# Synthesis and Characterization of Some NewBis- 1,3-Oxazepines-4,7-Dione and Bis-1,5-Disubstituted tetrazoles Linked to Benzothiazole and Thiadiazole Moieties and Containing Two Azo groups

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**Abstract**

This work includes synthesis of six bis-1,3-oxazepines-4,7-dione [5-7] , [9-11] and two bis-1,5-disubstituted tetrazoles [8] and [12] starting from 5,5'-(1,4-phenylenebis(diazene-1,2-diyl))bis(2-hydroxybenzaldehyde) [2] and primary amines 5-amino-1,3,4-thiadiazole-2-thiol and 2-aminobenzothiazole .Firstlybis-azoaldehyde derivative[2] was prepared through coupling reaction between *P*-phenylenediamine [1] and 2-hydroxy benzaldehyde.The compound [2] was then converted to the correspondingbis- imines [3] and [4] viacondensation reaction with each primary amines 5-amino-1,3,4-thiadiazole-2-thiol and2-amino benzothiazole,respectively , in presence of glacial acetic acid as catalyst in absolute ethanol .The bis-imines [3] and [4] were then introduced in [2+5] cycloaddition reaction with each maleic anhydride , phthalic anhydride and 3-nitrophthalic anhydride respectively ,in dry benzene to give bis-1,3-oxazepines-4,7-dione [5-7] and [9-11] ,respectively .Treatment ofbis- imines [3] and [4] with sodium azide under [2+3]cycloaddition conditions in tetrahydrofuran as solvent resulted the formation of new bis-1,5-disubstitutedtetrazoles [8] and [12], respectively.The structures of the prepared compounds were confirmed by C.H.N. elementary analysis and the spectroscopic methods including FT-IR,$^{1}$H NMR and $^{13}$C NMRspectra.These new derivatives probably have some biological activity.

**Keywords :** bisoxazepines , bistetrazoles , , تترازولات ثنائية اوكسازيبينات ثنائية

**الخلاصة**

يتضمن هذا البحث تحضير مشتقات 1،3–اوكسازيبين –4،7– دايون [5-7] و[9-11] ومشتقي تترازول1،5–ثنائي التعويض[8]و [12] ثنائية جديدة من المركب 5,5'–(1,4– فنيلين بس ( ديازين–1،2– دايل ) بس (2– هيدروكسي بنزالديهايد )[2] والامينين الاوليين 5– امينو– 1،3،4–ثايادايازول–2–ثايول و 2–امينو بنزو ثيازول. اولا تم تحضير مشتق الازوالديهايد الثنائي[2] من خلال تفاعل ازدواج ما بين*p*– فنيلين ثنائيامين[1] مع 2–هيدروكسي بنزالديهايد. مركب [2] تم تحويلة لاحقا الى مشتقي الايمين الثنائي[3]و [4] من خلال تفاعل تكاثف مع كل من الامينين الاوليين 5– امينو– 1،3،4– ثايادايازول–2–ثايول و 2–امينو بنزو ثيازول ، على التوالي ، بوجود حامض الخليك الثلجي كعامل مساعدفيالايثانول

المطلق. بعد ذلك تم ادخال الايمينين الثنائيين[3] و [4] في تفاعل الاضافة الحلقية [2+5]مع كل من انهدريدالماليك و انهدريدالفثاليك و3- نترو انهدريدالفثاليك ، علي التوالي في البنزين الجافتم الحصول على مشتقات 1،3-اوكسازيبين الثنائية[5-7] و [9-11] على التوالي. ان معاملة الايمينين الثنائيين [3] و [4] مع ازيد الصوديوم تحت شروط الاضافة الحلقية [2+3] في التتراهيدرو فيوران كمذيب اعطت مشتقي التترازول-1،5- ثنائي التعويض الثنائيين [8] و [12] على التوالي.شخصت تراكيب المركبات المحضرة بوساطة التحليل الكمي الدقيق للعناصر (C.H.N.)والطرائق الطيفية المتضمنة اطياف الاشعة تحت الحمراء واطياف الرنين النووي المغناطيسي للبروتون ولنواة نظير $^{13}C$.ان المركبات الجديدة المحضرة من المحتمل ان تمتلك فعالية بايولوجية.

**Introduction**

1,3-Oxazepine is unsaturated seven-membered hetrocycle containing oxygen atom in position (1), nitrogen atom in position (3) in addition of five carbons. Oxazepine derivatives showed various biological activities such as antibacterial[1] and inhibitors for some enzymes action[2]. Some of oxazepine derivatives are used in another applied fields[3,4]. For a long time, the synthesis of 1,3- and 1,4-oxazepine rings was based on two limited classical types of reactions, the first reaction is called Valence-bond isomerization which is carried out via irradiation of polyarylpyridine N-oxides.This irradiation results in ring expansion to 1,3-oxazepine in high yield and some deoxygenation to the parent amines[5] . The second reaction is called Enamines condensation which is carried out by reaction of Erythro 1,2-diphenyl-2-phenylaminoethanol with dimethylacetylenedicarboxylate in methanol at room temperature to give a mixture of the Michael adduct and tetrahydro-1,4-oxazepin-7-one[6].

Recently, cycloaddition reaction, which is a type from a pericyclic reactions is used in synthesis of 1,3-oxazepine ring[7-9]. This type of reactions is not limited and gives various 1,3-oxazepine ring derivatives. The type of cycloaddition reaction that used in synthesis of 1,3-oxazepine ring was classified as (2+5) → 7 cycloaddition reaction in which two atoms of imine group as two-membered component was added to five-membered component such as maleic or phthalic anhydrides to give a seven-membered heterocycle[10,11]. It is important to refer that a new synthesis includes three-membered components reaction is recently used for the synthesis of 1,3-oxazepine ring[12].

Tetrazoles are an increasingly popular functionality[13] with wide ranging applications including various biological properties such as antiviral [14], antibacterial[14,15],antifungal [14,15],anti-inflammatory[14,15],analgesic activity[14,15],antihypertensive[14,16] and inhibitors for enzymes action[17,18]. In addition to their various biological properties,tetrazoles also serve as precursors for the synthesis of further interesting nitrogen-containing heterocycles[13,14]. Also,this functional group has roles in coordination chemistry as a ligand and in various materials science applications including propellants[19] and explosives[20].So, Several methods have been reported for the synthesis of tetrazoles[21-24],but the most direct method to form tetrazoles is via the formal(2+3) cycoaddition of an organic azides and nitriles[13,25].

Benzothiazoles have a wide range of biological activities including antimicrobial, antifungal, ,anti-inflammatory, antitumor, anticancer , antituberculosis and antilieshmanial[26-29].On the other hand thiadiazoles showed antifungal[30],antibacterial[31],antitubercular[32], as well as analgesic effects[32]. Compounds containing 1,3,4-thiadiazole ring also exhibit anti-inflammatory[33] ,inhibition for enzymes action[34] and the

depression effect on the central nervous system[35].

Azo derivatives showed various biological activities such as antibacterial[36],antifungal[37] and inhibitors for some enzymes action[38].

The aim of this research is synthesis of some new oxazepine and tetrazole derivatives containing the biologically active azo group ,thiadiazole and benzothiazole ring as attempt for increasing the biological activity and its variety.

**Experimental**

**General**

The chemicals used in this work were obtained from Merck,Fluka and Sigma-Aldrich and were used without further purification.Benzene and THF were dried by standard method.TLC were performed on pre-coated sheets with 0.25 mm layer of Silica Gel GF254 of the Merck company, the detection was followed by coloring with iodine or $H_2SO_4$ in ethanol (60%) followed by heating .Melting points (M.P.) were determined by Electro thermal Stuart melting point apparatus, GOWLLANDS, England and were uncorrected.The Elemental analysis measured on E.A.300, Euro- Vector, Italy, in AL-al-bayt University (Jordan).FT-IR spectra were recorded on FT-IR $8400_S$, Schimadzu-Spectrophotometer and using KBr discs in Kerbala University.$^1$H NMR spectra of compounds[6] and[9]were recorded on BRUKER 300 MHz advance Ultra Shield Instrument (Switzerland) using tetramethylsilane as internal reference and DMSO-D6-d$^6$ as solventin AL-al-bayt University (Jordan).$^1$H NMR spectra of compounds [5],[7],[8]and [10]were recorded on BRUKER 300MHz using tetramethylsilane as internal reference andDMSO-D6-d$^6$ as solvent inZelinsky Institute of Organic Chemistry, Moscow (Russia).$^{13}$C NMR spectrum of compound[9]was recorded on BRUKER spectrometer operating at 75MHz using tetramethylsilane as internal reference and DMSO-D6-d$^6$ as solvent in AL-al-bayt University (Jordan). (ChemDraw Ultra 8.0. pro .) was used to give assistance for interpretation of the aromatic protons chemicals shifts.

**Prepration Methods:**

**Synthesis of 5,5'-(1,4-phenylenebis(diazene-1,2-diyl))bis(2-hydroxybenzaldehyde)[2]**

*P*-phenylenediamine[1] ( 53.7mmol, 5.7996g) was dissolvedin a mixture of concentrated hydrochloric acid (32mL) and distilled water (32 mL). The mixture was cooled at 0°C in an ice bath,then a solution of sodium nitrite (115.942mmol, 8g) dissolved in distilled water (40 mL) was added dropwise to the mixture with stirring. The temperature of the ice bath was controlled between 0-5°C during the addition. Asolution of 2-hydroxybenzaldehyde (107.4mmol,13.1028g) dissolved in (180 mL) of (10%w/v) sodium hydroxyide solution was prepared.The solution was cooled to (5$^o$C) by immersion in an ice bath and stirred vigorously,then the diazonium salt solution was added very slowly to the phenoxidesolution, a deep browncolour developed and a deep browncrystals soon separated. When all the diazonuim salt solution has been added, the mixture was allowed to stand in an ice bath for 30 min. with occasional stirring,then the solution was filtered and the precipitate was washed well with distilled water, recrystallized from ethanol and dried upon filter paper then in oven , yield 55%, M.P.233-235$^o$C.

**General procedure for the synthesis of bis-imines[3] and[4]**

5,5'-(1,4-phenylenebis(diazene-1,2-diyl))bis(2-hydroxybenzaldehyde)[2](1mmol,0.374g) was dissolved in absolute ethanol (10 mL)containing a drop of glacial acetic acid ,then5-amino-1,3,4-thiadiazole-2-thiol (2mmol ,0.266g ) or 2-aminobenzothiazole(2mmol,0.3g ) in absolute ethanol (10 mL) was added dropwise . The reaction mixture was

refluxed with stirring on a water bath at 65°C for 2h.The mixture was then allowed to cool down to room temperature .The solvent was removed by evaporation under reduced pressure and the coloured precipitate was filtered , then recrystallized .TLC , recrystallization solvents , melting points , percent yields and $R_f$ values were listed in Table (1) .

**General procedure for the synthesis ofbis- 1,3-Oxazepines-4,7-diones[5-7] and [9-11]**

imine derivative [3]( 1mmol, 0.604g ) or imine derivative [4] ( 1mmol, 0.638g ) and maleic anhydride ( 2mmol ,0.196g ) or pthalic anhydride ( 2mmol , 0.296g )or 3-nitrophthalic anhydride ( 2mmol , 0.386g ) were dissolved indry benzene( 20 mL).The reaction mixture was refluxed with stirring on a water bath at 75ºC for 7h. The reaction mixture was then allowed to cool down to room temperature , then the coloured precipitate was filtered and recrystallized .TLC , recrystallization solvents , melting points , percent yields and $R_f$ values were listed in Table (1) .(C.H.N.) elementary analysis data were listed in Table (2) .

**General procedure for the synthesis of bis-1,5 disubstitutedtetrazoles[8] and [12]**

A mixture of imine derivative [3] ( 1mmol, 0.604g ) or imine derivative [4] ( 1mmol,0.638g ) and sodium azide (2mmol , 0.13g ) in tetrahydrofuran ( 20 mL) was heated with stirring on a water bath for 24h., the temperature of the water bath was controlled between 50-55ºC.The reaction mixture was then allowed to cool to room temperature . The solvent was removed by evaporation under reduced pressure and the coloured precipitate was filtered , then recrystallized .TLC , recrystallization solvents , melting points , percent yields and $R_f$ values were listed in Table (1) . (C.H.N.) elementary analysis data were listed in Table (2)

**Table (1) . Molecular formulas , Molecular weights , percent yields, melting points , recrystallization solvents,TLC, $R_f$ values of the prepared compounds (2-12)**

| Comp. No. | Formula | M.Wt g/mole | Yield % | M.P °C | Recrystallization Solvent | TLC | $R_f$ |
|---|---|---|---|---|---|---|---|
| [1] | $C_6H_8N_2$ | 108 | - | `143-145 | - | - | - |
| [2] | $C_{20}H_{14}N_4O_4$ | 374 | 55 | 233-235 | Ethanol | - | - |
| [3] | $C_{24}H_{16}N_{10}O_2S_4$ | 604 | 72 | 180-182 | Ethanol | $Et_2o$ / n-hexane 2:8 | o.49 $Et_2o$:n-hexane 1:1 |
| [4] | $C_{34}H_{22}N_8O_2S_2$ | 638 | 71 | 216-218 | ethyl acetate | $Et_2o$:n-hexane 1:9 | o.46 $Et_2o$:n-hexane 1:1 |
| [5] | $C_{32}H_{20}N_{10}O_8S_4$ | 800 | 65 | 140-142 | Ethanol | $Et_2o$:n-hexane 2:1 | o.60 $Et_2o$ |
| [6] | $C_{40}H_{24}N_{10}O_8S_4$ | 900 | 66 | 160-162 | Ethanol | $Et_2o$:n-hexane 2:1 | o.62 $Et_2o$ |
| [7] | $C_{40}H_{22}N_{12}O_{12}S_4$ | 990 | 68 | 138-140 | Ethanol | $Et_2o$:n-hexane 3:1 | o.61 $Et_2o$:n-hexane 1:1 |
| [8] | $C_{24}H_{14}N_{16}O_2S_4$ | 686 | 62 | 165-167 | Ethanol | $Et_2o$/n-hexane 1:1 | o.57 $Et_2o$:n-hexane 1:1 |
| [9] | $C_{42}H_{26}N_8O_8S_2$ | 834 | 63 | 142-144 | Ethanol | $Et_2o$:n-hexane 2:1 | o.66 $Et_2o$ |
| [10] | $C_{50}H_{30}N_8O_8S_2$ | 934 | 66 | 134-136 | Ethanol | $Et_2o$/n-hexane 2:1 | o.68 $Et_2o$ |
| [11] | $C_{50}H_{28}N_{10}O_{12}S_2$ | 1024 | 69 | 146-148 | ethyl acetate | $Et_2o$/n-hexane 3:1 | o.63 $Et_2o$:n-hexane 1:1 |
| [12] | $C_{34}H_{20}N_{14}O_2S_2$ | 720 | 59 | 132-134 | ethyl acetate | $Et_2o$:n-hexane 1:1 | o.59 $Et_2o$:n-hexane 1:1 |

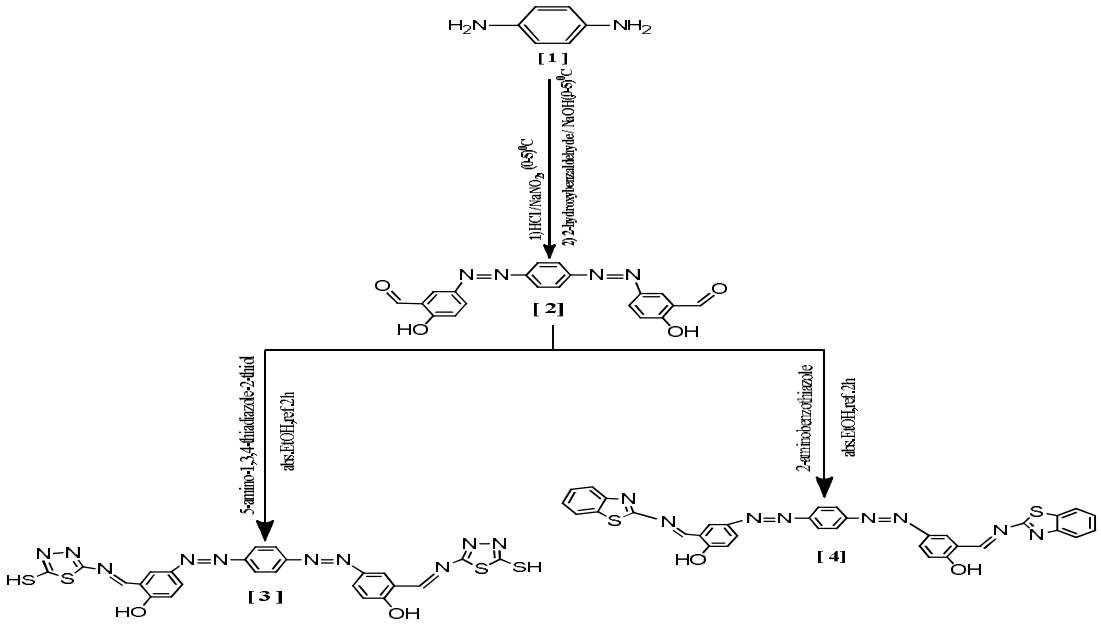
**Table(2): (C.H.N.) elementary analysis of the prepared compounds [5-12]**

| Comp. No . | Calculated % | | | Found % | | |
|---|---|---|---|---|---|---|
| | C | H | N | C | H | N |
| 5 | 48.oo | 2.50 | 16.50 | 48.07 | 2.71 | 17.61 |
| 6 | 53.33 | 2.66 | 15.55 | 53.21 | 2.78 | 15.69 |
| 7 | 48.48 | 2.22 | 16.96 | 48.51 | 2.27 | 17.08 |
| 8 | 41.98 | 2.04 | 32.65 | 42.15 | 2.19 | 32.50 |
| 9 | 60.43 | 3.11 | 13.42 | 60.31 | 3.20 | 13.52 |
| 10 | 64.23 | 3.21 | 11.99 | 64.28 | 3.27 | 11.87 |
| 11 | 58.59 | 2.73 | 13.67 | 58.73 | 2.60 | 13.77 |
| 12 | 56.66 | 2.77 | 27.22 | 56.77 | 2.88 | 27.31 |

