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Research Article

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Synthesis and identification of some derivatives of 1,3,4-thiadiazole

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ABSTRACT

This research involved synthesis heterocyclic compounds such as (1,3,4- thiadiazole derivatives , imidazolidine derivatives, tetrazole derivatives, oxazepine derivatives and β-Lactam derivatives) were prepared by reaction 4-aminobenzoic acid with phenol in Acidic medium ,(0-5)C^{O} and sodium nitrate to get azo derivative (1) which react with thiosemicarbazide to get 1,3,4- thiadiazole derivative (2). Derivative (2) react with benzaldehyde derivatives (4-nitrobenzaldehyde , 2-hydroxy benzaldehyde , 2-bromobenzaldehyde , 4-hydroxybenzaldehyde ,benzaldehyde ,4-dimethyl amino benzaldehyde, 4-Chlorobenzaldehyde and vanillin) to get shiff base (3-10). The cyclization of Shiff base Derivatives (3,4) with α-aminoacid (tryptophan and leucine) Consecutive give the corresponding imidazolidine derivatives (11,12),and when cyclization of Shiff base Derivative (5) with sodium azide give tetrazole derivative (13). Shiff base Derivatives (6,7,8) react with (Itaconic, succinic anhydride and malic anhydride) Consecutive to give oxazepine derivatives (14,15,16) Consecutive. cyclization of Shiff base Derivatives (9,10) with chloroacetylchloride give the corresponding β-lactam (17,18). All this compounds characterized by means of FT-IR, and some of the compoundes by means 1H-NMR, and 13C-NMR and follow reaction by Rf - TLC and Measure ment melting point.

Key words: Thiadiazole, Thiazolidin, Imidazolidin, tetrazole, oxazepine β-Lactam

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INTRODUCTION

Azo compounds composed of two neighborhood nitrogen atoms connected with double-bond(-N=N-) The starting materials of azo compound preparation is the diazonium salts, which are more important in the synthesis of different pure organic compounds.[1,2]

Azo compounds of Schiff bases and their derivatives have been used in preparation other compounds such as (1,3,4- thiadiazole derivatives, imidazolidine derivatives, tetrazole derivatives, oxazepine derivatives and β-Lactam derivatives), Heterocyclic play an important role in biochemical processes because the side groups of the most typical and essential constituents of living cells are based on aromatic heterocycles[3].

The triazole derivatives related to an important group of heterocyclic compounds that have been subjected to extensive study of the recent past.

Diverse biological activities such as antibacterial, antifungal, anti-inflammatory, also Oxazine derivatives showed various biological activities, such as antibacterial, Antimicrobial and anticonvulsant activity, as telomerase inhibitors, as Potent agonists of the human TRPV1 receptor inhibitors for some enzymes action, Some of oxazine derivatives are used in another applied fields [5,4].

β-lactam drugs are most widely prescribed antibiotics used in medicine. 2-azetidinone derivative possess wide therapeutic activity like antifungal, anticonvulsant, antitumour, antiviral, cholesterol absorption inhibitior and

enzyme inhibition activities.Also β-Lactam antibiotics (e.g. ampicillin, amoxicillin) are traditionally used for the treatment of common bacterial infections in both humans and food-producing animals. β-Lactam residues in foods can result in the development of new strains of bacteria resistant to these antibiotics and in allevgic reactions.[6]

A number of 2-imino imidazolidine compounds exhibiting the aromatic (heteroaromatic) motif at the exocyclic nitrogen atom, collectively termed 'centrally acting antihypertensive drugs' have been used in medical practice . The classic centrally acting antihypertensives such as clonidine induced peripheral sympathoinhibition concomitant with an increase of the vagal tone and a fall in blood pressure in effect of the a2-adrenoceptor stimulation in the ponto-medullary region of the brainstem [7].

EXPERIMENTAL SECTION

(FTIR)Spectra(4000-400cm-1)in KBr disk were recorded on aSHIMADZU FTIR-8400S fourier.transform. melting point were measured using Stuart, UK.

^{1}HNMR and ^{13}C-NMR were recorded on fourier transformation bruker spectrometer ,operating at (400MHz) with (DMSO-ds) measurments were made at Department of chemistry ,kashan university .Iran.

General method of synthesis of 4-((4-hydroxyphenyl)diazenyl)benzoic acid compound (1) [8]

4-Amino-benzoic acid (0.005 m.mole,0.685gm) of the aromatic amine was dissolved in 5 ml of concentrated HCl and 8 ml of distilled water .The mixture is cooled to $0C^{0}$ and (0.005 m.mole, 0.345gm) of sodium nitrite to added drop wise with continuous stirring. The solution was left for 15 minutes to be stable after completing the addition (0.005 m.mole , 0.27gm) of phenol dissolved in(1 gm NaOH in 50ml H_2O) was added, a brown precipitate was formed, filtered and recrystallised from ethanol.

