Pt(15)	S(1)	2.353	S(8)	60.000	Cl(16)	60.000	Pro-R
Cl(17)	Pt(15)	2.333	S(1)	90.000	S(8)	60.000	Pro-R
C(2)	S(1)	1.815	S(8)	109.470	Pt(15)	141.056	Pro-R
C(5)	S(1)	1.815	C(2)	109.472	S(8)	141.054	Pro-R
C(9)	S(8)	1.815	S(1)	103.885	Pt(15)	136.037	Pro-R
C(12)	C(2)	1.815	S(1)	109.470	C(9)	146.642	Pro-R
C(3)	C(5)	1.523	S(1)	109.471	C(5)	59.999	Dehidal
C(6)	C(9)	1.523	S(1)	109.471	C(2)	180.000	Dehidal
C(10)	C(12)	1.523	S(8)	109.471	S(1)	179.684	Dehidal
C(13)	C(3)	1.523	S(8)	109.471	S(1)	-60.003	Dehidal
C(4)	C(6)	1.509	C(2)	110.000	S(1)	60.001	Dehidal
C(7)	C(10)	1.509	C(5)	110.000	S(8)	-59.999	Dehidal
C(11)	C(13)	1.509	C(9)	110.000	S(8)	60.003	Dehidal
C(14)	C(4)	1.509	C(12)	110.000	C(2)	180.000	Dehidal
O(19)	O(19)	1.360	C(3)	107.100	C(3)	-61.085	Dehidal
Lp(32)	O(19)	0.600	C(4)	100.936	Lp(32)	-66.547	Pro-S
Lp(33)	C(4)	0.600	C(4)	100.939	Lp(32)	128.506	Dehidal
O(18)	C(7)	1.210	O(19)	124.966	C(5)	112.798	Dehidal
O(21)	O(21)	1.360	C(6)	107.100	C(6)	-61.085	Dehidal
Lp(34)	O(21)	0.600	C(7)	100.936	Lp(34)	-66.547	Pro-S
Lp(35)	C(7)	0.600	C(7)	100.939	Lp(34)	128.506	Dehidal
O(20)	C(11)	1.210	O(21)	124.966	C(11)	112.798	Dehidal
O(23)	O(23)	1.360	C(10)	107.100	C(12)	-61.085	Dehidal
Lp(36)	O(23)	0.600	C(11)	100.936	Lp(36)	-66.547	Pro-S
Lp(37)	C(11)	0.600	C(11)	100.939	Lp(36)	128.506	Dehidal
O(22)	C(14)	1.210	O(23)	124.966	C(12)	112.798	Dehidal
O(25)	O(25)	1.360	C(13)	107.100	C(13)	-61.085	Dehidal
Lp(38)	O(25)	0.600	C(14)	100.936	Lp(38)	-66.547	Pro-S
Lp(39)	C(14)	0.600	C(14)	100.939	Lp(38)	128.506	Dehidal
O(24)	S(1)	1.210	O(25)	124.966	C(5)	63.281	Pro-S
H(26)	S(8)	1.405	C(2)	172.756	C(9)	153.888	Pro-S
H(29)	O(19)	1.405	S(1)	102.226	C(3)	180.000	Dehidal
H(27)	O(21)	0.972	C(4)	106.100	C(6)	180.000	Dehidal
H(28)	O(23)	0.972	C(7)	106.100	C(10)	180.000	Dehidal
H(30)	O(23)	0.972	C(11)	106.100	C(13)	180.000	Dehidal
H(31)	O(25)	0.972	C(14)	109.410	C(14)	108.800	Pro-R
H(40)	C(13)	1.113	C(12)	109.410	C(14)	108.800	Pro-S
H(41)	C(13)	1.113	C(12)	109.410	C(11)	108.800	Pro-R
H(42)	C(10)	1.113	C(9)	109.410	C(11)	108.800	Pro-S



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H(43)	C(10)	1.113	C(9)	109.410	C(7)	108.800	Pro-R
H(44)	C(6)	1.113	C(5)	109.410	C(7)	108.800	Pro-S
H(45)	C(6)	1.113	C(5)	109.410	C(4)	108.800	Pro-R
H(46)	C(3)	1.113	C(2)	109.410	C(4)	108.800	Pro-S
H(47)	C(3)	1.113	C(2)	109.471	C(13)	109.410	Pro-R
H(48)	C(12)	1.113	S(8)	109.471	C(13)	109.410	Pro-S
H(49)	C(12)	1.113	S(8)	109.471	C(10)	109.410	Pro-R
H(50)	C(9)	1.113	S(8)	109.471	C(10)	109.410	Pro-S
H(51)	C(9)	1.113	S(8)	109.471	C(6)	109.410	Pro-R
H(52)	C(5)	1.113	S(1)	109.471	C(6)	109.410	Pro-S
H(53)	C(5)	1.113	S(1)	109.471	C(6)	109.410	Pro-R
H(54)	C(2)	1.113	S(1)	109.471	C(3)	109.410	Pro-S
H(55)	C(2)	1.113	S(1)	109.471	C(3)	109.410	Pro-S