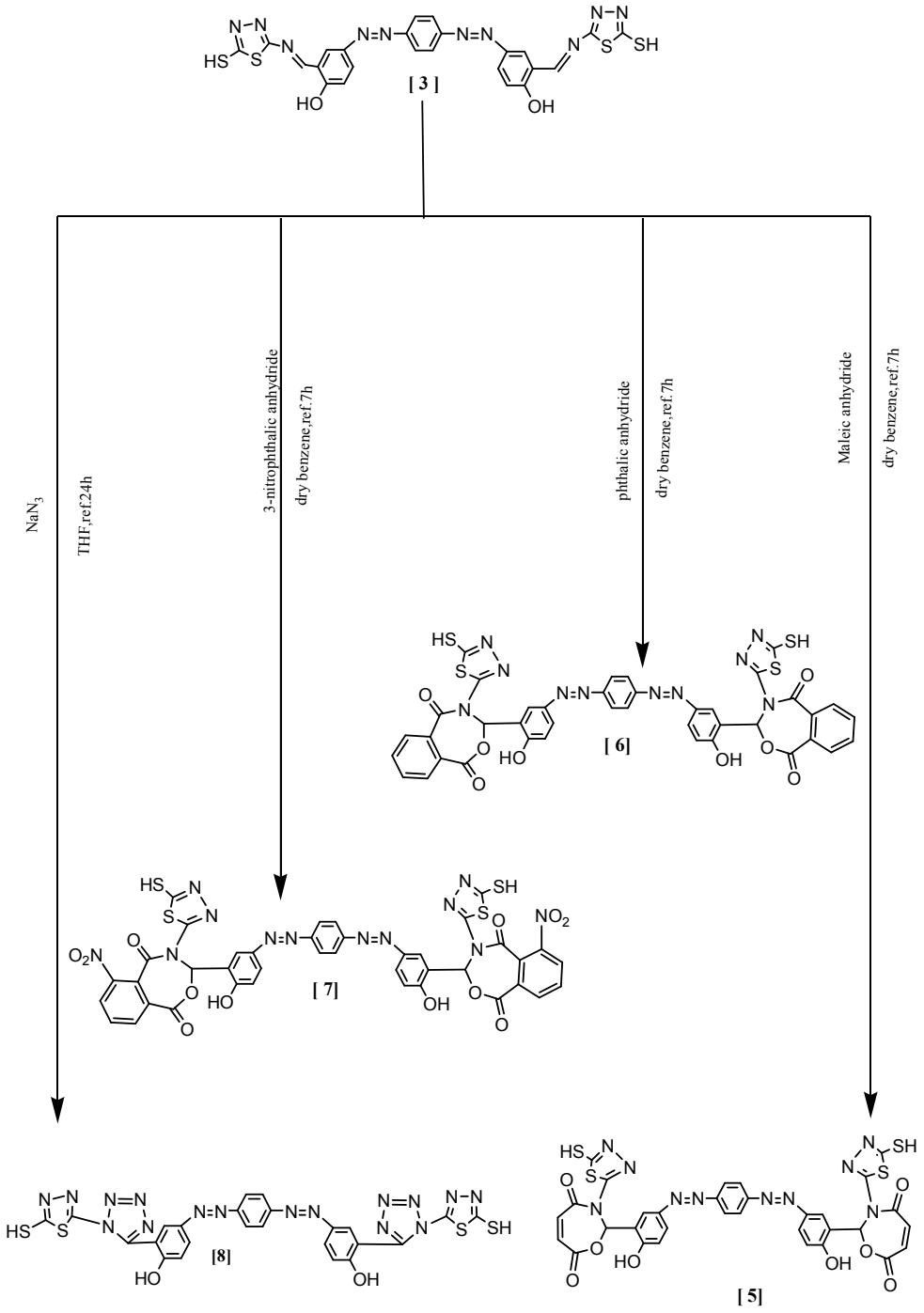
**Results and Discussion**

Since each 1,3-oxazepines,1,5-disubstitutedtetrazoles ,thiadiazoles ,benzothiazoles and azo compounds arebiologically active possessing a wide spectrum of biological applications ,the t

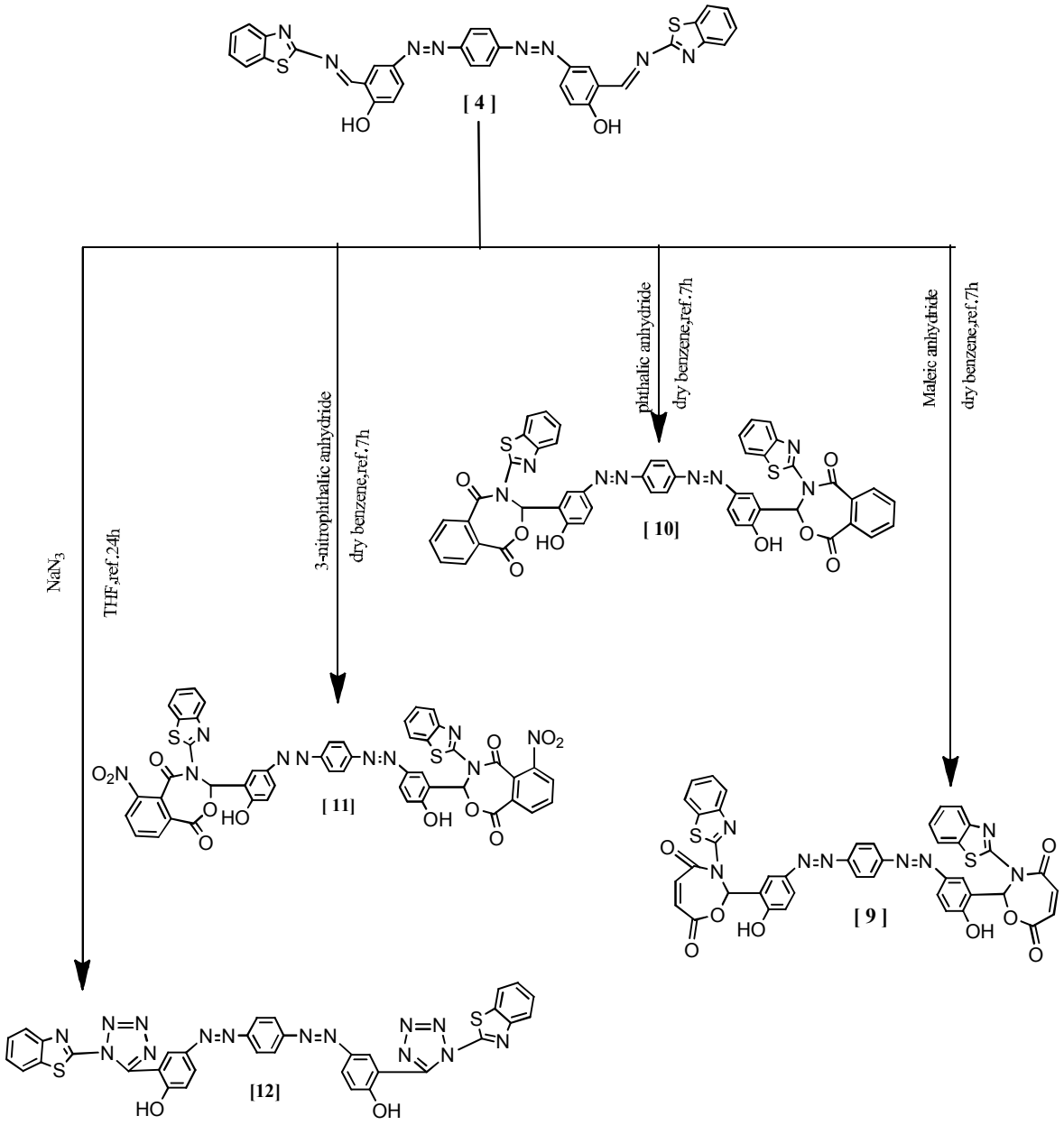
arget of the present work is to synthesize new compounds containing azo group and 1,3- oxazepine ring or tetrazole ring linked to either 1,3,4-thiadiazole or benzothiazole moiety with expected biological activity. The synthetic plan of this work is shown in the following Schemes:




**Schem (1): Synthesis pathways of compounds[2-4]**



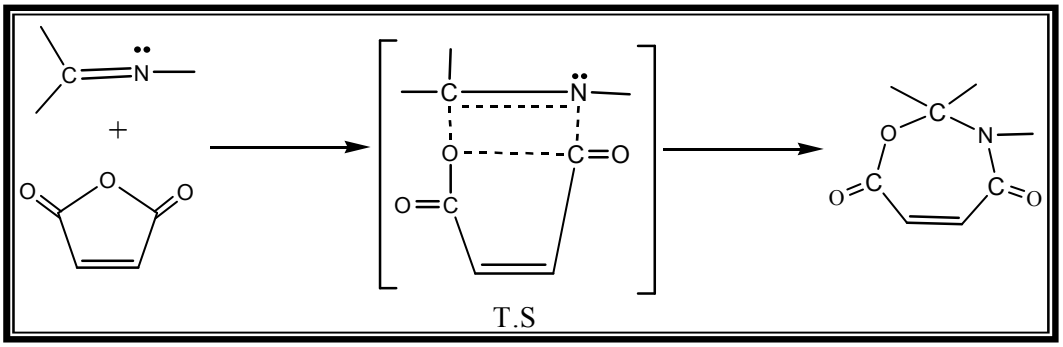

**Scheme(2) : Synthesis pathways of compounds [5-8]**




**Scheme (3) : Synthesis pathways of compounds [9-12]**

The Starting bis-azoaldehyde derivative [2] was prepared through coupling reaction between 4- amino aniline [1] and 2- hydroxybezaldehyde (Scheme 1).The FTIR spectrum of compound [2] (Figure 2) showed disappearance of the two bands at 3414 $cm^{-1}$ and 3375 $cm^{-1}$ which attributed to the asymmetric and symmetric stretching vibrations of ($-NH_2$) groups, also disappearance of the medium band at 1626 $cm^{-1}$ which attributed to the bending vibration of (N-H) and appearance of sharp strong band at 1658 $cm^{-1}$ attributed to the υ (C=O). The stretching vibration of carbonyl group was shifted to lower frequency due to the intramolecular hydrogen bonding with *ortho*hydroxy group[39]. The spectrum also showed appearance of three bands at 3612 $cm^{-1}$

,3533 $cm^{-1}$ and 3417 $cm^{-1}$, the first band attributed to the υ ( free O- H) while the second and the third bands attributed to the υ (bonded O-H) due to intramolecular hydrogen bonding with oxygen atom of *ortho* carbonyl group[39]. The reaction ofbis-azo aldehyde dervitaive [2] with two selected primary amines,5-amino-1,3,4-thiadiazole-2-thiol and 2-aminobenzothiazole resulted the formation ofbis-imine derivatives [3] and [4] respectively (Scheme 1). The FTIR spectra of thebis-imines[3] and [4] (Figures 3 and 4) showed disappearance of the strong band at 1658 $cm^{-1}$ for υ( C=O)and appearance of two strong bands at 1599 $cm^{-1}$ and 1631 $cm^{-1}$attributed to the υ ( C=N) respectively. The reaction ofbis-imines [3] and [4] with each maleic anhydride, phthalic anhydride and 3-nitrophthalic anhydride in dry benzene as solvent gave bis-1,3-oxazepine derivatives [5-7]and [9-11]respectively (Schemes 2 and 3). This reaction was classified as [2+5] cycloaddtion which proceeds via a single transition state involves the two atoms of imne group and five atoms of five - membered cyclic anhydride to produce a seven-membered 1,3-oxazepine ring as shown in Scheme 4[40]:




**Scheme(4): Approximate transition state geometry for maleic anhydride addition to imine group**

The elementary analysis (C. H. N.) of bis-1,3-oxazepine derivatives [5-7] and [9-11], Table2 , showed closeness between the calculated and found values .

The FTIR spectra of bis-1,3-oxazepines [5-7] , which were prepared frombis-imine derivative[3] , (Figs. 5,6 and 7)showed disappearance of the strong band at 1599 $cm^{-1}$whichattributed to the stretching vibration of exocyclic( C=N) group and appearance of the following characteristic absorption bands:

Bis-1,3-oxazepine compound [5] (Fig. 5) : the broad strong band at 1716 $cm^{-1}$ attributed to the υ (C=O) groups for lactam and lactone structure in 1,3-oxazepine ring due to the vibration coupling[39]. The medium band at 1627 $cm^{-1}$ attributed to the υ (C=C) inside 1,3-oxazepine ring. The other bands were listed in Table 3.

Bis-1,3- oxazepine compound [6] (Fig. 6) : the strong band at 1687 $cm^{-1}$ attributed to the υ (C=O) groups for lactam and lactone structure in 1,3- oxazepine ring due to the vibration coupling[39]. The other bands were listed in Table 3.

Bis-1,3- oxazepine compound [7] (Fig . 7) : the broad strong band at 1722 $cm^{-1}$ attributed to the υ (C=O) groups for lactam and lactone structure in 1,3-oxazepine ring due to the vibration coupling[39]. The strong and medium

bands at 1543 $cm^{-1}$ and 1352 $cm^{-1}$ attributed to the asymmetric and symmetric stretching vibrations of ( -$NO_2$) groups. The other bands were listed in Table 3.

$^1$H NMR spectrum of compound[5], Fig. (13), (300 MHz, DMSO-$d^6$) showed the following signals at δ (ppm):the signal at (δ=1.17)ppm attributed to sulfhydryl protons(S-H).It is necessary to mention here that 1,3-oxazepine compounds[5-7] are exsistedin tow tautomericthiol and thione forms and this caused appearance of (N-H) amine signal at (δ =1.23)ppm.The integration value of both signals is equal(2) which initially refers to form the bis-oxazepinestructure.The singlet signal at (δ=2.50)ppm belong to the solvent (DMSO).Thebroad signal at (δ=3.35)ppm due to the water in solvent DMSO[39].The singlet signal at (δ=6.63)ppm attributed to the (C-H) Protons of olefinic double bond inside oxazepine rings which provides good evidence for the formation of oxazepinering.The expansion spectrum(Fig.13c) showed appearance of three signals in the down field at the range (7.08-7.55)due to presence of three types of nonequivalent aromatic protons as shown in the theoretical $^1$H NMR spectrum of compound[5],Fig.(20), the signal at(δ =7.08)ppmattributed to protons(a),(2H,2×Ha).The signal at(δ=7.46)ppm belong to protons(b)(4H,4×Hb).The signal at (δ=7.55)ppm due to protons(c),(4H,4×Hc).The singlet signal of (C-H)protons inside oxazepine rings interacted with the signals of the aromatic protons.The signal of phenolic (O-H) Protons appears as broad at(δ =13)ppm.The height of this broad signalis equal(2) which gives good evidence for the synthesis of bis-oxazepine structure, this conclusion is supported by appearance of olefinic (C-H) protons signal at (δ =6.63)ppm.

$^1$H NMR spectrum of compound[6], Fig. (14), (300 MHz, DMSO-$d^6$) showed the following signals at δ (ppm): the signal at (δ =1.045-1.066)ppm, ( J 6.3 Hz) belong to sulfhydryl proton(S-H). The singlet signal at(δ= 1.25)ppm attributed to the (N-H) protons in thione form. The singlet signal at (δ =2.50) ppm due to the solvent (DMSO). The signal at (δ = 3.42-3.44)ppm attributed to the $H_2O$ in (DMSO) solvent. The spectrum also showed appearance of seven signalsin the down field region at the range (δ=6.965-7.922)ppm attributed toseven nonequivalent types of aromatic protons in three different types of substituted benzene ringsas shown in the expansion spectrum(Fig.14a).Determination of (δ)values for these aromatic protons is very difficult, therefor the theoretical chemical shifts calculations(Fig.21)have been used to give assistance for the interpretation as follow:The signal at(δ =6.96)ppm attributed to protons (a),(2H,2×Ha).The signal at (δ = 7.01)ppm belong to protons (b),(2H,2×Hb).The signal at (δ =7.04)ppm due to protons (c),(2H,2×Hc).The signal at (δ=7.13)ppm attributed to protons (d),(4H,4×Hd).The signal at(δ=7.58)ppm belong to protons (e), (2H,2×He).The signal at (δ=7.66)ppm due to protons (f),(4H,4×Hf). The signal at (δ =7.92)ppm attributed to protons (g),(2H,2×Hg). The singlet signal of (C-H)protons insideoxazepine rings interacted with the signals of the aromatic protons.The broad signal at (δ = 13)ppm attributed to the phenolic (O-H) protons.

$^1$H NMR spectrum of compound [7], Fig. (15), (300 MHz, DMSO-$d^6$) showed the followingsignals at δ(ppm): The singlet signal at (δ= 1.05)ppm attributed to the thiol groups protons (S-H).The singlet signal at (δ=1.22)ppm due to the

(N-H) protons in structure of thionetautomer. The integration value of both signals is equal (2) which initially refers to presence of bis-oxazepine structure.The singlet signal at (δ =2.50)ppmbelong to the solvent (DMSO).The broad signal at (δ=3.40)ppm due to the water in (DMSO).The expansion spectrum(Fig.15c) showed appearance of seven signals in the down field at the range (δ = 6.98-8.02)ppm attributed to six nonequivalent types of aromatic protons and (C-H) protons inside oxazepine rings ,as shown in the theoretical $^1$H NMR spectrum of compound [7], Fig(22), these signals can be interpreted in association with the theoretical chemical shifts as follow:the triplet signal at (δ6.98-7.03) ppm attributed to protons(a),(2H,2×Ha).The triplet signal at the range(δ = 7.18-7.23) ppm due to protons(b), (4H,4×Hb),this signal appeared as triplet due to interaction of doublet of proton(b) with singlet of the other(b) proton.The doublet signal at (δ =7.32-7.34) ppm belong to protons(c),(2H,2×Hc).The singlet signal at(δ=7.49)ppm attributed to (C-H) protons inside oxazepine rings.The quartet signal at (δ =7.58-7.69)ppm belong to protons(d),(4H,4×Hd), this signal appeared asquartet due to the *p*-disubstituted benzene ring.The doublet signal at (δ =7.93-7.95)ppm belong toprotons(e),(2H,2×He).The doublet signal at (δ =8-8.02)ppm attributed toprotons(f),(2H,2×Hf).The signal of phenolic (O-H) Protons appears asbroad at (δ =13)ppm .

The FT-IR spectra of bis-1,3- oxazepines [9-11] , which were prepared frombis-imine derivative [4] , (Figs.9,10 and 11) showed disappearance of the strong band at 1631 cm$^{-1}$whichattributed to the stretching vibration of exocyclic (C=N) groups and appearance of the following characteristic absorption bands:

Bis-1,3- oxazepine compound [9] (Fig .9):
the medium band at 1707cm$^{-1}$attributed to the
υ (C=O) groups for lactam and lactone structure in 1,3- oxazepine ring due to the vibration coupling[39].The medium band at 1614 cm$^{-1}$attributed to the υ (C=C) inside 1,3-oxazepine ring. The other bands were listed in Table 3.
Bis-1,3- oxazepine compound [10] ( Fig .10):the strong band at1672cm$^{-1}$ attributed to the υ (C=O) groups for lactam and lactone structure in 1,3-oxazepine ring due to the vibration coupling[39].The other bands were listed in table 3.

Bis-1,3- oxazepine compound [11] ( Fig . 11) :the strong bands at 1720 cm$^{-1}$ and 1653 cm$^{-1}$ attributed to the υ (C=O) groups for lactam and lactone structure , respectively , in 1,3-oxazepine ring . The strong bands at 1535 cm$^{-1}$ and 1352 cm$^{-1}$ attributed to the asymmetric and symmetric stretching vibrations of (-$NO_2$) groups. The other bands were listed in Table 3.

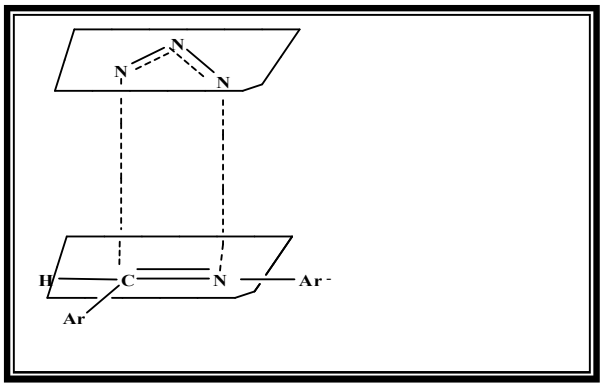
$^1$H NMR spectrum of compound[9], Fig. [17], (300 MHz, DMSO-d$^6$) showed the following signals at δ (ppm): The singlet signal at (δ = 2.50)ppm belong to (DMSO) solvent. The singlet signal at (δ = 6.22)ppm due toolefinic (C-H) protons inside oxazepine ring which gives good evidence for the formation of this ring. The spectrum also showed appearance of a large number of signals in the down field at the range (δ =7.029-8.920)ppm attributed to eight nonequivalent aromatic protons in three different types of substituted benzene rings in addition of (C-H) protons inside oxazepine rings. The singlet signal at(δ = 7.029)ppm attributed to protons(a), (2H,2×Ha).The triplet signal at the range(δ=7.224-7.358)ppm belong to protons(b),(2H,2×Hb).The triplet signal

at the range (δ=7.653-7.753)ppm attributed to protons($b^{\backslash}$), (2H,2×$Hb^{\backslash}$).The singlet signal at (δ=8.053)ppm may be due to (C-H) protons inside oxazepinerings.The singlet signal at (δ =8.132)ppm belong toprotons(c), (2H,2×Hc).The singlet signal at (δ=8.246)ppm attributed to protons($c^{\backslash}$), (2H,2×$Hc^{\backslash}$).The singlet signal at (δ=8.329)ppm belong to protons(d), (2H,2×Hd).The doublet signal at the range(δ=8.778-8.791)ppm attributed to protons(e), (4H,4×He).The signal at the range (δ=8.873-8.920) due to protons(f), (2H,2×Hf). The braod signal at (δ =9.63)ppm due to phenolic (O-H) protons.