General method of synthesis of) 4-((4-(5-amino-1,3,4-thiadiazol-2-yl)phenyl) diazenyl) phenol compound (2) [9]

In a 100 ml round bottom flask was placed a mixture of (0.0185 mole , 4.5gm) of shiff base(1) and (0.0185mole, 1.6926gm) thiosemacarbazide in 8 ml of phosphorous oxychloride,The reaction mixture was (3h), after that the soulution coolded and add (40ml) distell water ,after that refluxed (4h) . the reaction mixture was coolded and kept at(24h) .the solvent was then removed and the resulting solid was recrystallized from ethanol to give compound (2).

General method of synthesis of schiff bases compounds (3-10)[10]

A mixture of equimolar quantities (0.01mol) of aromatic benzaldehyde derivatives and (2) was refluxed for(2-3)h in 30 ml of ethanol. The reaction mixture was cooled and kept for (24 hs) . The crystals found was filtered , dried and recrystallized from ethanol to give compounds (3-10)

General method of synthesis of imidazolidin-4-one derivative (11,12)[11]

A mixture of schiff bases(3,4) (0.001mol) dissolved in THF (15mL) and (tryptophan ,leucine)consective (0.001mol)was dissolved in THF (15mL)and refluxed for 24 hs.The reaction was then cooled and the resulting final (11,12) consecutive ,recrystallized from ethanol.

Method of synthesis) (E)-4-((4-(5-(5-(2-bromophenyl)-2,5-dihydro-1H-tetrazol-1-yl)-1,3,4-thiadiazol-2-yl) phenyl)diazenyl)phenol (13)[12]

A mixture of schiff bases(5) (0.001mol, 0.464 gm) dissolved in THF (15mL) and (sodium azide) (0.001mol)was dissolved in THF (15mL)and refluxed for 12 hs.The reaction was then cooled and the resulting final (13),recrystallized from ethanol.

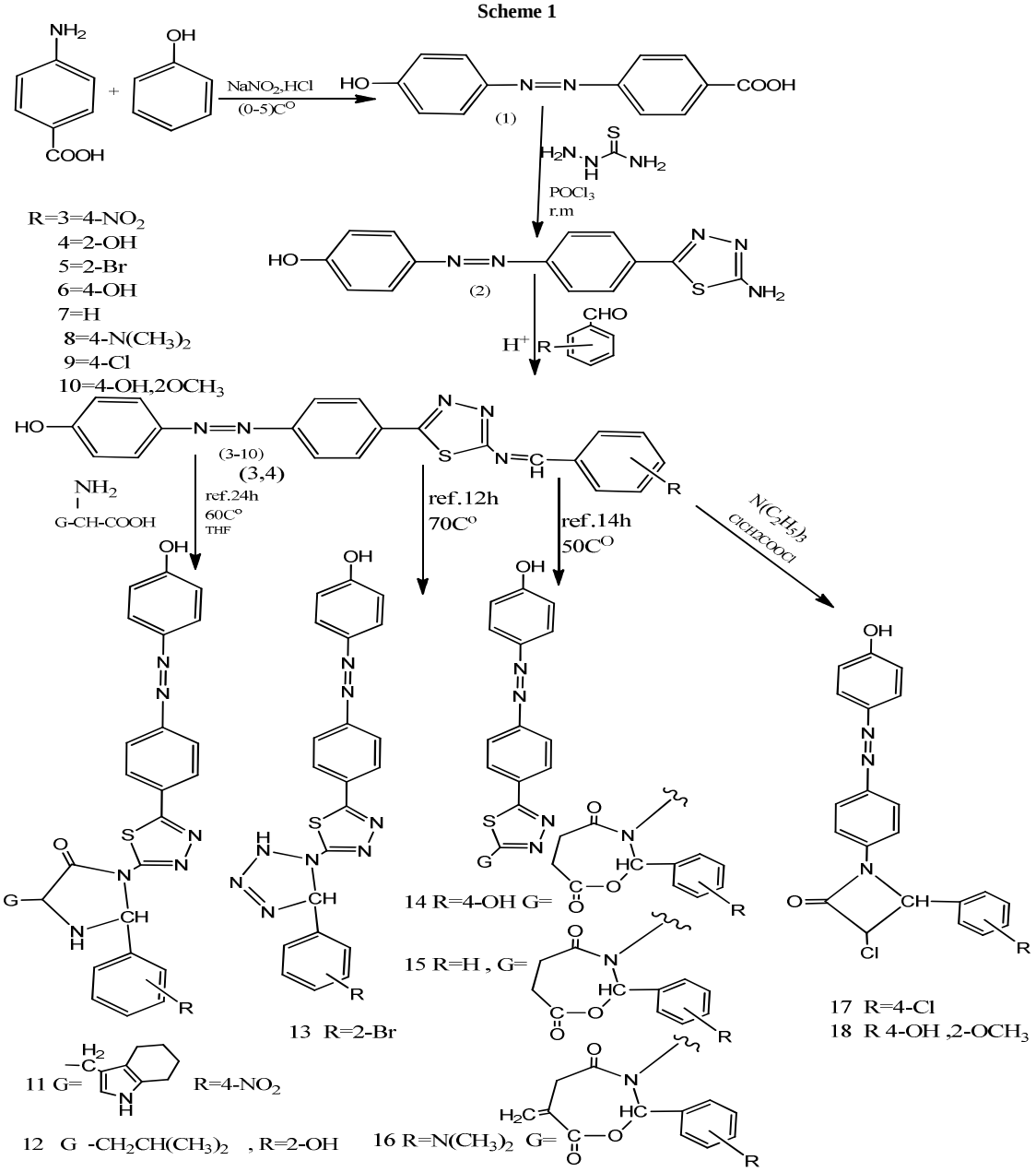
General method of synthesis of oxazepine (14-16) [13]