Table 3. Cartesian coordinates for Cis-[Pt(H₂L)₂Cl₂] (I)

Atom	X	Y	Z
S(1)	0.389	1.207	0.610
C(2)	-0.359	2.304	1.847
C(3)	0.225	3.704	1.703
C(4)	-0.061	4.243	0.323
C(5)	2.185	1.142	0.865
C(6)	2.812	0.221	-0.173
C(7)	2.241	-1.170	-0.042
S(8)	-1.118	0.418	-0.631
C(9)	-1.307	1.666	-1.936
C(10)	-2.376	1.213	-2.921
C(11)	-3.694	1.038	-2.208
C(12)	-1.684	-1.171	0.039
C(13)	-0.513	-2.143	0.096
C(19)	-0.970	-3.470	0.652
Pt(15)	0.454	-1.057	-0.027
Cl(16)	1.841	0.542	-0.732
Cl(17)	-1.743	-1.328	0.709
O(18)	-0.689	5.235	0.028
O(19)	0.540	3.407	-0.565
O(20)	1.630	-1.804	-0.871
O(21)	2.553	-1.613	1.206
O(22)	-4.737	1.614	-2.420
O(23)	-3.512	0.077	-1.263
O(24)	-0.936	-4.553	0.114
O(25)	-1.430	-3.238	1.911
H(26)	1.125	0.406	-0.279
H(54)	-0.142	1.916	2.867
H(55)	-1.460	2.345	1.689
H(46)	1.328	3.661	1.850
H(47)	-0.241	4.378	2.456
H(52)	2.401	0.751	1.885
H(53)	2.612	2.164	0.759
H(44)	3.912	0.174	-0.009
H(45)	2.588	0.606	-1.193

H(29)	-1.437	-0.787	0.017
H(50)	-0.339	1.792	-2.471
H(51)	-1.610	2.635	-1.480
H(42)	-2.077	0.239	-3.369
H(43)	-2.497	1.984	-3.715
H(48)	-2.479	-1.589	-0.618
H(49)	-2.088	-1.018	1.065
H(40)	0.279	-1.730	0.760
H(41)	-0.114	-2.303	-0.931
H(27)	0.347	3.768	-1.447
H(28)	2.179	-2.508	1.275
H(30)	-4.368	-0.024	-0.813
H(31)	-1.719	-4.100	2.255
Lp(32)	1.119	3.504	-0.439
Lp(33)	0.219	2.907	-0.486
Lp(34)	3.150	-1.655	1.166
Lp(35)	2.226	-1.240	1.544
Lp(36)	-3.416	-0.405	-1.607
Lp(37)	-3.130	0.354	-0.891
Lp(38)	-0.923	-3.079	2.190
Lp(39)	-1.914	-2.903	1.796

IV. CONCLUSION

1. The complexes of thiocarbon acids with varied content and structure have been obtained with bivalent platinum and investigated.
2. The effect of the chemical composition and structure of platinum salts preliminarily taken for synthesis on composition and structure of obtained compounds has been defined.
3. It has been proved that platinum complexes of potential tridentate thiodiacetic acid also are coordinated maximal bidentally.
4. Depending on condition the five-membered chelate ring is formed as a result of deprotonation and protonation of thiodiacetic acid in platinum complexes.
5. It has been proved that cis-complexes of platinum are more biologically active than its trans-analogues.

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AUTHOR'S BIOGRAPHY



Azizova Esmet Nizami gizi

Ph.D in chemistry, Senior researcher, Azerbaijan National Academy of Sciences, Institute of Catalysis and Inorganic Chemistry named after acad. M.Nagiyev, Baku, Azerbaijan



Manafov Manaf Rizvan oglu

Ph.D in technical sciences, Associate professor, Azerbaijan National Academy of Sciences, Institute of Catalysis and Inorganic Chemistry named after acad. M.Nagiyev, Baku, Azerbaijan