$^{13}$C NMR spectrum of compound[9], Fig. (18), (75MHz, DMSO-$d^6$) showed the following signals at δ (ppm): The signal at (δ =168)ppm attributed to the carbonyl groups carbon atoms which bonded with oxygen (C12,2×C12). The signal at (δ =167)ppm belong to (C11,2×C11). The signal at (δ =151.5)ppm due to the carbonyl groups carbon atoms which bonded with nitrogen (C10,2×C10). The signal of carbon atoms which directly bonded with phenolic hydroxy groups (C9,2×C9) is combined with signal of carbon atoms (C10), this conclusion is supported by ChemNMR C-13 Estimation Fig. (25). The signal at (δ =132.5)ppm belong to the aromatic carbon atoms(C8,2×C8). The signal of carbon atoms (C7,2×C7) is combined with signal of the aromatic carbon atoms (C8) due to closeness of their chemical shifs. The signal at (δ =130)ppm attributed to the aromatic carbon atoms (C6,2×C6). The signal at (δ =126.3)ppm attributed to the unsaturated carbon atoms which bonded with carbonyl group carbon atoms (C12) inside oxazepine rings (C5,2×C5). The signal of the aromatic carbon atoms (C4,2×C4) is combined with signal of the aromatic carbons (C5) due to closeness of their chemical shifts. The signal at (δ =122)ppm belong to the aromatic carbon atoms (2×C3 ,2×$C3^{\backslash}$ ,2×$C3^{\backslash\backslash}$ and 2×$C3^{\backslash\backslash\backslash}$ ) due to closeness of their chemical shifts. The signal at (δ =121)ppm belong to the aromatic carbon atoms (4×C2,2×$C2^{\backslash}$ and 4×$C2^{\backslash\backslash}$) due to closeness of their chemical shifts. The signal of the unsaturated carbon atoms (2×C1) inside oxazepine rings which are bonded with carbonyl group carbon atoms (C10) is combined with signal of the aromatic carbon atoms (2×$C1^{\backslash}$ ) and signal of the saturated carbon atoms inside oxazepine rings (2×$C1^{\backslash\backslash}$) at (δ=117.5)ppm due to closeness of their chemical shifts[39].

$^1$H NMR spectrum of compound[10] ,Fig.(19), (300 MHz, DMSO-$d^6$) showed the following signalsat δ (ppm): the singlet signal at(δ =2.50)ppm attributed to the solvent (DMSO).The broad signal at (δ =4.15)ppm due to the water in solvent (DMSO).The spectrum also showed appearance of three signals in the down field region at the range(7.09-8.20)) attributed to the aromatic protons and (C-H) protons inside oxazepinerings.The signal at (δ =14)ppm attributed to the phenolic(O-H) protons.The spectrum also showed disappearanceof signals in the high field region due to absence of the aliphatic protons.

The reaction of eachbis-imine derivatives [3] and [4] with sodium azidein tetrahydrofuran produced bis-1,5-disubstitutedtetrazole derivatives [8] and [12] respectively (Schemes 2 and 3). This reaction was classified as [2+3] cycloaddition. The common features of this type of reactions is best accommodated by transition state geometry in which the dipolarphile molecule and its ligands lies in one plane, and the azide as a 1,3- dipolar group lies in a parallel plane above or below , so that the orbitals perpendicularto the planes interact to form bonds , as shown in Scheme 5[13]:




**Scheme (5): Approximate transition state geometry for azide addition to imine**

The elementary analysis (C.H.N.) of bis-1,5-disubstitutedtetrazole derivatives [8] and [12],Table 2, showed closeness between the calculated and found values. The FTIR spectra of bis-1,5-disubstituted tetrazoles [8] and [12] (Figures 8 and 12) : showed disappearance of the strong bands at 1599 $cm^{-1}$ and 1631 $cm^{-1}$ which attributed to the stretching vibrations of exocyclic (C=N) groups in imine derivatives [3] and [4] respectively and appearance of strong bands at 1570 $cm^{-1}$and 1599 $cm^{-1}$ attributed to the stretching vibrations of (C=N) inside tetrazole ring. Beside this , the FT-IR spectra of these compounds were devoid of a strong band at 2160- 2120 $cm^{-1}$ attributed to the stretching vibration of azide group.

signals attributed to four nonequivalent aromatic protons in addition of phenolic(O-H) protonsas follows: the signal at (δ=7)ppm attributed to protons(a),(2H,2×Ha).The signal at (δ=7.2)ppm belong to protons(b),(2H,2×Hb).The signal at

$^1$H NMR spectrum of compound[8] ,Fig.(16), (300 MHz, DMSO-$d^6$) showed the following signals atδ(ppm): the singlet signal at (δ = 1.05)ppm attributed to sulfhydryl (S-H) protons.The singlet signal at(δ = 1.25)ppm due to (N-H) protons in thioneform.The integration value of both signals is equal (2) which provides good evidence for the formation of bis-tetrazolestructure.The singlet signal at (δ=2.5)ppm due to the solvent (DMSO).The signal at (δ = 3.3) ppm belong to water in solvent (DMSO).The spectrum also showed appearance of five signals in the down field region at the range (δ =7-8.4)ppm which is analogous to the region in the theoretical spectrum Fig.(23) ,these

(δ=7.7) ppm due toprotons(c) ,(2H,2×Hc).The signal at (δ=8.1)ppm attributed to protons(d),(4H,4×Hd).

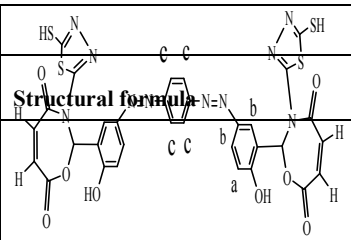
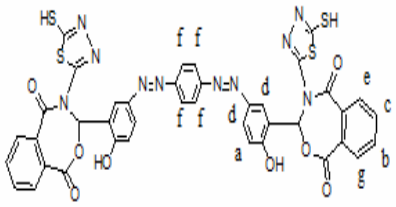
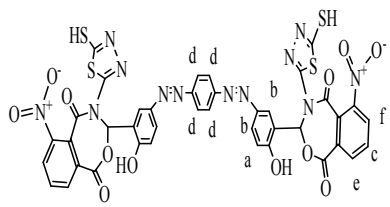
The singlet signal at (δ =8.25) ppm attributed to the phenolic (O-H) protons.

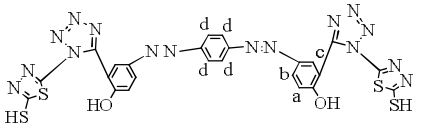
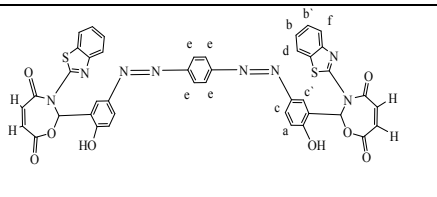
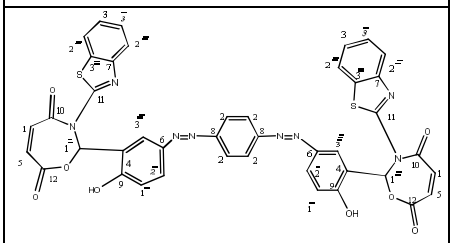
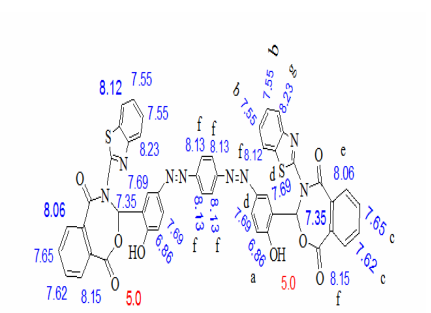
**Table (3) : FT-IR data of the prepared compounds ( 1 – 12 ) in $cm^{-1}$**

sp=sharp , br =broad , w = weak , s = strong , m = medium , o.o.p = out of plane , oxaz. = oxazepine , tetraz.= tetrazole, **δ** = bending vibration

| Comp. No . | $\nu_{O-H}$ | $\nu_{NH_2}$ | $\nu_{C-H}$ arom . | $\nu_{C=O}$ | $\delta_{NH_2}$ | $\nu_{C=N}$ | $\nu_{C=C}$ alkene | $\nu_{C=C}$ arom. | $\nu_{NO_2}$ | $\delta_{O-H}$ in plane | $\nu_{C-N}$ | $\nu_{C-O}$ | $\delta_{C-}$ aro.o.o.p | $\delta_{O-H}$ o.o.p. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [ 1 ] | – | 3414(sp,w) asym. 3375 (sp,w) Sym. | 3090(w) 3014(w) 2985(w) | – | 1626(s) | – | – | 1516(s) 1450(w) | – | – | 1313(w 1261(m | – | 831( 715( | – |
| [ 2 ] | 3612–3417 (SP,w) | – | 3115(w) 3028(w) | 1658(s) | – | – | – | 1591(m) 1477(s) | – | 1375(m) | 1280(s) | 1193(w) 1151(m) Phenol | 896(n 837( 752( | 694(m) |
| [ 3 ] | 3651–34oo (sp,w) | – | 3066(w) 2968(w) | – | – | 1599(s) | – | 1512(m) 1464(s) | – | 1367(m) | 1267(s) | 1207(m) Phenol | 883(w 848(w 752( | 688(w,br) |
| [ 4 ] | 3560–3265 (sp,w) | – | 3112(w) 3055(w) | – | – | 1631(S) | – | 1527(s) 1450(w | – | 298(m,br) | 1298(m,br) ractedwith δo-H | 1200(w) 1107(s) Phenol | 993( 846( 738( | 632(m) |
| [ 5 ] | 3591–3196 (sp,w) | – | 3140(w) 3101(w) 3037(w) | 1716(s) oxaz . | – | – | 1627(m) | 1560(w) 1508(w) | – | 1396(s) | – | 7(s) phenol 80(s) oxaz. | 979(w 852(s,b | 698(w) |
| [ 6 ] | 3518–3244 ( w ) | – | 3134(w) 3051(w) | 1687(s) oxaz . | – | – | – | 1587(s) 1491(w) | – | 1402(s) | 1278(s) | 7(w) oxaz. | 912( 794(n 742(n | 673(m) |
| [ 7 ] | 3113 ( br ) | – | 3975(w) | 1722(s) oxaz . | – | – | – | 1608(w) 1469(m) | 1543(s) asym. 1352(m) Sym. | 1394(m) | 1251(s) | 9(m) oxaz. | 902(n 756( | 686(s) |
| [ 8 ] | 3566–3174 (sp,w) | – | 3063(w 2972(w) | – | – | 1570(s) tetraz. | – | 1489(w) | – | 1410(m | 1313(s) | 1217(w) Phenol | 939(n | 702(w) |
| [ 9 ] | 3497–3205 (w) | – | 3097(w) 3018(w) 2956(w) | 1707(m) oxaz . | – | – | 1614(m) | 1533(m) 1465(m) | – | 1367(s) | 1261(w) | 1203(w) phenol 0(w) oxaz. | 868( 748(w | 648(s) |
| [10] | 3379–3176 (sp,w) | – | 3068(w) 2993(w) | 1672(s) oxaz . | – | – | – | 1548(s) 1467(m) | – | 1375(m) | 1290(s) | 1097(bi phen +oxa interacte | 866(w 792(w 732( | 628(m) |
| [11] | 3362–3194 (sp,w) | – | 3099(w) | 1720(s) 1653(s) oxaz . | – | – | – | 1572(w) 1467(s) | 5(s) asym 52(s) sym | 1259(br) | 1259(br) Interacedt with δo-H | 1155(w) oxaz. | 906(n 783(w 750(n 698(n | 648(w) |
| [12] | 3456 (w,br) – 3325–3159 (sp,w) | – | 3037(w) | – | – | 9(s)ttetra z. | – | 1483(m) | – | 348(w) | 1286(m) | 1149(w) Phenol | 902(n 846(w 758(n | 688(w) |

**Table (4) : $^{1}$H NMR and $^{13}$C NMRdata of the prepared compounds ( 5– 10 ) atδ(ppm)in DMSO-d$^{6}$ solvent .**

| Comp. No . | Structural formula | $^{1}$ H NMR δ (ppm) | $^{13}$ C NMR δ (ppm) |
|---|---|---|---|
| |  | 1.17 (S, 2H, 2×S-H) . 1.23 (S, 2H,2×N-H) 2.50 (DMSO) . 3.35 (water in DMSO). 6.63(S,4H,4×C-H olefinic inside | |
| [ 5 ] | | oxazepine rings). 7.08(S, 2H,2×Ha) . 7.46(S,4H,4×Hb). 7.55(S,4H,4×Hc).The singlet signal of (C-H) protons inside oxazepine rings interacted with signals of the aromatic protons. 13(s,2H,2×O-H phenolic). | — |
| [ 6 ] |  | 1.045-1.066 (S, *J* 6.3, 2H, 2×S-H) . 1.25 (S, 2H,2×N-H). 2.50 (DMSO) . 3.42-3.44 (water in DMSO). 6.96(2H,2×Ha) . 7.01(2H,2×Hb) 7.04(2H,2×Hc). 7.13(4H,4×Hd) . 7.58(2H,2×He) . 7.66(4H,4×$H_f$) . 7.92(2H,2×Hg) . The singlet signal of (C-H) protons inside oxazepine rings interacted with signals of the aromatic protons. 13(S,2H,2×O-H phenolic). | — |
| [ 7 ] |  | 1.05 (S, 2H, 2×S-H) . 1.22 (S, 2H,2×N-H). 2.50 (DMSO) . 3.40 (water in DMSO). 6.98-7.03(t,2H,2×Ha) . 7.18-7.23(t,4H,4×Hb) .7.32-7.34(d,2H,2×Hc). 7.49(S,2H,2×C-H protons inside oxazepine rings) . 7.58-7.69(q,4H,4×Hd) . 7.93-7.95(d,2H,2×$H_e$) . 8-8.02(d,2H,2×$H_f$) . 13(S,2H,2×O-H phenolic ). | — |

| Comp. No . | Structural formula | $^{1}$ H NMR δ (ppm) | $^{13}$ C NMR δ (ppm) |
|---|---|---|---|
| [ 8 ] |  | 1.05 (S, 2H, 2×S-H) .<br>1.25 (S, 2H,2×N-H).<br>2.50 (DMSO) . 3.3(water in DMSO).<br>7(2H,2×Ha) . 7.2(2H,2×Hb).<br>7.7(2H,2×Hc). 8.1(4H,4×Hd).<br>8.25(s,2H,2×O-H phenolic). | — |
| [ 9 ] |  <br>  | 2.50 (DMSO) .<br>6.22(S,4H,4×C-H olefinic inside oxazepine rings).<br>7.029(S, 2H,2×Ha) . 7.224-7.358(t,2H,2×Hb).<br>7.653-7.753(t,2H,2×Hb$^{\prime}$) .<br>8.053(S,2H,2×C-H protons inside oxazepine rings) . 8.132(S,2H,2×Hc) .<br>8.246(S,2H,2×Hc$^{\prime}$) .<br>8.329(S,2H,2×Hd). 8.778-8.791(d,4H,4×He) . 8.873-8.920(2H,2×H$_{f}$) .9.63(s,2H,2×O-H phenolic). | 168(C12,2×C12).<br>167(C11,2 ×C11).<br>151.5(C10,2×C10 and C9,2×C9).<br>132.5(C8,2×C8 and C7,2×C7).<br>130(C6,2×C6).<br>126.3(C5,2×C5 and C4,2×C4).<br>122(2×C3 ,2×C3$^{\prime}$,2×C3$^{\prime\prime}$ and 2×C3$^{\prime\prime\prime}$)<br>121(4×C2,2×C2$^{\prime}$ and 4×C2$^{\prime\prime}$)<br>117.5(2×C1 +2×C1$^{\prime}$ and2×C1$^{\prime\prime}$) |
| [10] |  | 2.50 (DMSO) . 4.15 (water in DMSO).<br>7.09-8.20(26H, aromatic +2H,2× C-H protons inside oxazepine rings).<br>14(S,2H,2×O-H phenolic). | — |