In a 100 ml round bottom flask equipped with double surface condenser fitted with calcium chloride guard tube was placed a mixture of 0.01 mole of shiffbase (6,7,8)and 0.01mole (itaconic ,succinicnhydride , malicanhydride) consecutive in 20 ml of Ethanol absolute.The reaction mixture was refluxed in water bath at $78C^{\circ}$ 3he, the solvent was then removed and the resulting solid was recrystallized from anhydrous THF to give compounds (14,15,16) consecutive.

General method of synthesis of azetidinones (17,18) [14]

A mixture of schiff bases(9,10) (0.001mol) and triethylamine (0.006mol) was dissolved in 1,4 – Dioxan (25mL) , to this well stirred cooled solution of chloro acetyl chloride (0.0024mol)was added drop wise at10^{o}C.The reaction mixture was stirred for 6 hs. Half of the solvent separated and yield compounds(17,18) consecutive recrystallized from chloroform.

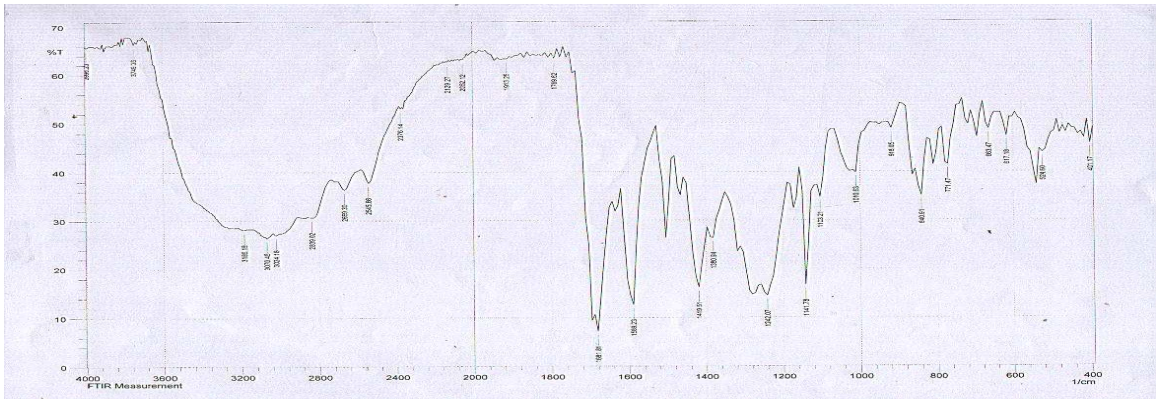
Scheme 1

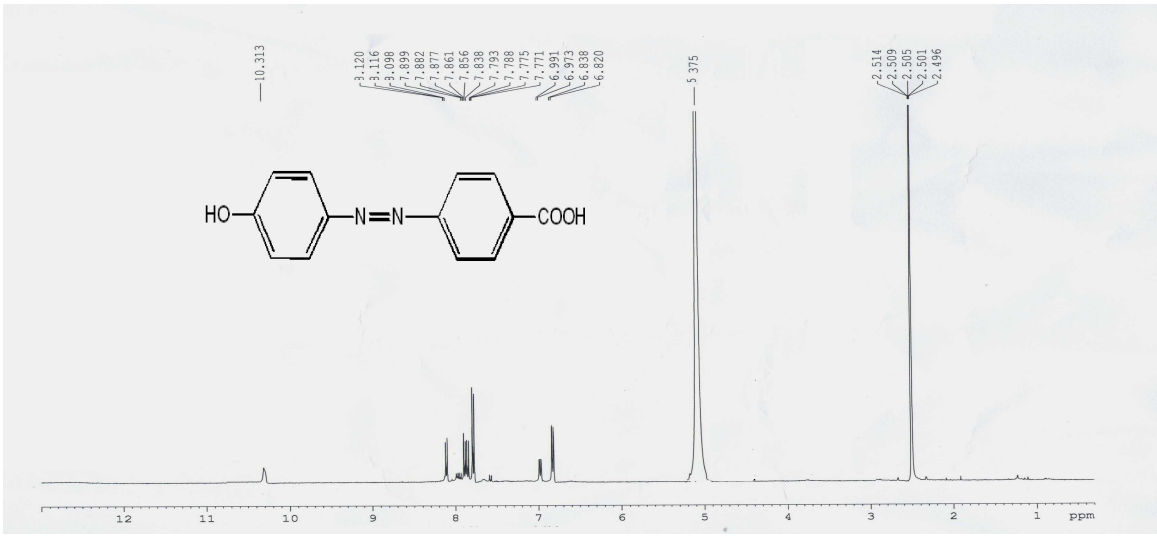


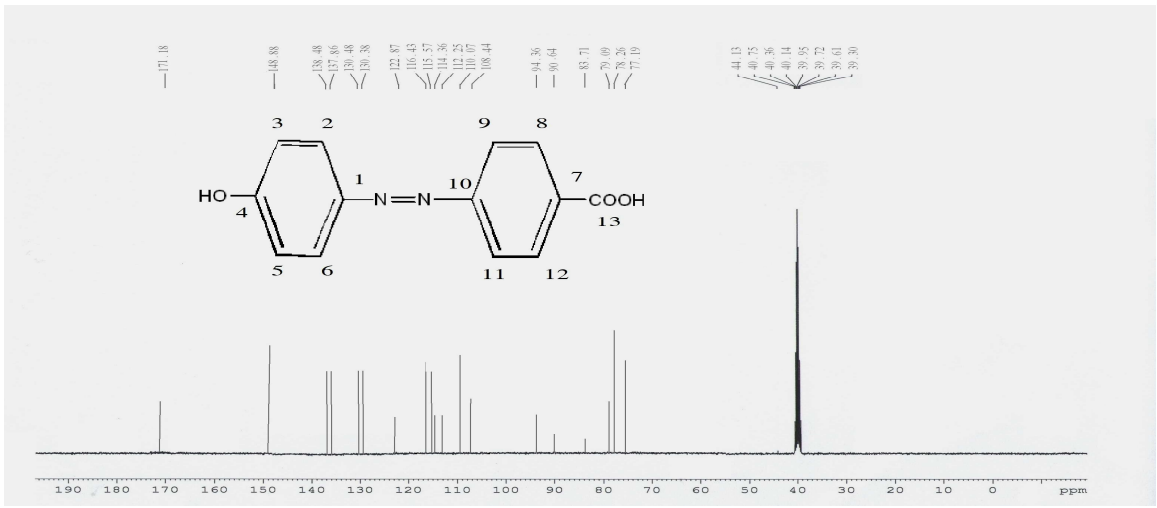
RESULTS AND DISCUSSION

compound (1) 4-((4-hydroxyphenyl)diazenyl)benzoic acid