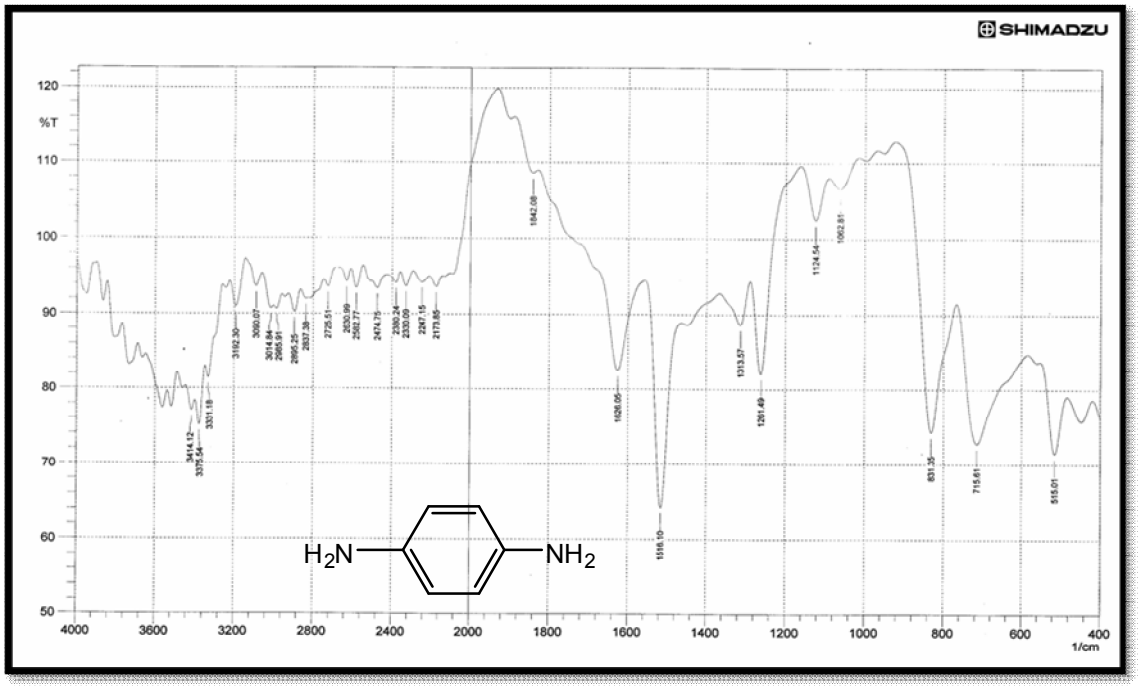



**Fig. 1:FT-IR spectrum of compound [1]**

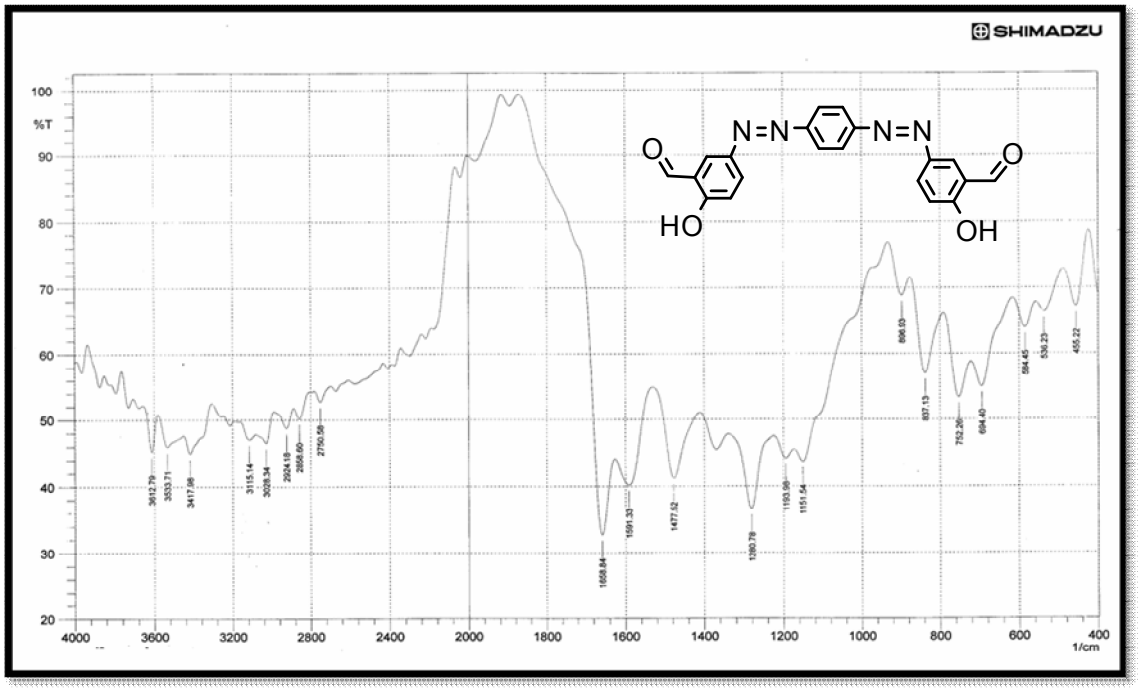



**Fig. 2:FT-IR spectrum of compound [2]**

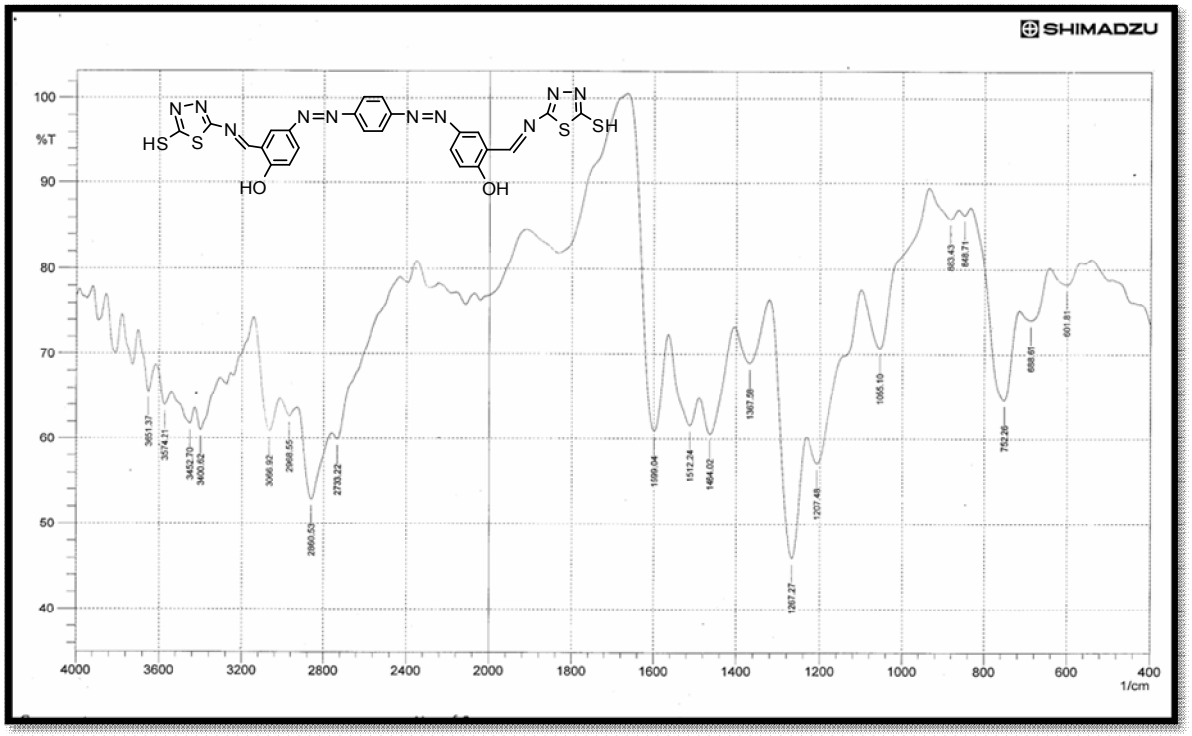



**Fig. 3:FT-IR spectrum of compound [3]**

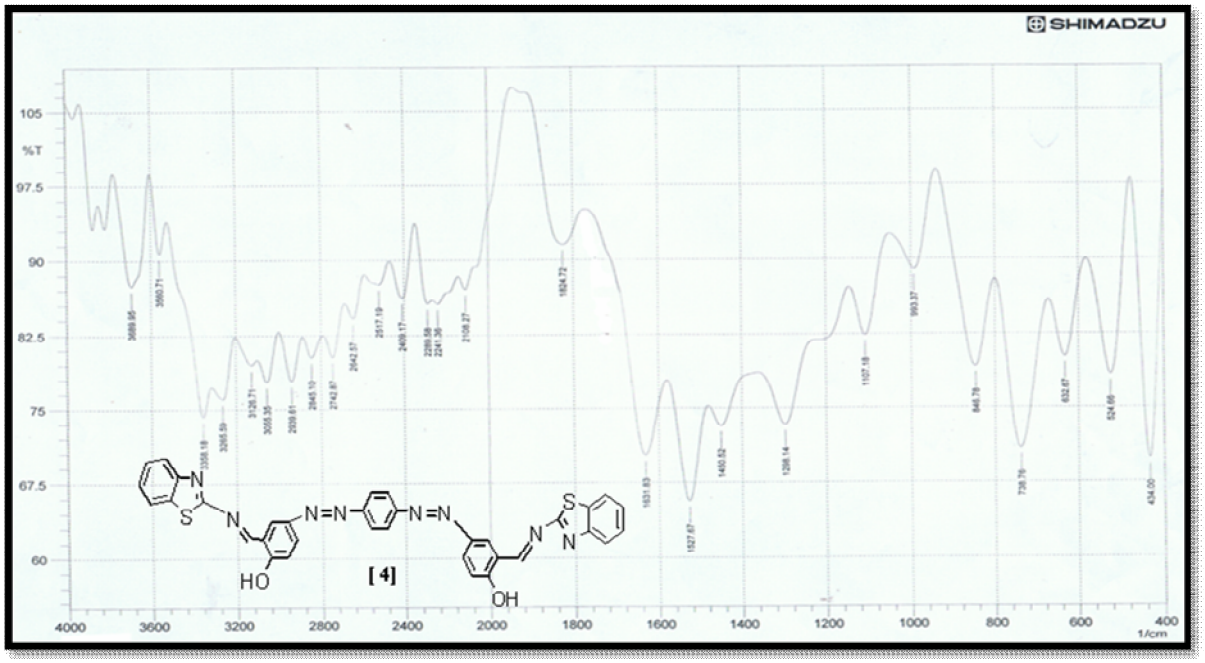



**Fig. 4:FT-IR spectrum of compound [4]**

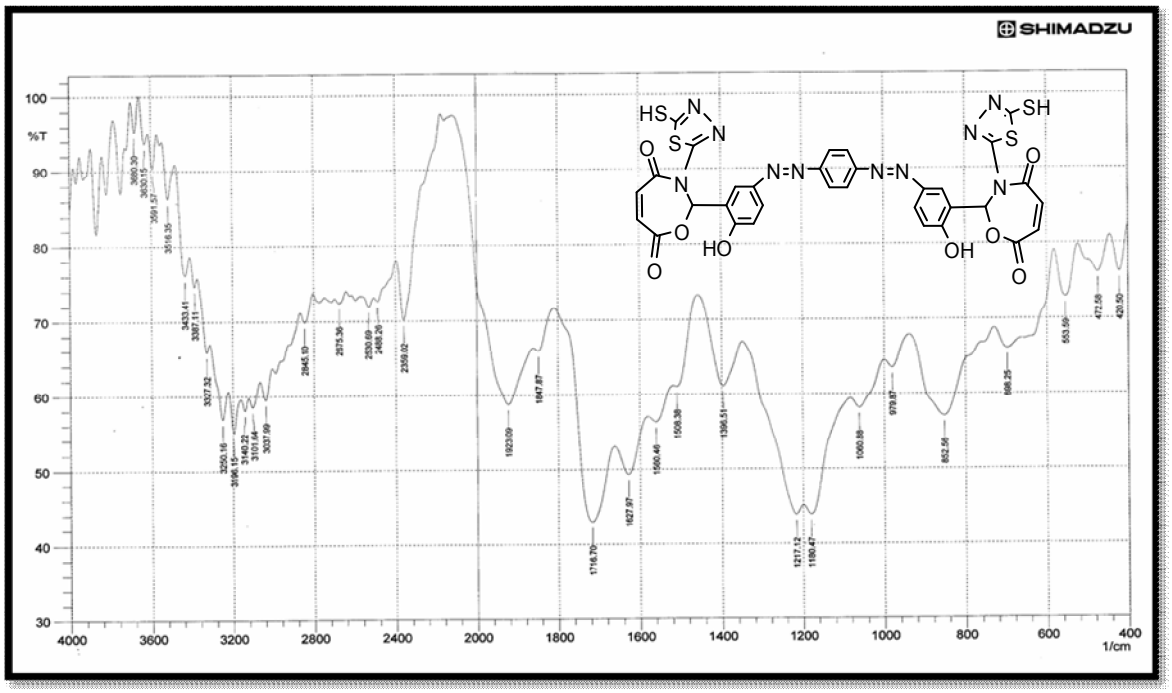



**Fig. 5:FT-IR spectrum of compound [5]**

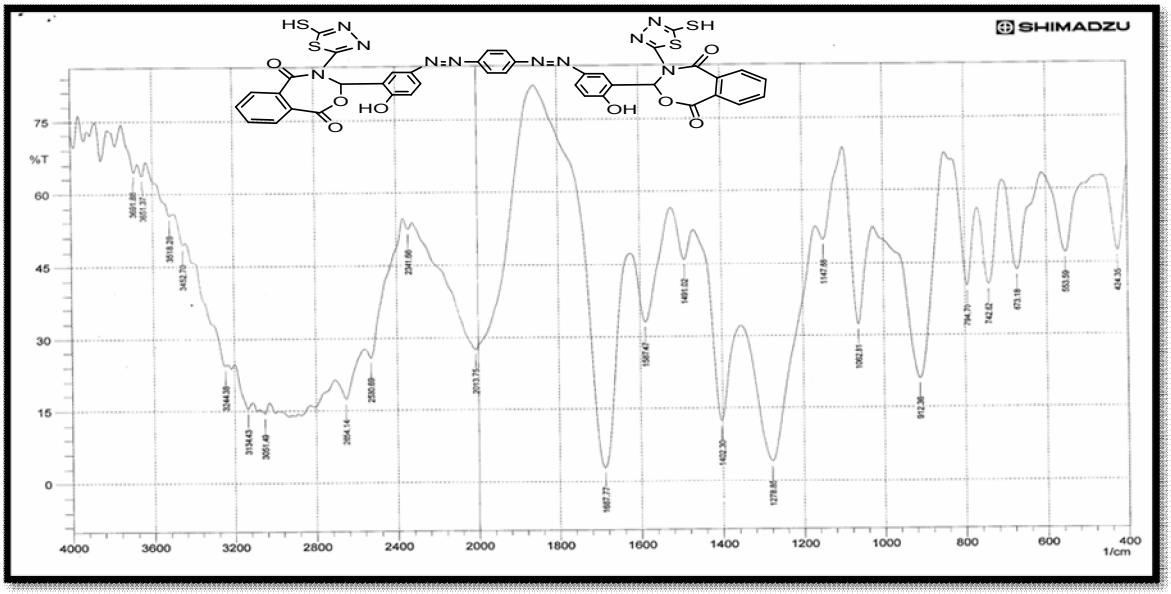



**Fig. 6:FT-IR spectrum of compound [6]**

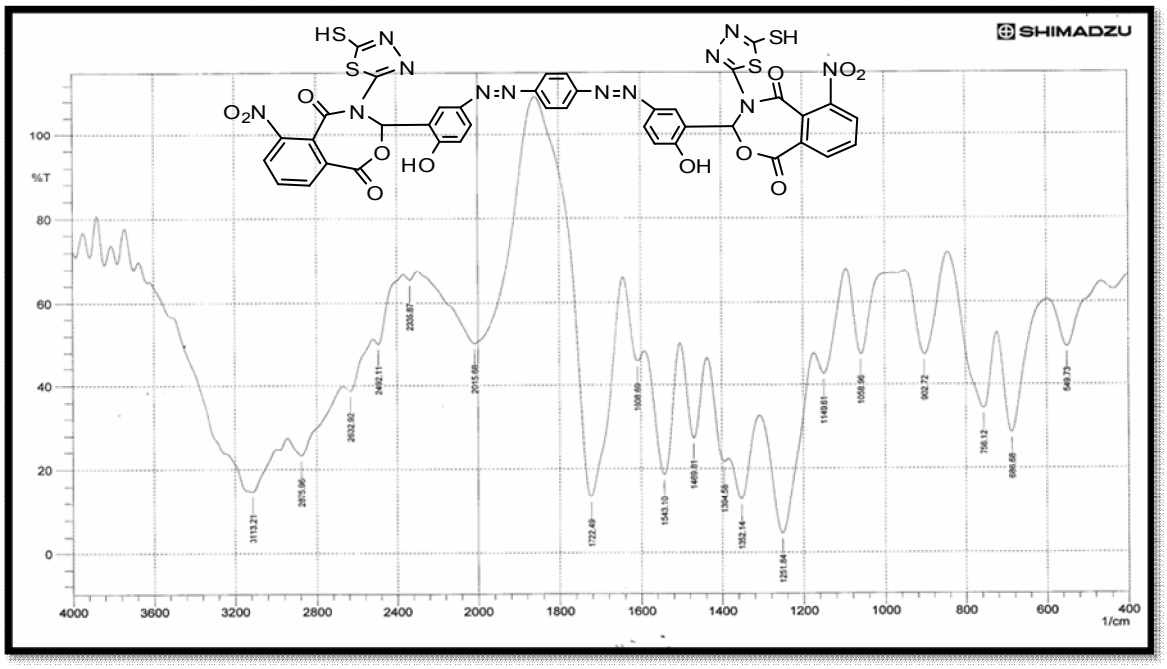



**Fig.7:FT-IR spectrum of compound [7]**

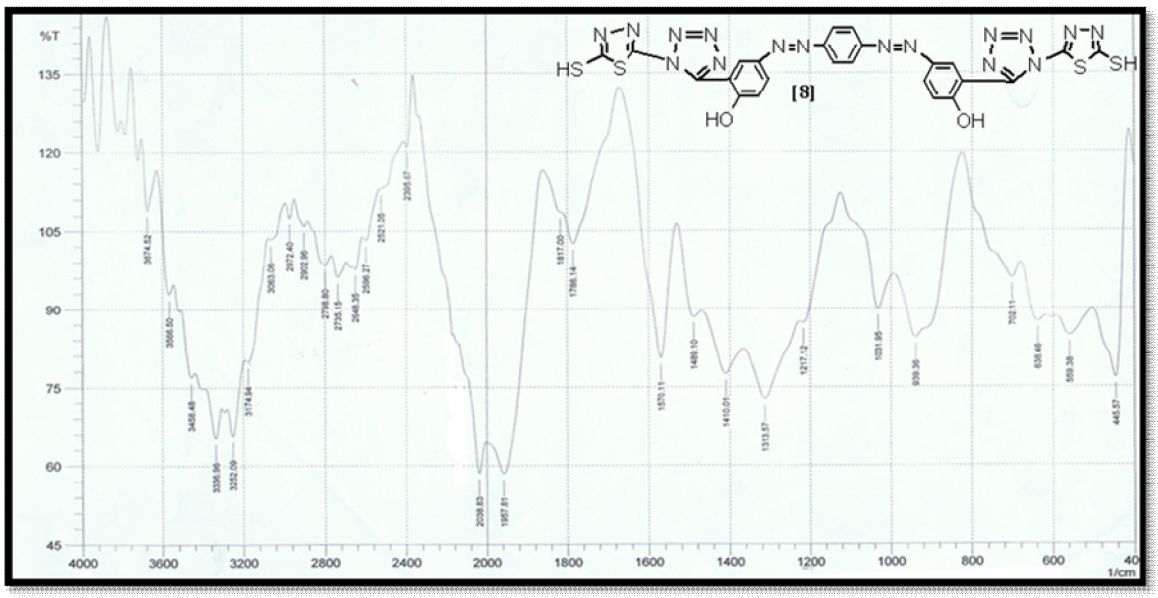



**Fig. 8:FT-IR spectrum of compound [8]**

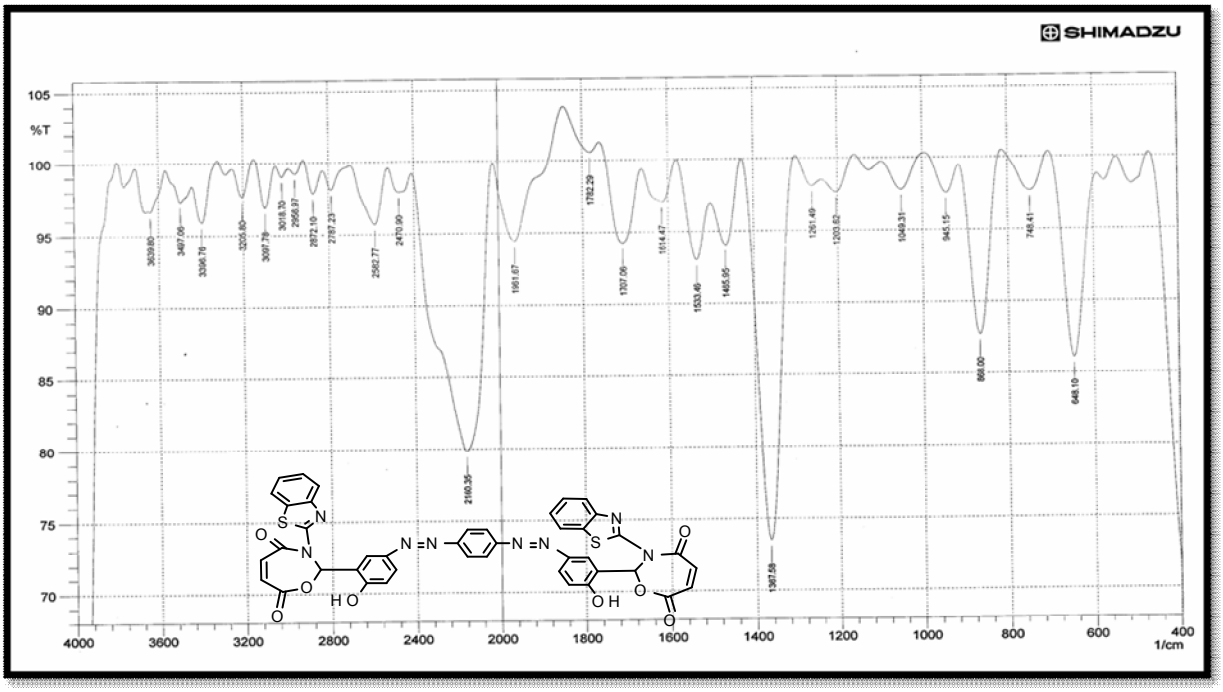



**Fig.9:FT-IR spectrum of compound [9]**

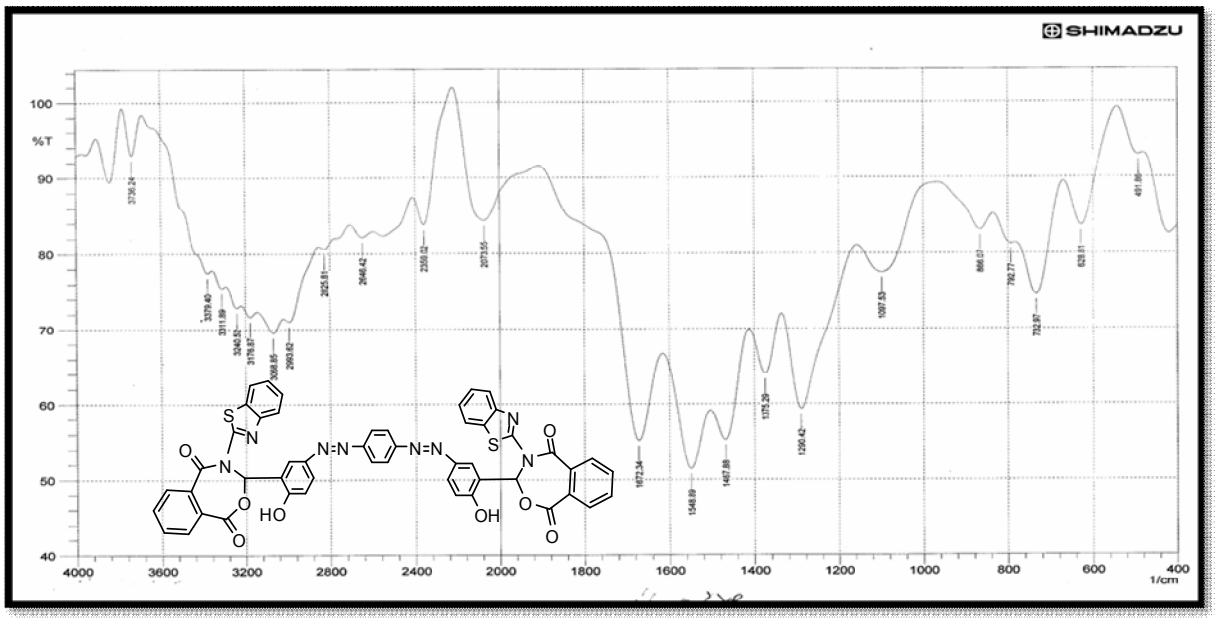