This compound was obtained as Brown solid yield 78%,R_f =0.4, M.P (205-207)^{O}C. The infrared spectrum data of compound(1) show absorption at (3024) cm^{-1} for(Ar-H),(3350) cm^{-1}(O-H) ,(1700) cm^{-1} (C=O),and show new band at (1541) for (N=N). The^{1}H-NMR(DMSO) spectrum data of compound (1) show δ:6.8-8.1(m , 8H , Ar-H) , 5.37 (m , 1H , OH,OH-Ar) ,10.3 (m , 1H,OH ,COOH). The^{13}C-NMR(DMSO) spectrum data of compound (1) show δ:171.18 (C13), 148.8 (C4), 138.4(C10), 130.4(C7), 122.8(C12,C8), 115.4(C2,C6), 110.07(C9,C11), 108.4(C3,C5). 112.6(C2,C5) ,22.9 (C17,C18).







compound (2) 4-((4-(5-amino-1,3,4-thiadiazol-2-yl)phenyl)diazenyl)phenol

brown solid yield 83%, Rf =0.36 , M.P(213-215)^{O}C. The infrared spectrum data of compound (2) show absorption at (3070) cm^{-1} for (Ar-H),(3286,3163) cm^{-1} (NH_2), (1604) cm^{-1} (C=N),and show band at (3350) for (OH) ,(1257) cm^{-1} (C-S),and show new band at (1504) for (N=N). The^{1}H-NMR(DMSO) spectrum data of compound (1) show δ:6.8-7.4(m , 8H , Ar-H), 5.2 (m, 1H, OH, OH-Ar), 6.79 (m, 2H, NH2). The^{13}C-NMR(DMSO) spectrum data of compound (1) show δ:159.7 (C13), 146.6 (C14), 138.4(C4), 130.7(C1), 116.42(C7), 112.25(C8, C12), 110.09(C9, C11), 108.4(C2, C6), 104.49 (C3, C5).

Table (1) infrared spectrum data for(1,2) compounds

Comp.	υAr-H arom.	υN-H	υC=N	υC-H aleph.	υOH	υArOCH$_3$ CO
1	3055	3309	1650	2923	-	-
2	**3055**	**3379**	**1681**	-		

compound (3) 4-((1E)-(4-(5-((4-nitrobenzylidene)amino)-1,3,4-thiadiazol-2-yl) phenyl) diazenyl)phenol
Brown solid yield 79%,Rf =0.32 ,M.P (101)^{O}C. The infrared spectrum data of compound (3)show absorption at (3078) cm^{-1} for (Ar-H),(3394) cm^{-1}for (O-H),(1587)cm^{-1} (C=N),and show band at (1604) for (C=C) cm^{-1} ,(1350) cm^{-1} for (NO2).

compound (4) 2-(((5-(4-((E)-(4-hydroxyphenyl)diazenyl)phenyl)-1,3,4-thiadiazol-2-yl)imino)methyl)phenol (4)
Brown solid, yield 73% ,Rf =0.42 , M.P(190)^{O}C.The infrared spectrum data of compound (4)show absorption at (3070)cm^{-1} for (Ar-H),(3370) cm^{-1} (O-H),(1604)cm^{-1}(C=N),and show band at(1504)cm^{-1}for (N=N) .

compound(5)4-((1E)-(4-(5-((2-bromobenzylidene)amino)-1,3,4-thiadiazol-2-yl)phenyl) diazenyl) phenol
Purple solid, yield 80% ,Rf =0.31 , M.P(113)^{O}C.The infrared spectrum data of compound (5)show absorption at (3070)cm^{-1} for (Ar-H),(3286) cm^{-1} (O-H),(1589)cm^{-1}(C=N),(1504) cm^{-1} for(N=N), and show band at (686) for (C-Br).

compound(6) 4-((1E)-(4-(5-((4-hydroxybenzylidene)amino)-1,3,4-thiadiazol-2-yl) phenyl) diazenyl) phenol
Brown solid, yield 82% ,Rf =0.45 , M.P(128)^{O}C.The infrared spectrum data of compound (6) show absorption at (3066) cm^{-1} for (Ar-H),(3400) cm^{-1} (O-H),(1604)cm^{-1}(C=N),and show band at (1504) for (N=N).

compound(7)4-((1E)-(4-(5-(benzylideneamino)-1,3,4-thiadiazol-2-yl)phenyl)diazenyl) phenol
Brown seram, yield 75% ,Rf =0.31 .The infrared spectrum data of compound (4)show absorption at (3070)cm^{-1} for (Ar-H),(3280) cm^{-1} (O-H),(1596)cm^{-1}(C=N),and show band at(1504)cm^{-1}for (N=N).

compound (8) 4-((1E)-(4-(5-((4-(dimethylamino)benzylidene)amino)-1,3,4-thiadiazol-2-yl) phenyl) diazenyl) phenol
Brown seram, yield 78% ,Rf =0.The infrared spectrum data of compound(8)show absorption at (3050)cm^{-1} for(Ar-H),(3330) cm^{-1} (O-H),(1589)cm^{-1} (N=N),(2985,2885) cm^{-1} for(C-H)CH$_3$.

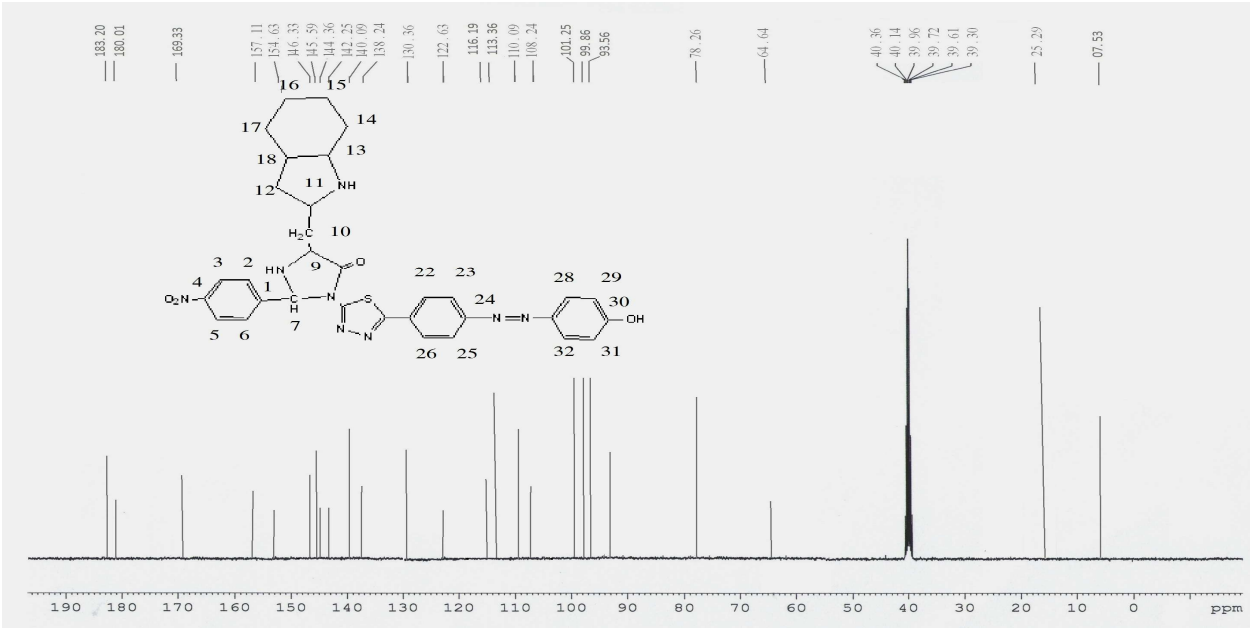
compound (9) 4-((1E)-(4-(5-((4-chlorobenzylidene)amino)-1,3,4-thiadiazol-2-yl) phenyl) diazenyl)phenol
Brown seram, yield 82% ,Rf =0.42. The infrared spectrum data of compound (9) show absorption at (3016) cm^{-1} for (Ar-H),(3255) cm^{-1} (O-H),(1596)cm^{-1}(C=N),and show band at (1504) for (N=N),(779) cm^{-1} for (C-Cl).