**Fig. 10:FT-IR spectrum of compound [10]**

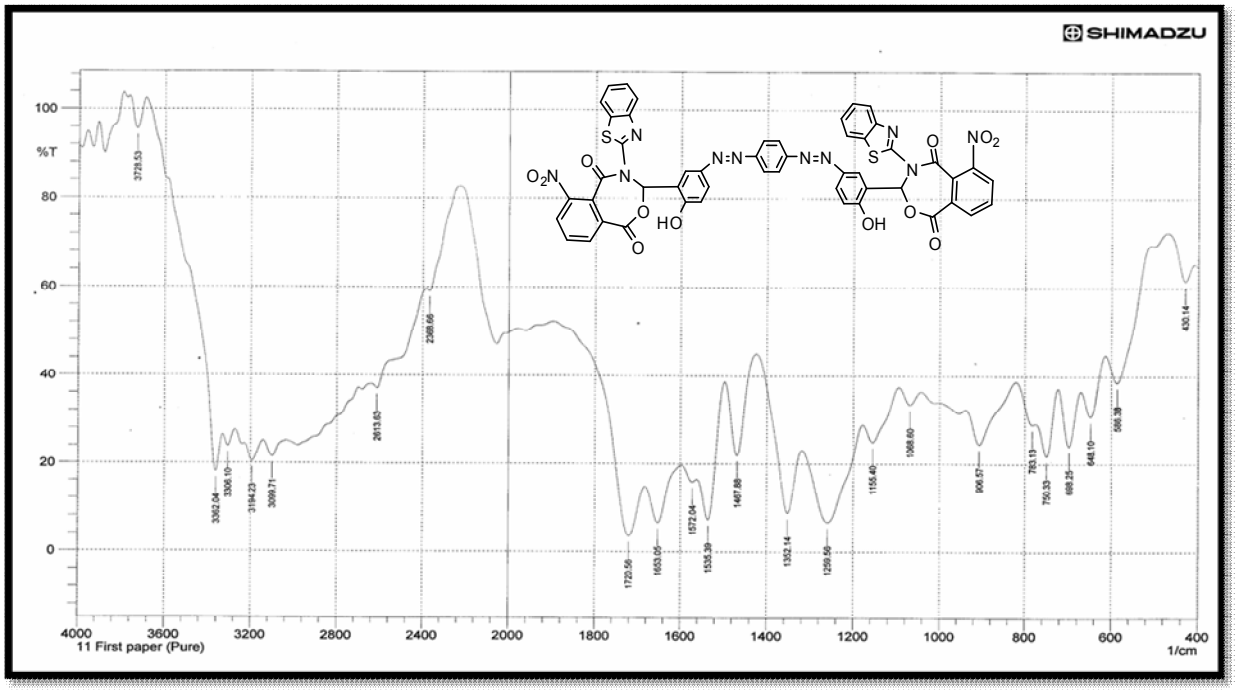



**Fig. 11:FT-IR spectrum of compound [11]**

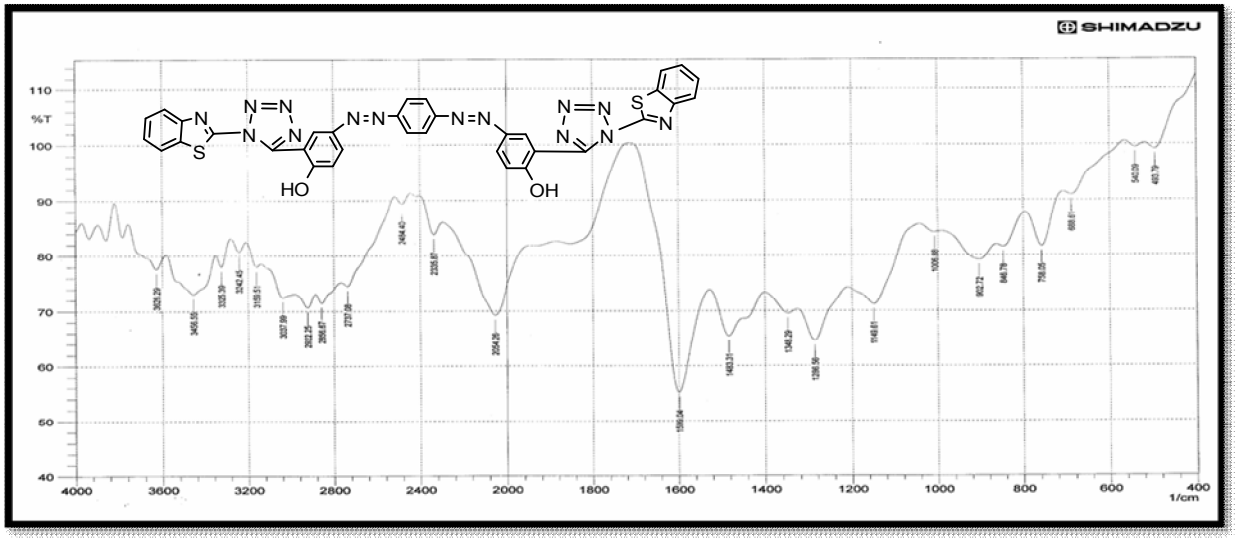



**Fig. 12:FT-IR spectrum of compound [12]**

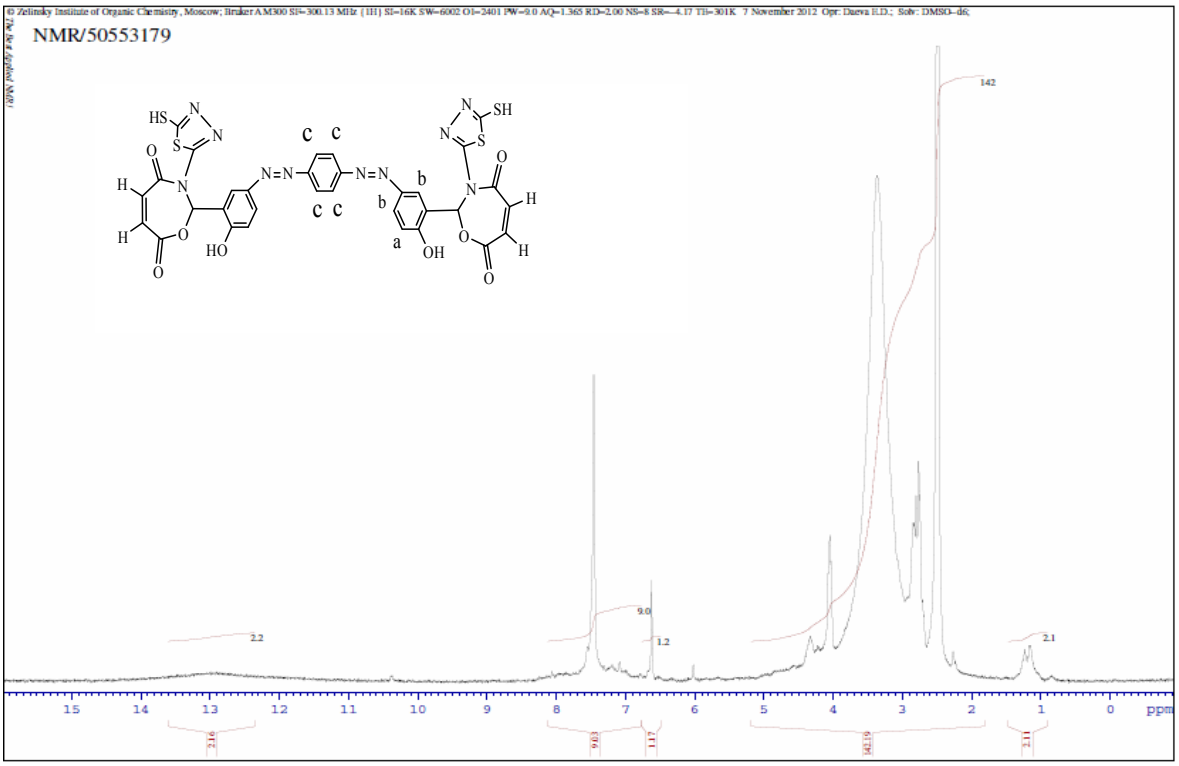



***Fig.13:[1]H NMR spectrum of compound [5]***

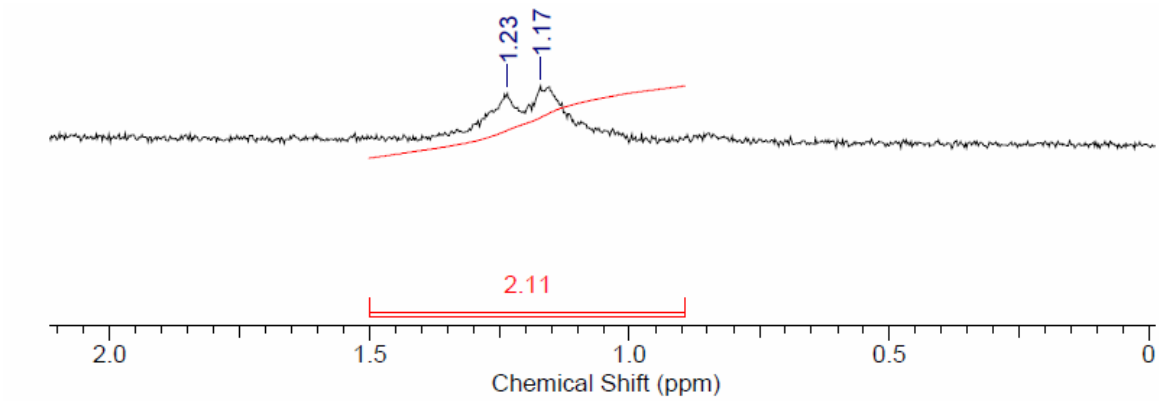



**Fig 13a: expansion [1]H NMR spectrum of compound [5]**

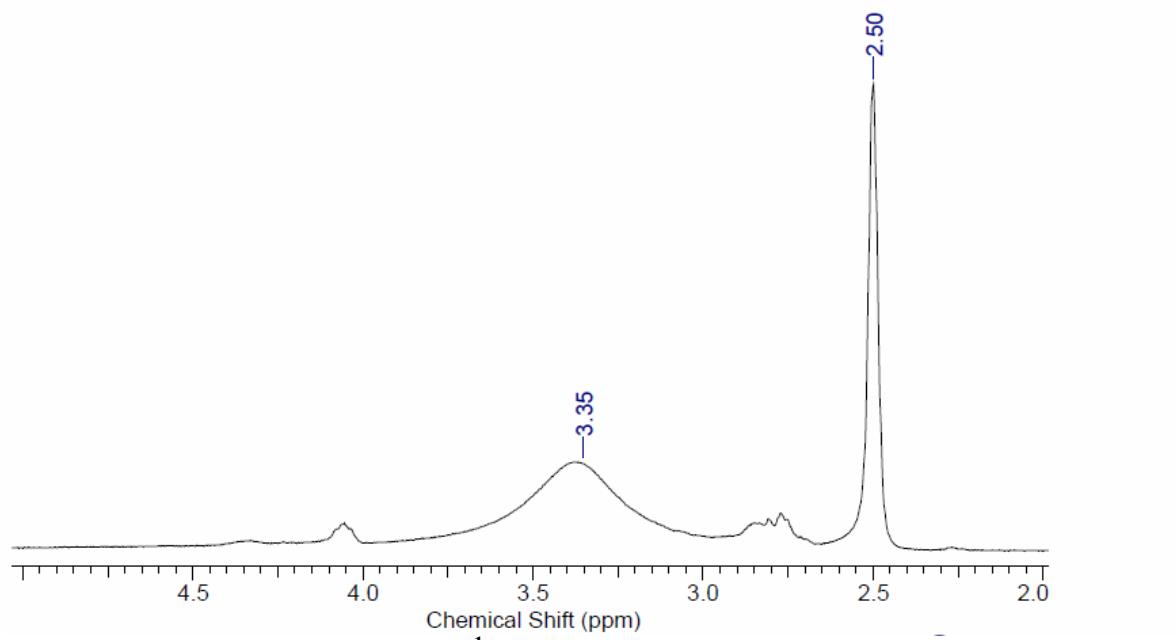



**Fig 13b: expansion $^{1}$H NMR spectrum of compound [5]**

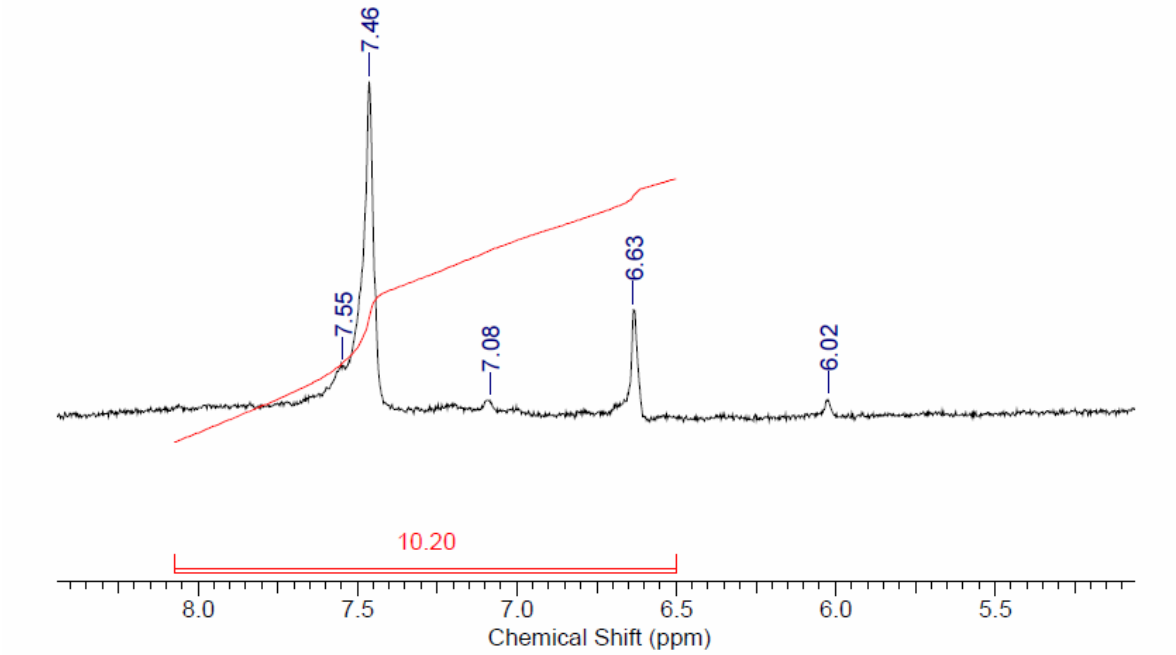
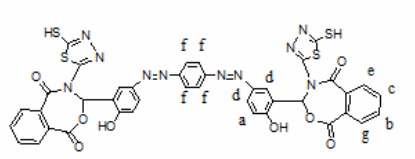



**Fig 13c: expansion $^{1}$H NMR spectrum of compound [5]**



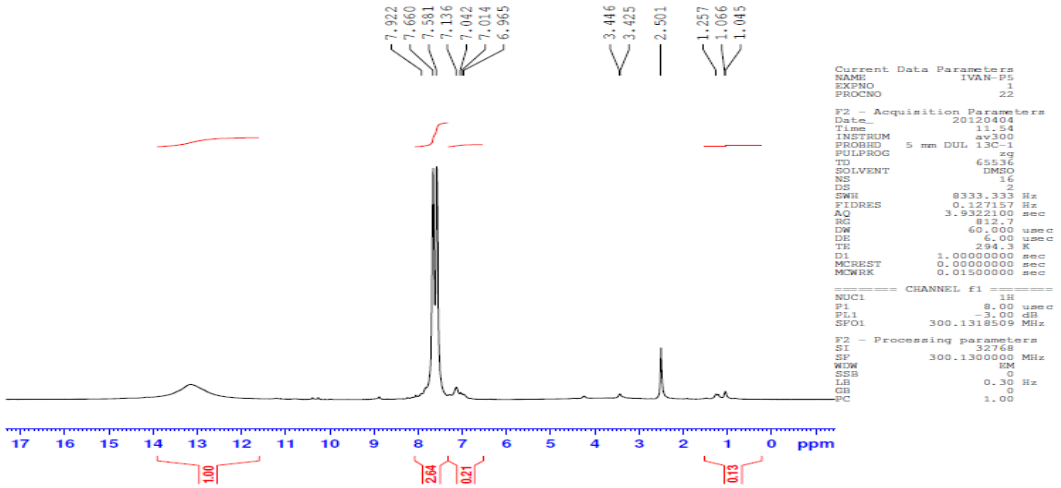



**Fig . (14) : $^{1}$H NMR spectrum of compound [6]**

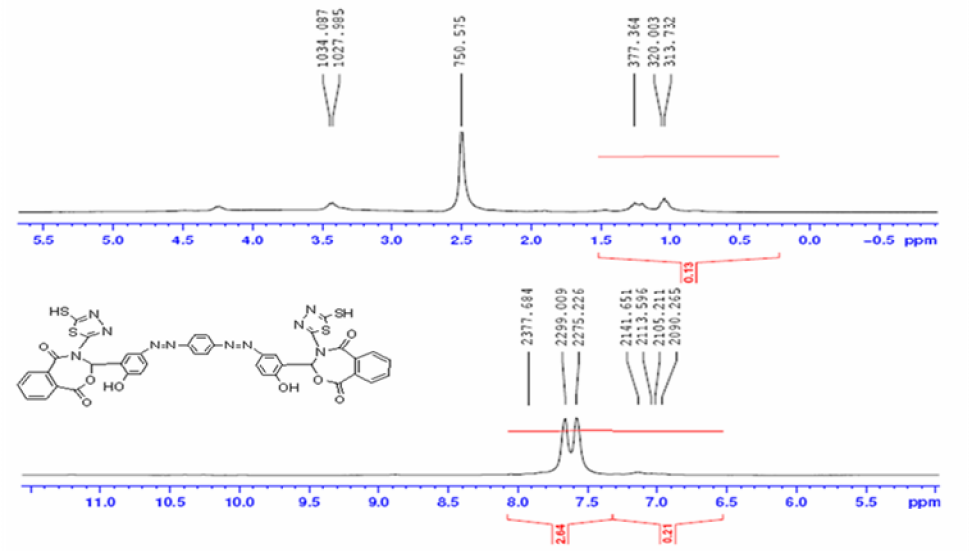



Fig .(14a) :expansion$^{1}$H NMR spectrum of compound [6]

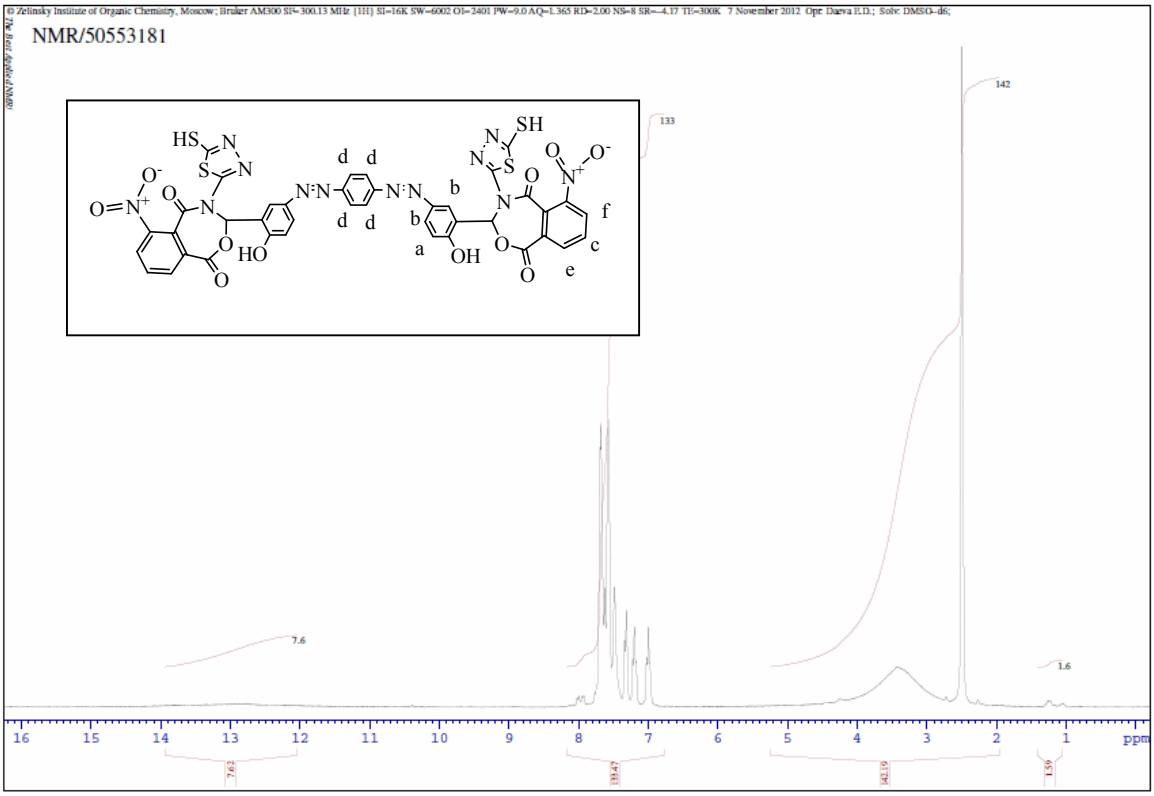



**Fig .15: $^{1}$H NMR spectrum of compound [7]**

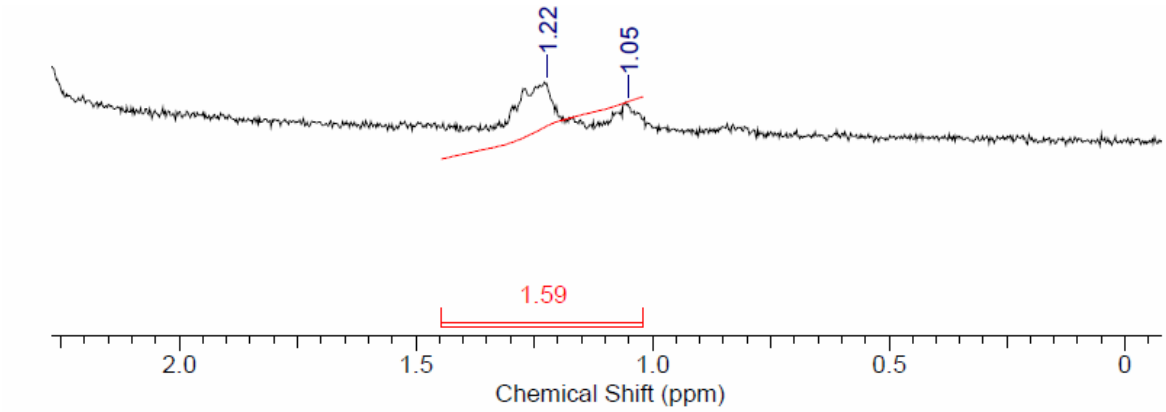



**Fig .15a: expansion$^{1}$H NMR spectrum of compound [7]**

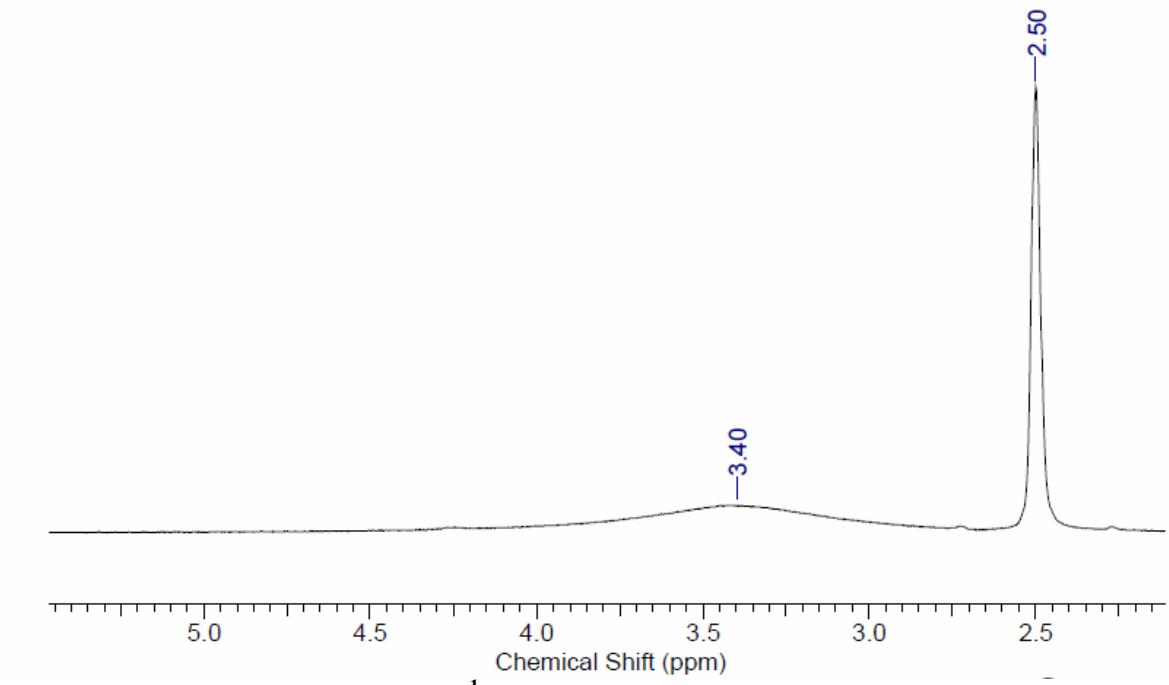



**Fig .15b: expansion$^{1}$H NMR spectrum of compound [7]**

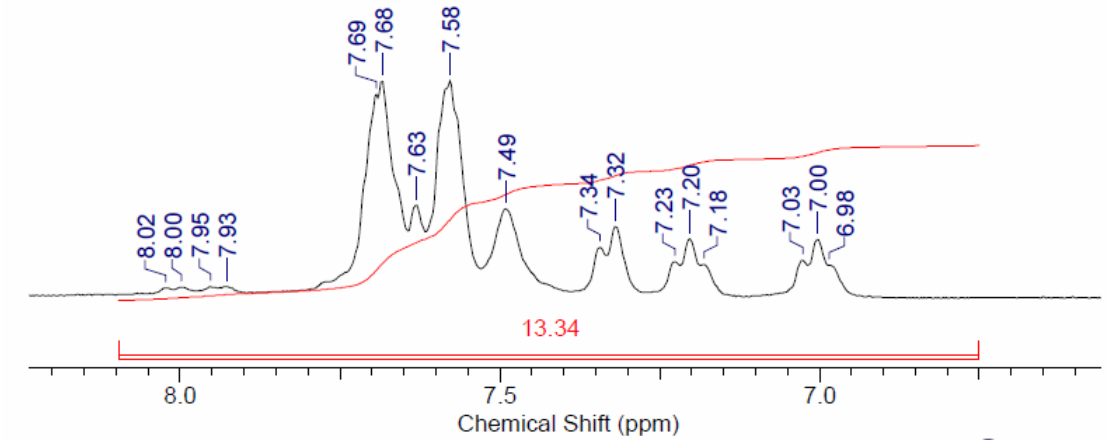



**Fig .15c: expansion$^{1}$H NMR spectrum of compound [7]**

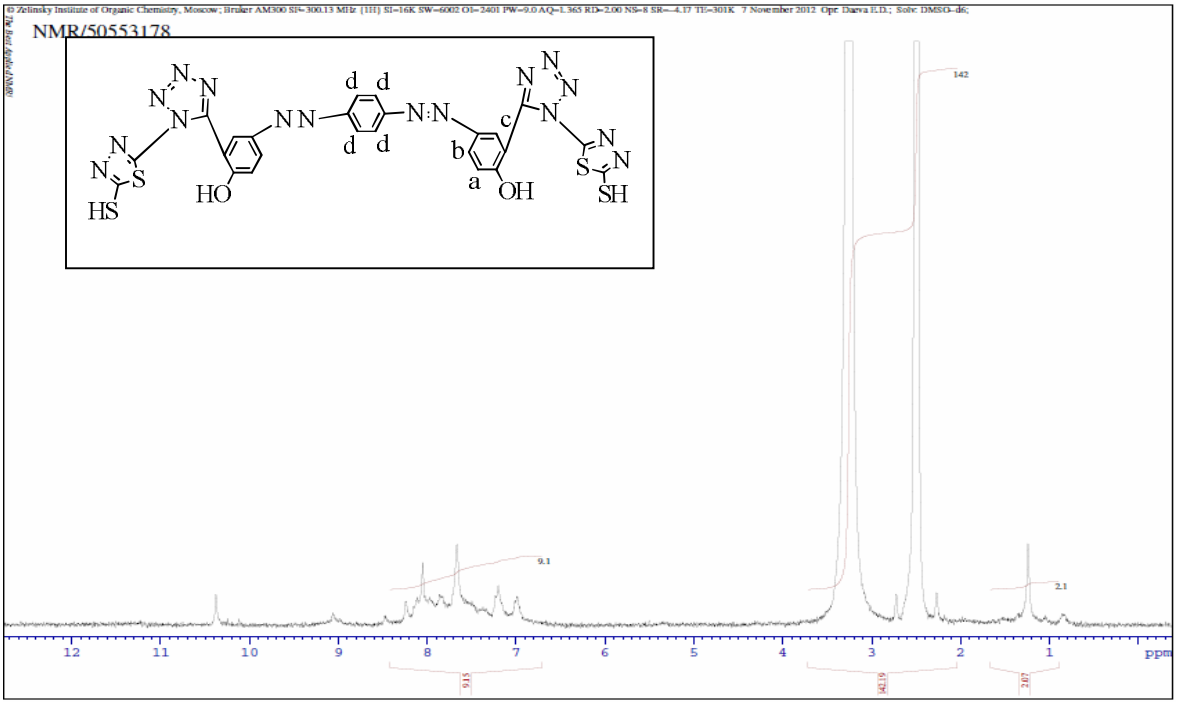



**Fig .16: $^{1}$H NMR spectrum of compound [8]**

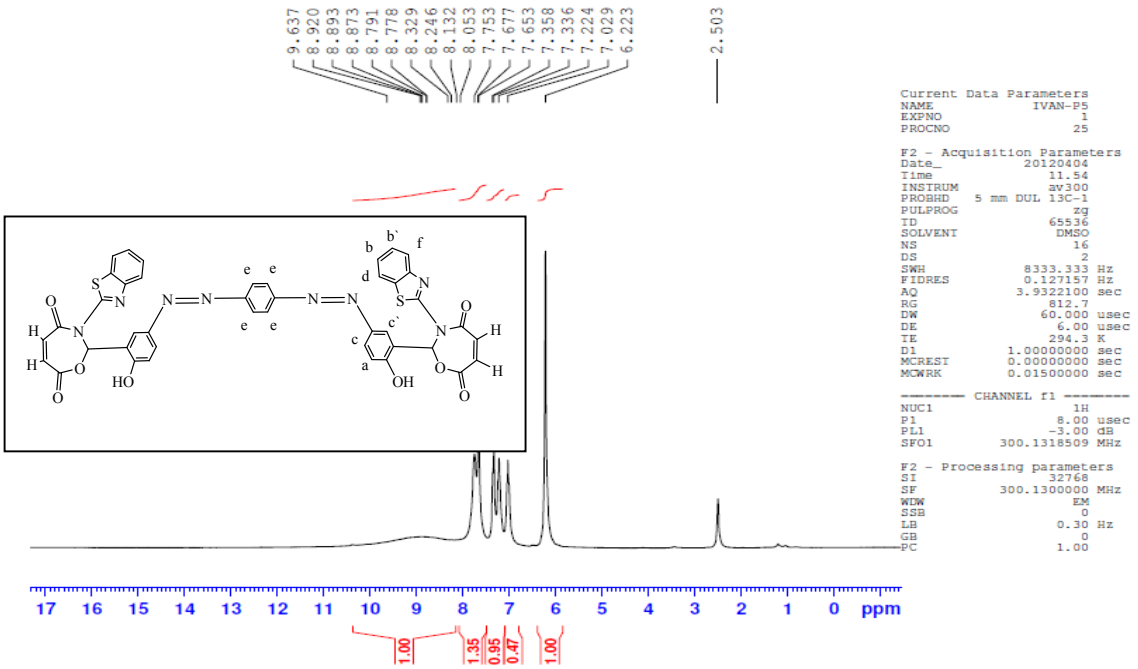
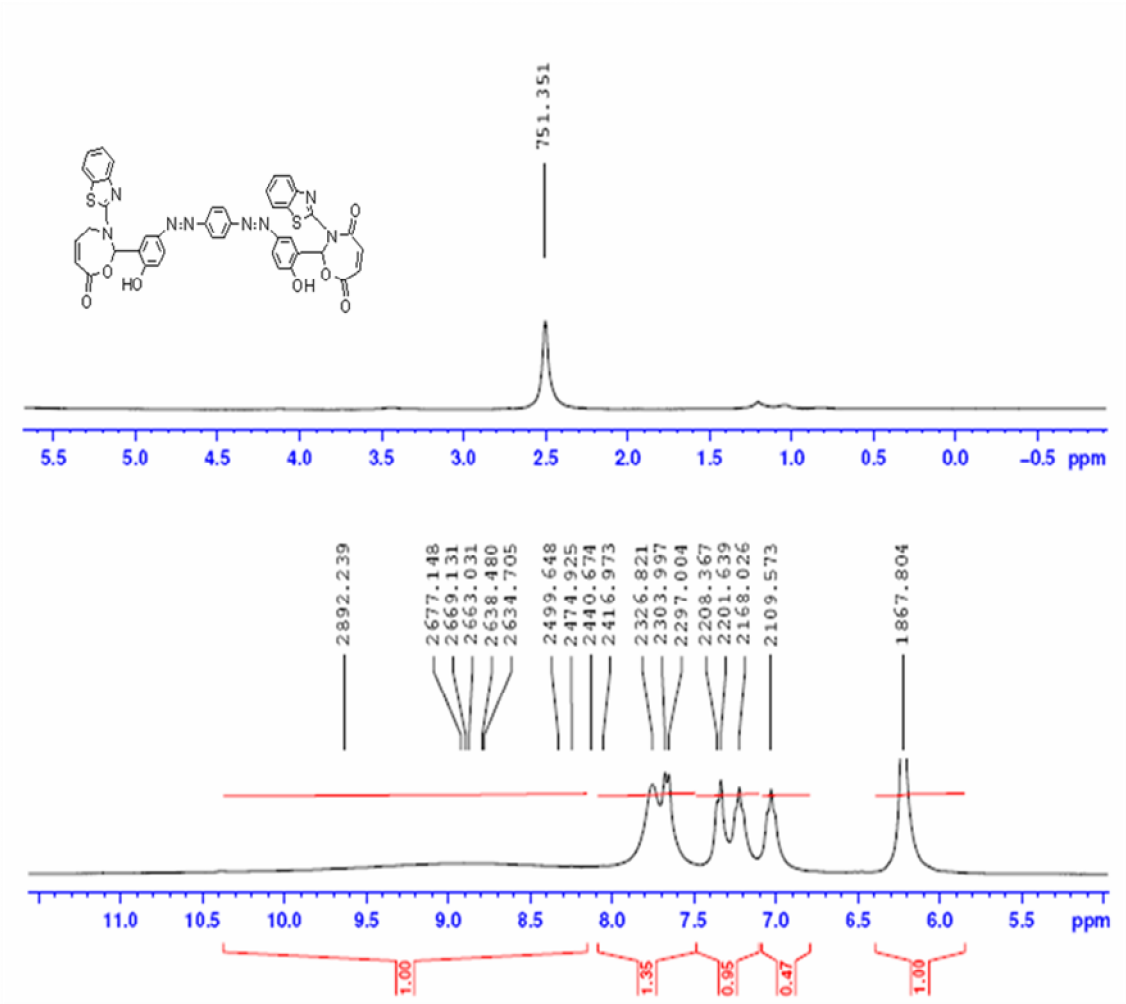