compound(10)4-(((5-(4-((E)-(4-hydroxyphenyl)diazenyl)phenyl)-1,3,4-thiadiazol-2-yl)imino)methyl)-2-methoxy phenol
as Brown seram, yield 80 ,Rf =0.52.The infrared spectrum data of compound (10) show absorption at (3070) cm^{-1} for (Ar-H),(1622) cm^{-1} (C=N),and show new band at (2823-2932) for (C-H)CH$_3$, (3300) cm^{-1} for(OH) .

Table (2) infrared spectrum data for imidazolidn-4-one derivatives compounds (3-10) cm^{-1}

Comp.	υ(C-H)$_{arom}$	υC=N	υC=O	υOH
3	3078	1587	1726	**3394**
4	3070	1604	1720	**3370**
5	3070	1589	-	**3286**
6	3066	1604	-	**3400**
7	3070	1545	-	**3280**
8	3050	1589	-	**3330**
9	3016	1596	-	**3255**
10	**3070**	**1622**	-	**3300**

compound (11) (E)-3-(5-(4-((4-hydroxyphenyl)diazenyl)phenyl)-1,3,4-thiadiazol-2-yl)-2-(4-nitrophenyl)-5-((4,5,6,7-tetrahydro-1H-indol-3-yl)methyl)imidazolidin-4-one
Purple solid, yield =84% ,Rf =0.32 , M.P(123)^{O}C.The infrared spectrum data of compound (11) show absorption at (3055) cm^{-1} for (Ar-H) ,(3371) cm^{-1} (N-H) and show band at (1335)for (NO2). The ^{1}H-NMR(DMSO) spectrum data of compound (11) show δ:7.1-8.5(m , 12H , Ar-H) ,5.2 (m , 1H , OH) ,0.9 (m , 8H,CH$_2$), 1.2 (m, 2H, CH$_2$), 3.4(m,2H,CH$_2$-N), 3.8(m, 3H,CH). The^{13}C-NMR(DMSO) spectrum data of compound (11) show δ:183 (C20,C8) , 180 (C19) ,169(C30), 153(C24), 154(C1), 146(C4), 145(C27), 142(C21), 7.5(C16), 25 (C15,C14), 64(C17), 78(C10) , 93(C9), 99(C7), 101(C29,C31) , 108-140(carbon for aromating ring).



compound (12) (E)-2-(2-hydroxyphenyl)-3-(5-(4-((4-hydroxyphenyl) diazenyl) phenyl)-1,3,4-thiadiazol-2-yl)-5-isobutylimidazolidin-4-one

Brown solid, yield =85% ,Rf =0.33 , M.P(177)^{O}C. The infrared spectrum data of compound (12) show absorption at (3078) cm^{-1} for (Ar-H),(3140) cm^{-1} (N-H), (2931,2834) cm^{-1} for (C-H) CH_3. The ^{1}H-NMR(DMSO) spectrum data of compound (12) show δ:7.01-7.4(m, 11H, Ar-H), 5.1 (m, 2H, OH), 1.17 (m, 6H, CH_3), 1.2 (m, 2H, CH), 3.38(m,1H,CH) , 6.8(m, 1H,CH). The ^{13}C-NMR(DMSO) spectrum data of compound (12) show δ:17.6 (C1) , 62.2 (C2) ,70.27(C3) , 78.87(C4) , 92.13(C5), 190(C6), 189(C13), 181(C12,C24),108 (carbon for aromatic ring).