**Fig .17: $^{1}$H NMR spectrum of compound [9]**




**Fig(17a).: expansion $^{1}$H NMR spectrum of compound [9]**

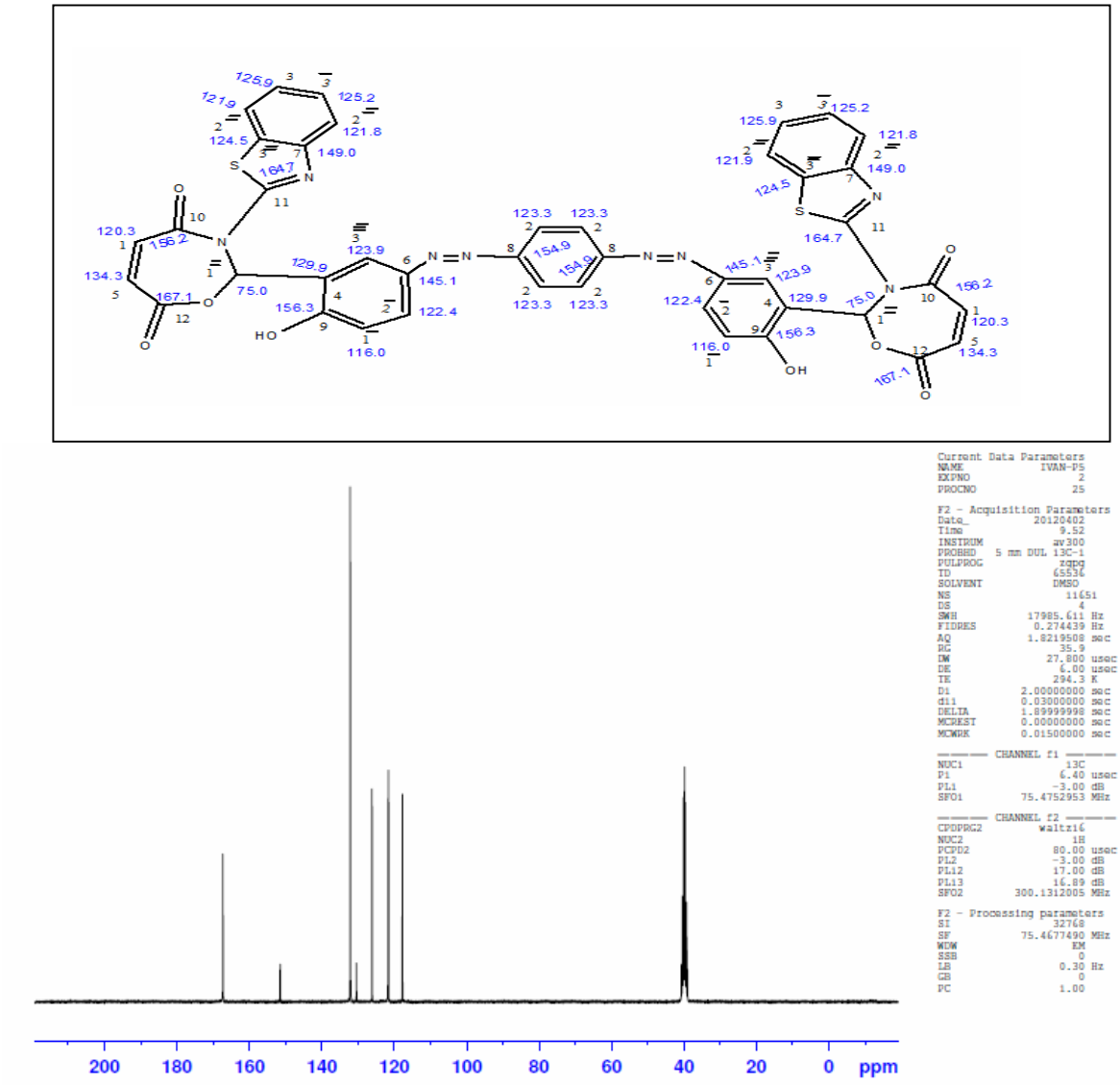



**Fig18: $^{13}$C NMR spectrum of compound [9]**

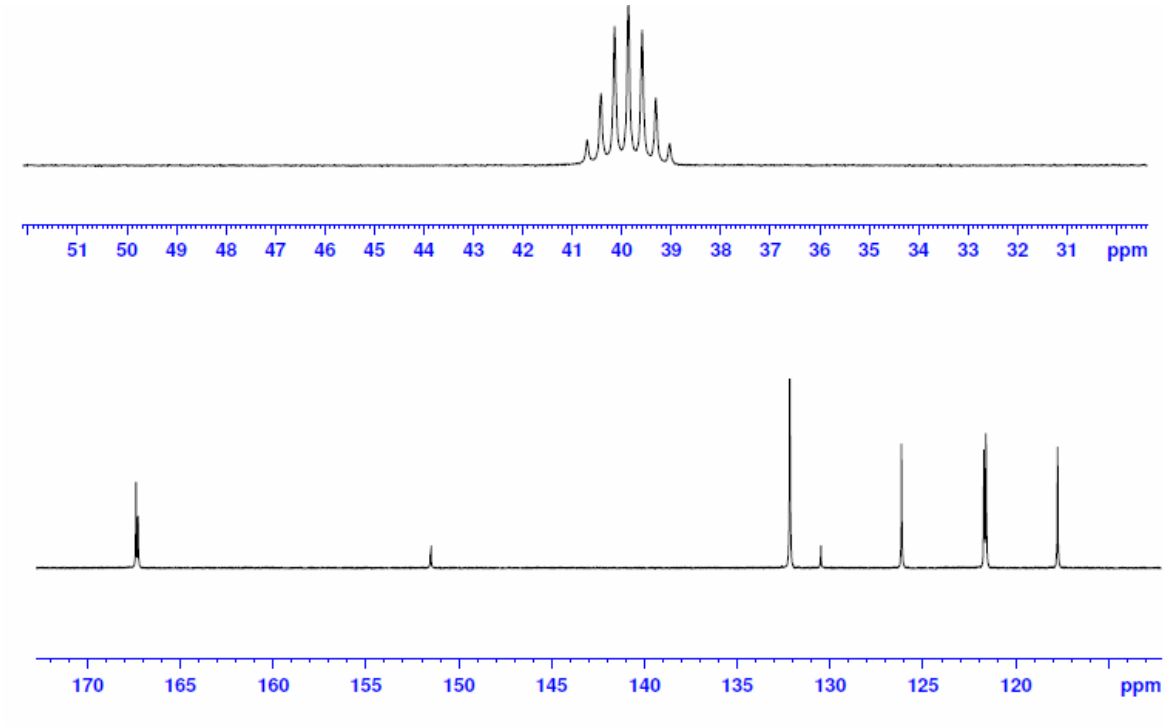



**Fig18a: expansion $^{13}$C NMR spectrum of compound [9]**

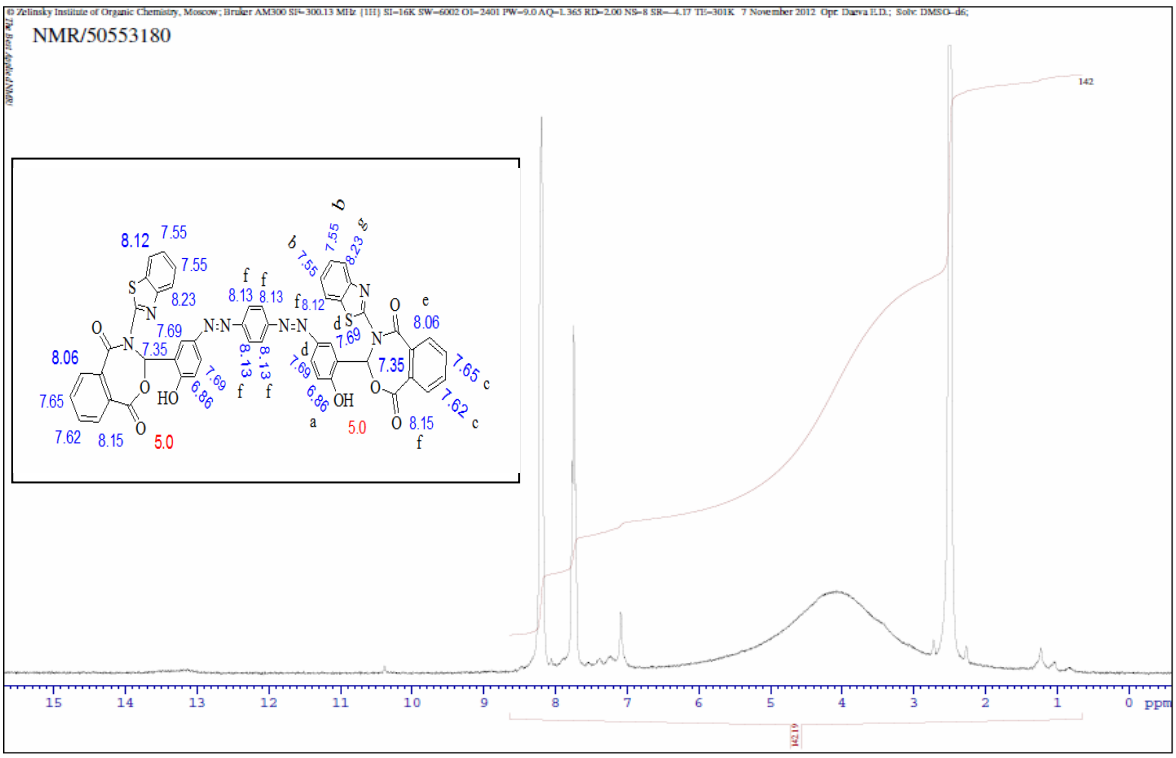



**Fig 19:$^{1}$H NMR spectrum of compound [10]**

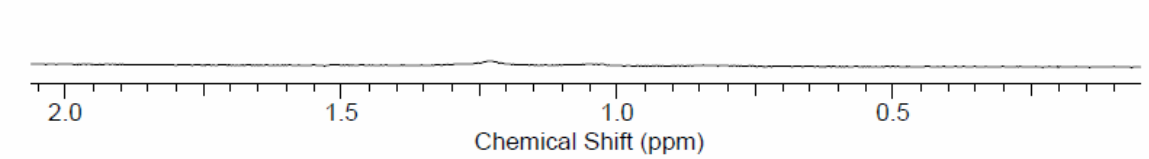



**Fig 19a: expansion$^{1}$H NMR spectrum of compound [10]**

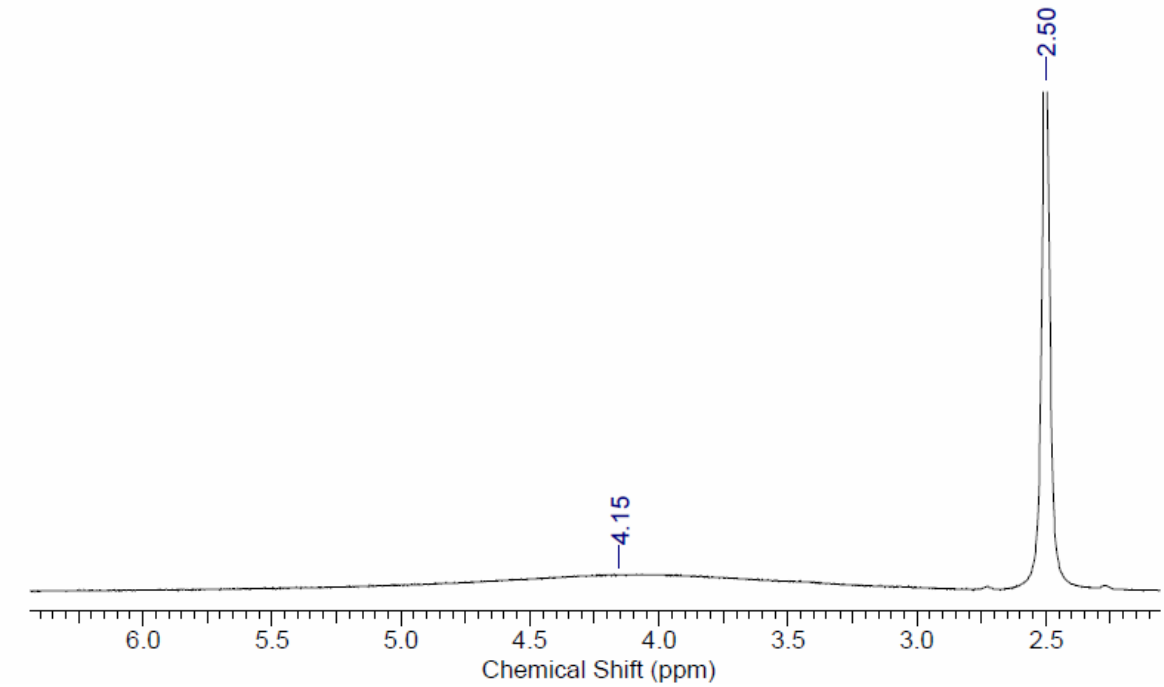



**Fig 19b: expansion$^{1}$H NMR spectrum of compound [10]**

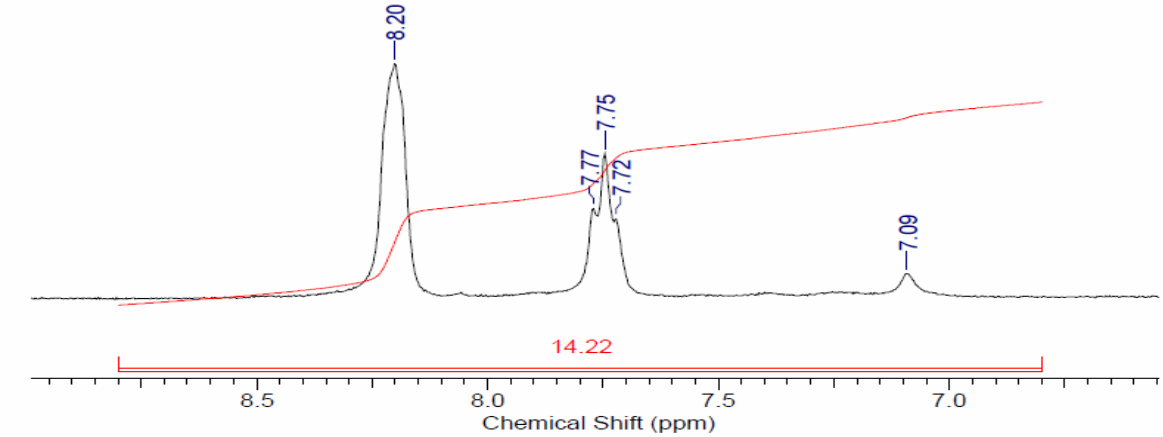



**Fig 19c: expansion$^{1}$H NMR spectrum of compound [10]**

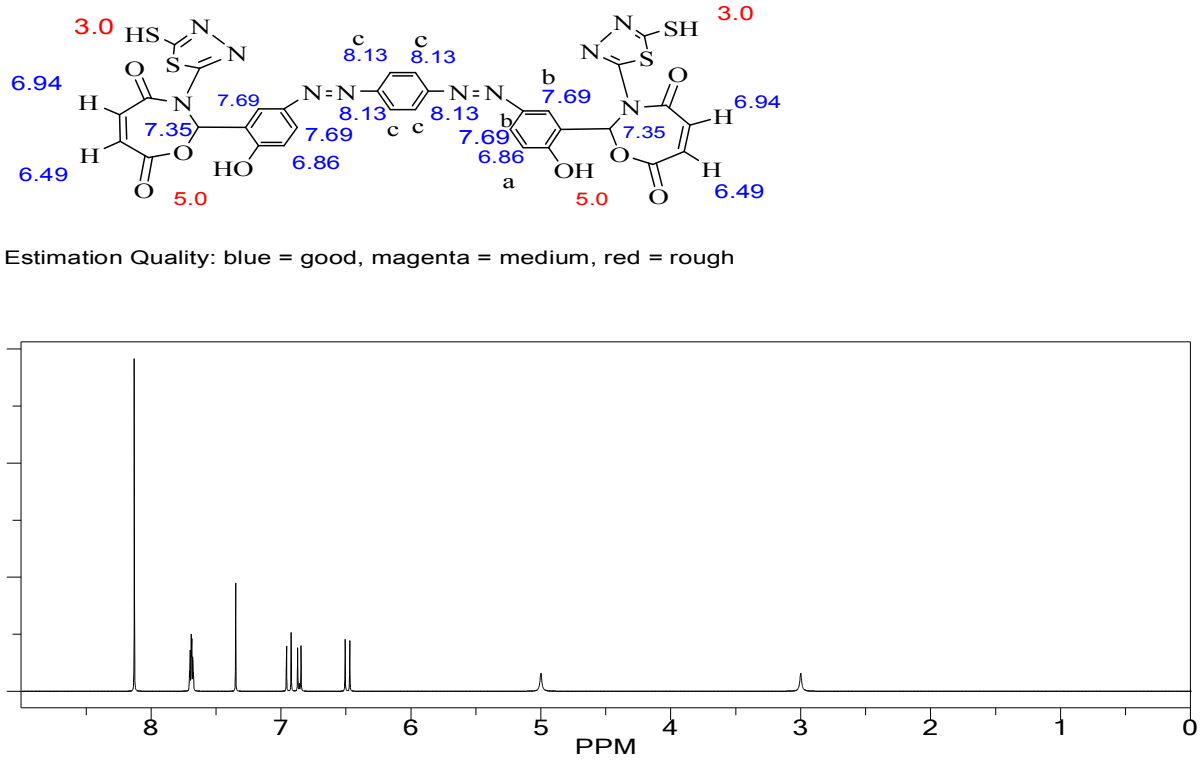
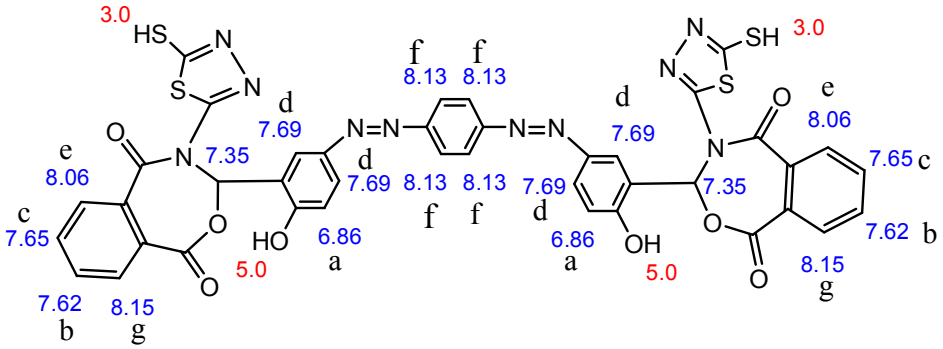



**Fig .20 : theoretical $^{1}$H NMR spectrum of compound [5]**

## ChemNMR H-1 Estimation




Estimation Quality: blue = good, magenta = medium, red = rough

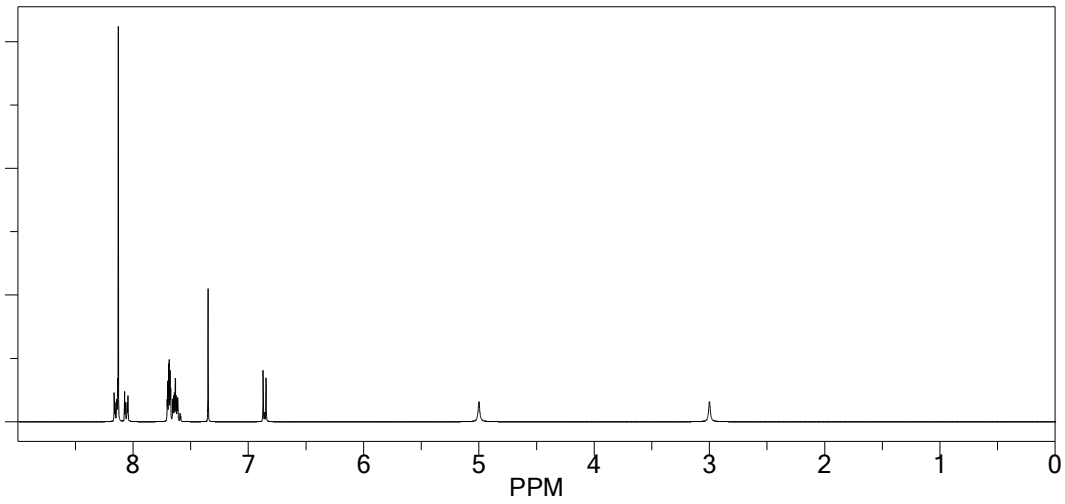
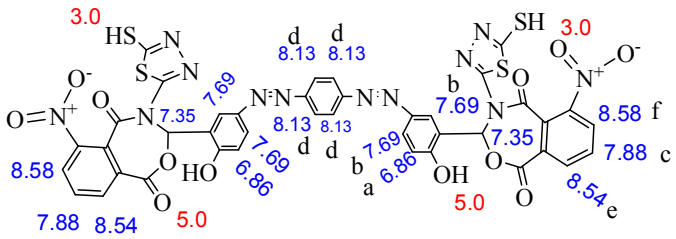