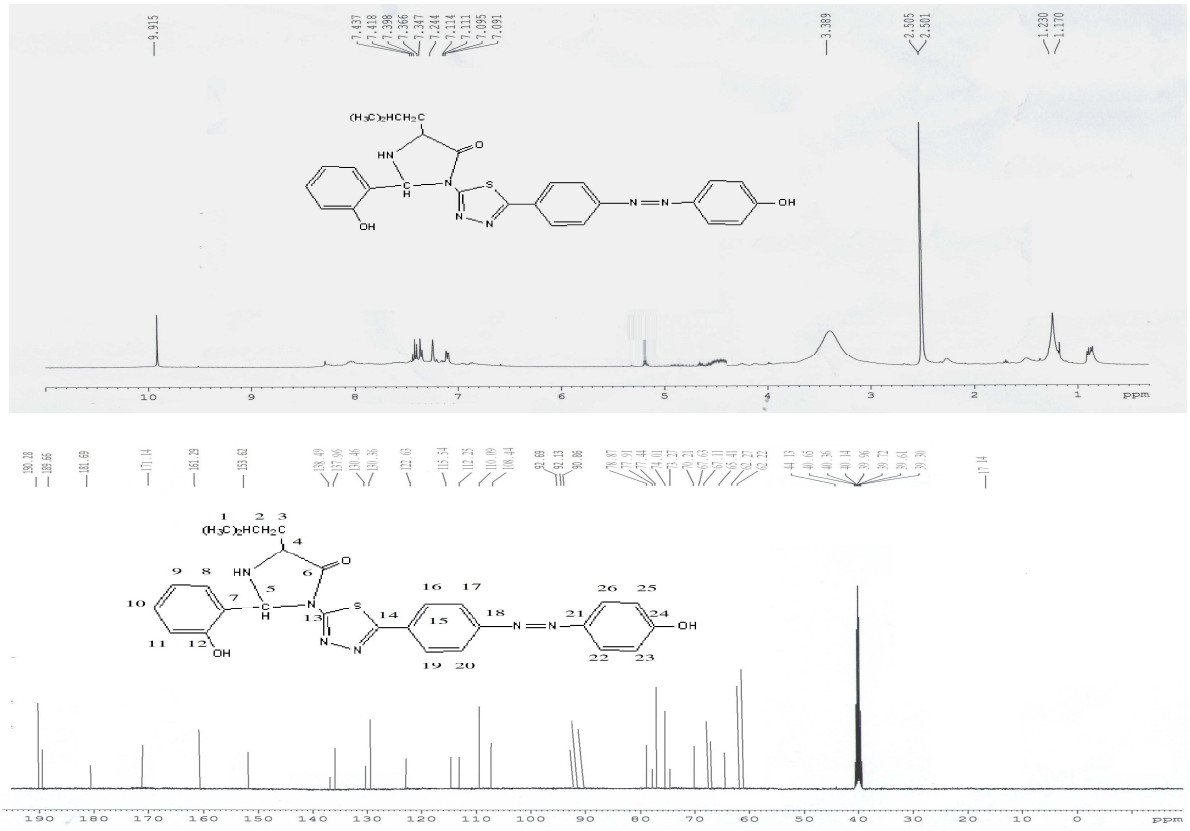
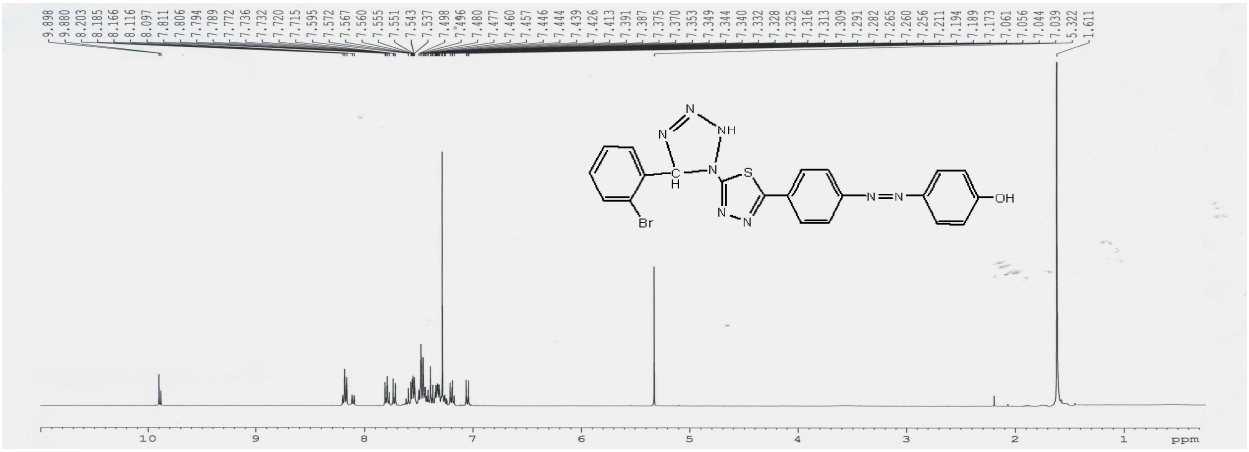