**Fig .21 : theoretical $^{1}$H NMR spectrum of compound [6]**

## ChemNMR H-1 Estimation




Estimation Quality: blue = good, magenta = medium, red = rough

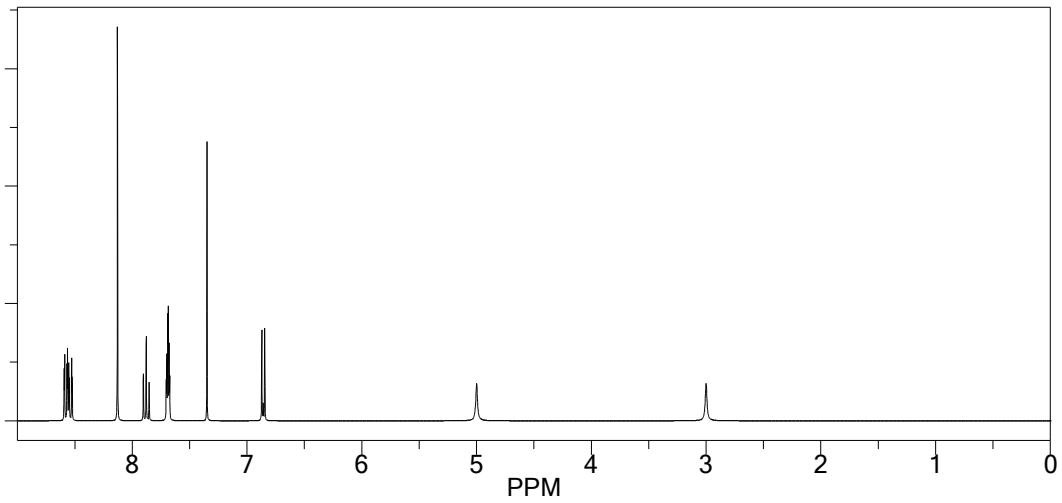
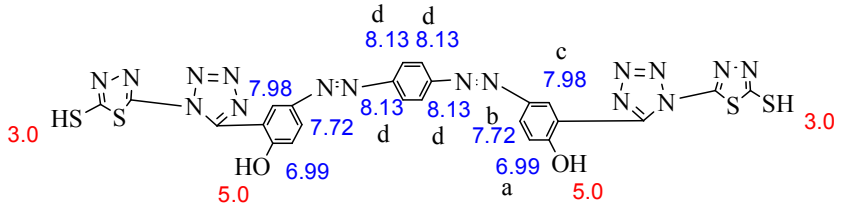



**Fig .22 : theoretical $^{1}$H NMR spectrum of compound [7]**

## ChemNMR H-1 Estimation




Estimation Quality: blue = good, magenta = medium, red = rough

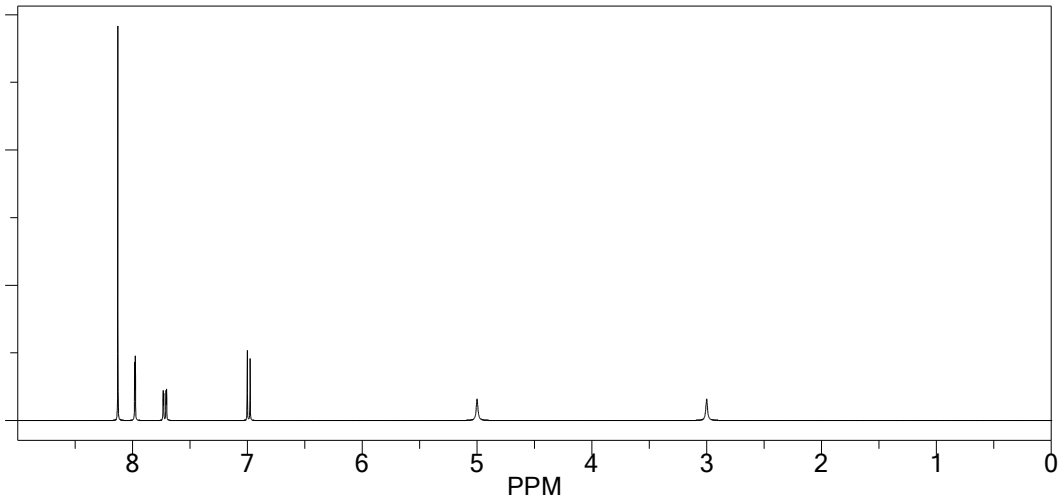
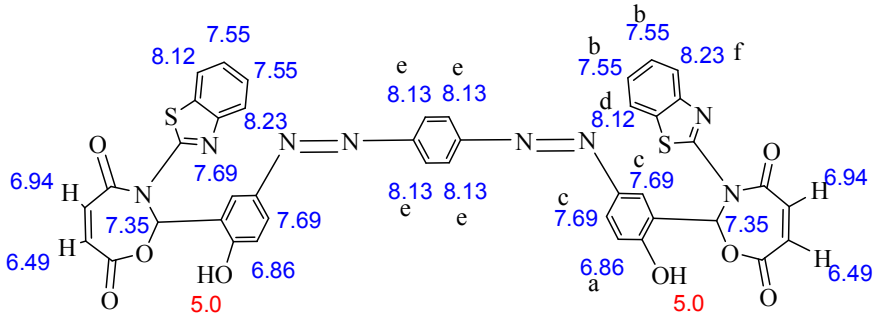



**Fig .23 : theoretical $^{1}$H NMR spectrum of compound [8]**

## ChemNMR H-1 Estimation




Estimation Quality: blue = good, magenta = medium, red = rough

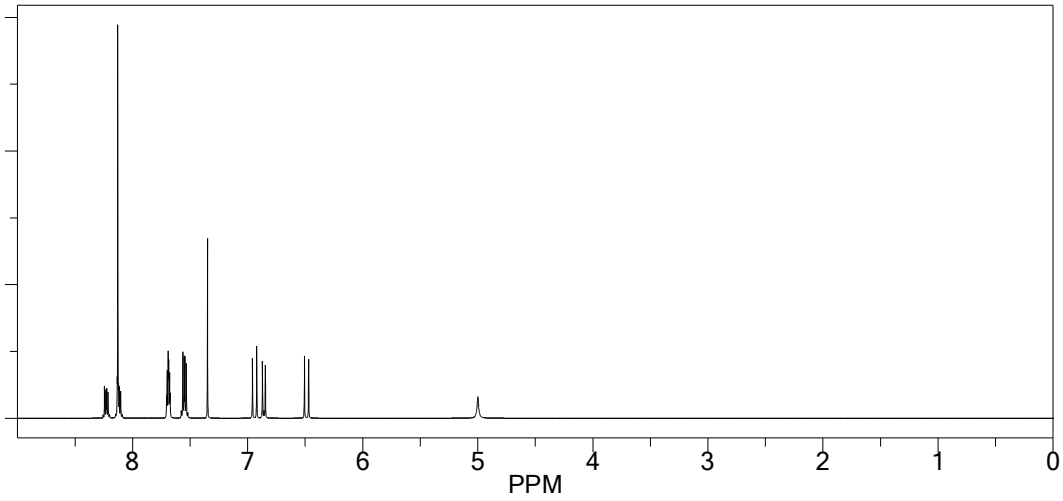



**Fig .24: theoretical $^{1}$H NMR spectrum of compound [9]**

ChemNMR $^{13}$C Estimation

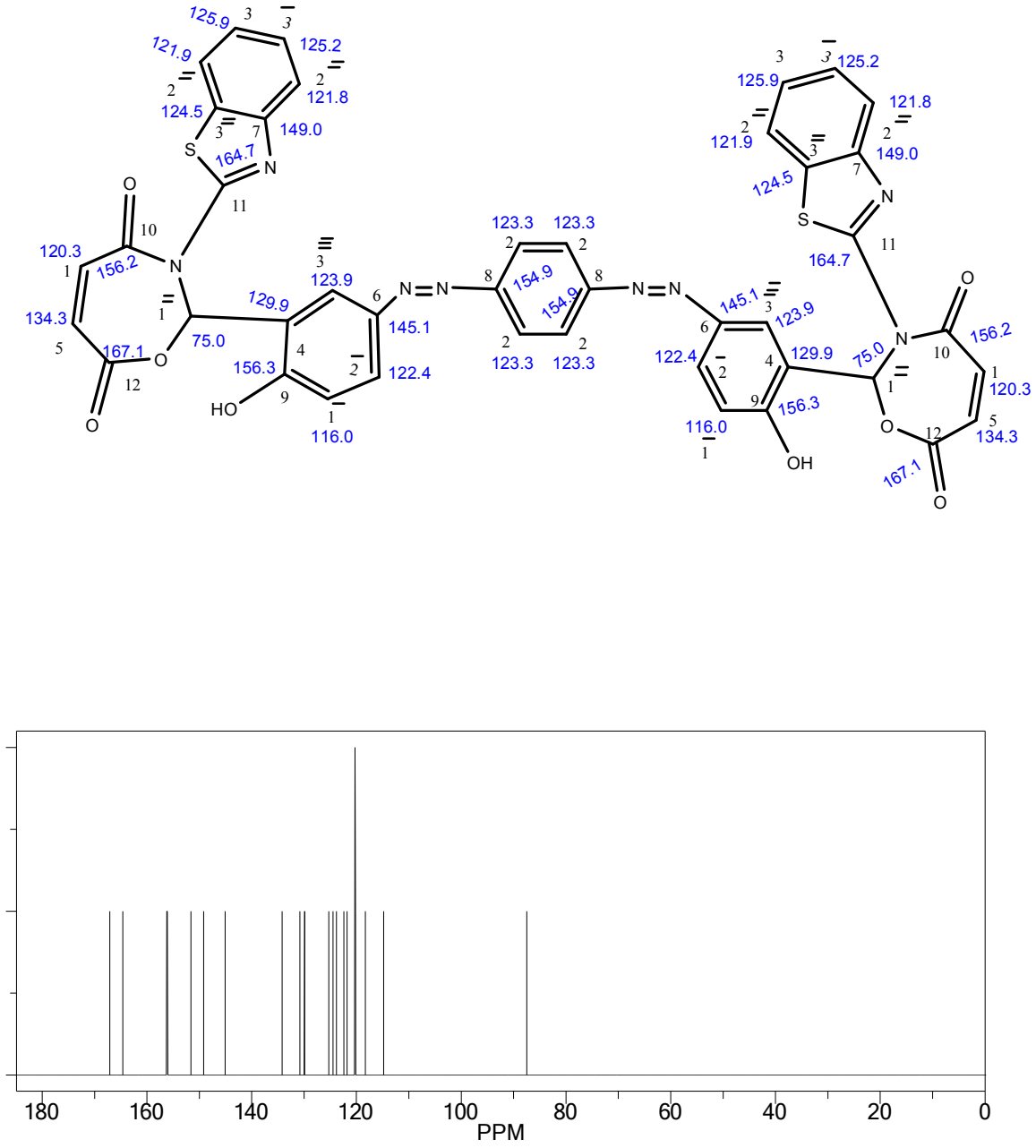
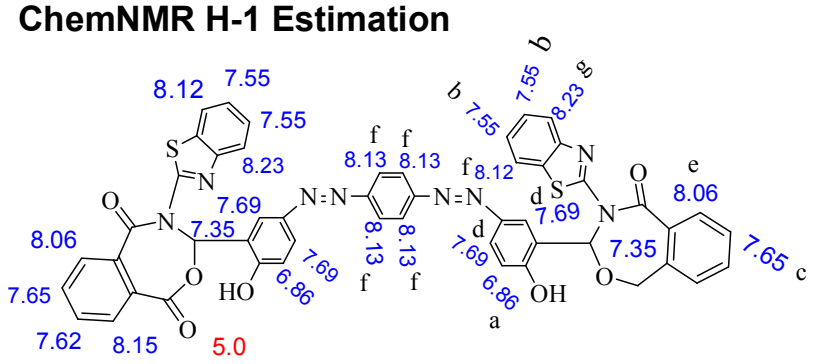



**Fig .25 : theoretical$^{13}$C NMR spectrum of compound [9]**



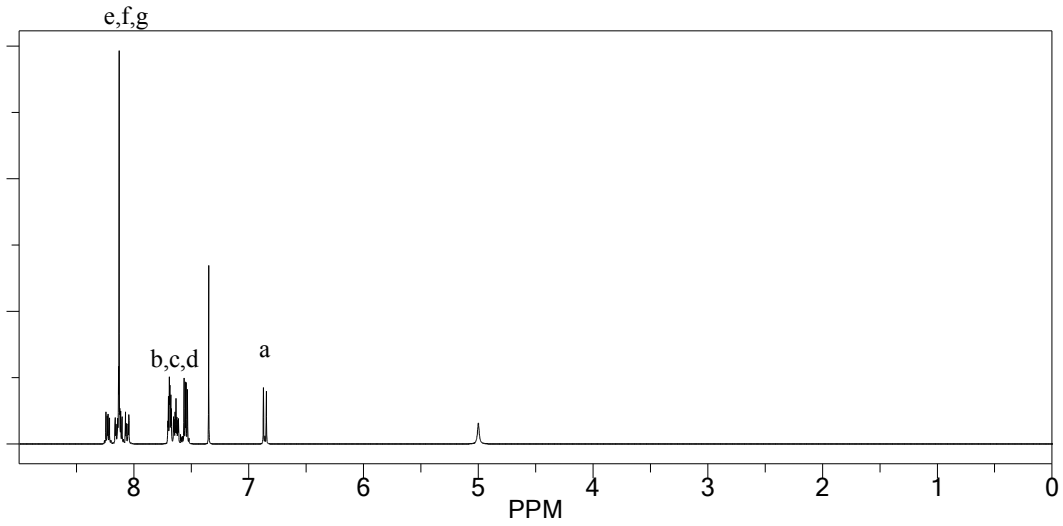




**Fig .26 : theoretical $^{1}$H NMR spectrum of compound [10]**

## References


**1**. M. H. Serrano-Wu, D. R. St. Laurent and Y. Chen., ***Bioorganic and Medicinal ChemistryLetters*****,** 2002, **12(19)**, 2757.

**2**. L. Smith, W. C. Wong and A. S. Kiselyov,***Bioorganic and Medicinal Chemistry Letters*****,** 2006, **14**,722.

**3.** P. G. Blain, ***Toxicological Reviews*****,** 2003, **22**, 2, 103.

**4**. G.Y.Yeap, A.T.Mohammad and H.Osman, ***J. of Molecular Structure*****,** 2010, **982**, 33.

**5.**Buchardt, C.L. Pedersen and N. Harrit, ***J.Org. Chem.*****,** 1972, **37**, 23, 3592.

**6.** O. Tsuge , K. Oe and T. Ohnishi , ***Heterocycles*****,** 1982, **19**, 9, 1609.

**7.**A.T.Mohammad,H.Osman and G,Y.Yeap,***Internatio.J.of Spectroscopy*****,** 2011,**1155**,945216.

**8**.I.A.Yass,***Kerbala.J.Pharm.Sci.*****,** 2010, **1**, 49.

**9.** Z. H. Abood, R.T.Haiwal and H.T.Ghanem***, J.ofUniversity of Babylon*** **,** 2013,**21**,1, 181.

**10**. H.D.Hanoon, ***National J. of Chemistry*****,** 2011, 41, 21, 77.

**11**.A.J.Mahrath,S. A.Aowda and S.N. Kamil , ***J.ofUniversity of Babylon*****,** 2013**, 21**,1, 156.

**12**. B. V. SubbaReddy, N. Majumder, T. P.Rao and B.Sridhar,***Tetrahydron Letters*****,** 2012,**53**,2273.

**13**. F.Himo,Z.P.Demko,L.Noodleman and K.B.Sharpless,***J.Am.Chem.Soc.*****,** 2001**, 224**,12210.

**14**. Z.N.Tisseh,M.Dabiri,M.Nobahar and H. R. Khavasi, ***Tetrahydron*****,** 2012, **68**, 1769.

**15**.V.H.Bhaskar and P.B.Mohite, ***J. ofOptoelectronics and Biomedical Materials*****,** 2011, **3**,1,7.

**16**.M.C.Sharma,D.V.Kohli and S.Sharma, ***J.ofOptoelectronics and BiomedicalMaterials*****,** 2010, **2**,2,45.

**17**.B.J.Al-Hourani, S. K. Sharma, M. Suresh and F.Wuest, ***Bioorganic and Medicinal Chemistry Letters,*** 2012, **22**, 2235.

**18**.T. Jin, S. Kamijo and y. Yamamoto**,** ***Tetrahydron Letters*****,** 2004, **45**, 9435.

**19.**K.Koguro,O.Toshikazu,M.Sunao and O.Ryozo, ***Synthesis*****,** 1998, 910.

**20**.J.Sauer,R.Huisgen and H.Strum,***Tetrahydron*** ,**1960,**11**,241.

**21**.A. R. Katritzky, C. Cai and N. K. Meher, ***Synthesis*****,** 2007,1204.

**22**.Y.H.Joo and J.M.Shreeve,***Organic Letters*****,** 2008,**10**,4665.

**23**.J. Roh, T. V. Artamonova, K. Vavrova, G. I. Koldobskii and A. Hrabalek. ***Synthesis*****,** 2009,2175.

**24**.B.Das,C.R.Reddy,D.N.Kumar,M.K rishnaiah and R.Narender, ***Synlett*****,** 2010,391.

**25**.J.J.Shie,J.M.Fang,***J.Org.Chem.*****,** 2007, **72**, 3141.

**26**.A. Bunescu, P. B. Hoggan and M. Sancelme, ***Appl. Environ. Microbiology*****,** 2008, **74**, 10, 2976.

**27**.J.Wang,F.Beng,J.Jiang,Z.Lu and L.Wang, ***Tetrahydron Letters***, 2008,**49**,467.

**28**.C.Chorao,F.Charmantray,P.B.Hogg an and M.Sancelme, ***Chemosphere*** **,** 2009,**75**,121.

**29**.R. V. Patel, P. K. Patel, P. Kumari, D. P. Rajani and K. H. Chikhalia, ***EuropeanJ.of Medicinal Chemistry*** 2012, **53**,41.

**30.**A. Padmaja, A. Muralikrishna, C. Rajasekhar and V. Padmavathi, ***Chem. Pharm. Bull,***. 2011, **59,**11,2509.

**31**.N.V.Madhav,A.S.Nayak,J.V.Rao and M.Saranjapani, ***J. of Pharmacy Research*****,** 2011,**4,**5,1396.

**32**.T.Singh,D.Kumar,H.Samal and P.Sudhakar,***International Research J. of Pharmacy*****,** 2012, **3,**4,390.

**33**.N.F.Eweiss and A. A. Bahajaj, ***J.Heterocyclic Chem.*****,** 1987, **24**,1173.

**34.**P.Guan,F.Sun,X.Hou,F.Wang,F.Yi,W. Xu and H.Fang,***Bioorganic and Medicinal Chemistry*****,** 2012,**20**,3865.

**35**.M.Uher and D. Berkes, ***Chem. Papers,*** 1999, **53**,3,215.

**36**.M.R.Yazdanbakhsh,H.Yousefi,M.Ma maghani,E.O.Moradi,M.Rassa,H.Poura mir and,M.Bagheri,***J.of Molecular Liquids*****,** 2011**, 269**,21.

**37.**H.Z.Shams,R.M.Mohareb,M.H.Helal and A.E.Mahmoud, ***Molecules*****,** 2011, **16**,6271.

**38**.C.D.Kwong,J.L.Clark,A.T.Fowler,F.G eng,H.S.Kezar,A.Roychowdhury,R.C. Reynolds,J.A.Maddry,S.Ananthan,J.A. Secrist,N.Shin,J.J.Piwinski,C.Li,B.Feld ,H.Huang,X.Tong,F.G.Njoroge and A. Arasappan, ***Bioorganic and Medicinal Chemistry Letters*****,** 2012, **21,** 2160.

**39.**R.M.Silverstein,G.C.Bassler and D.J.Kiemle"**Spectroscopic identification of Organic Compounds**"**2005**,7th Ed., John Wiley and Sons, Inc,NJ,USA.

**40**.V.K.Ahluwalia and R.K.Parashar "**Organic Reaction Mechanisms**"**2011**,4th Ed.,Narosa Publishing House Pvt. Ltd., New Delhi ,603**..**