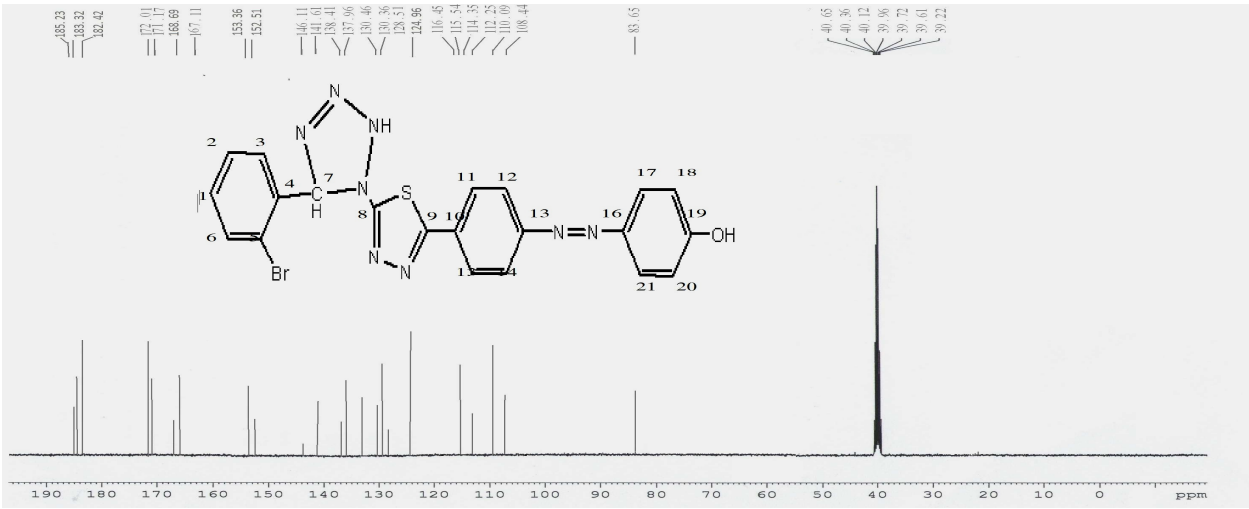
Table (3) infrared spectrum data for imidazolidn-4-one derivatives compounds (4-6) cm^{-1}

Comp.	υAr-H	υN-H	υC=N	υC-H aleph.	υC=O
11	3050	3150	1681	2970	**1690**
12	**3070**	**3363**	**1635**	**-**	**1712**

compound(13) (E)-4-((4-(5-(5-(2-bromophenyl)-2,5-dihydro-1H-tetrazol-1-yl)-1,3,4-thia diazol -2-yl) phenyl) diazenyl)phenol

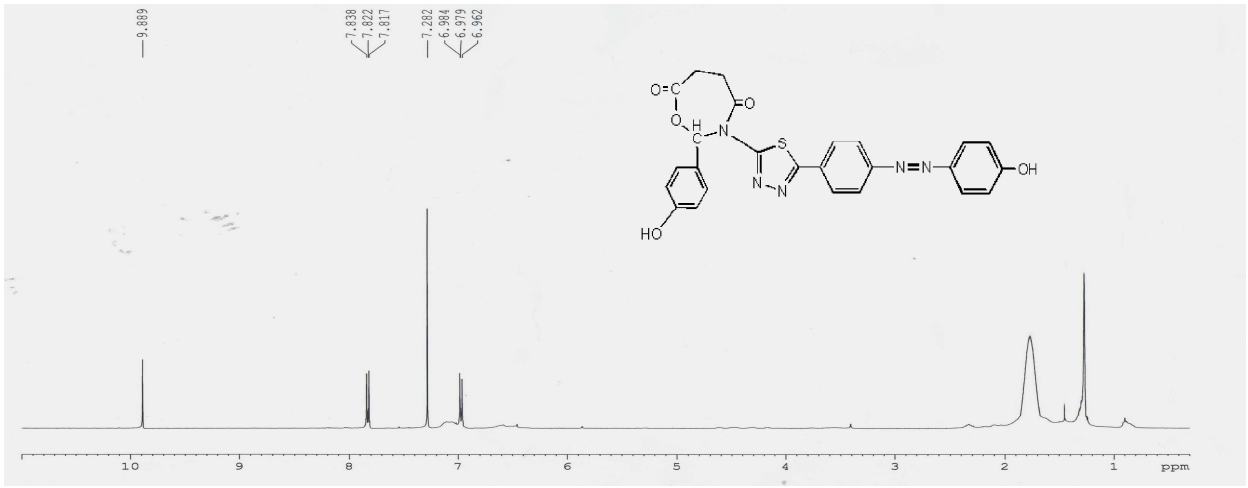
Brown solid, yield =80% ,Rf =0. 4 , M.P(106)^{O}C. The infrared spectrum data of compound(13) show absorption at (3070) cm^{-1} for (Ar-H),(3132) cm^{-1} for (N-H) imidazol and show new band at (3386) for (OH),(640) for (C-Br) , (1504) for (N=N). The^{1}H-NMR(DMSO) spectrum data of compound (13) show δ:7 -8.2(m , 12H , Ar-H) ,5.32 (m, 1H, OH),1.6 (m, 1H,CH), 9.8 (m,1H, NH). The^{13}C-NMR(DMSO) spectrum data of compound (13) show δ:83.65 (C7) , 183.3 (C8) ,172.2(C19) , 108-171 (carbon for aromatic ring).

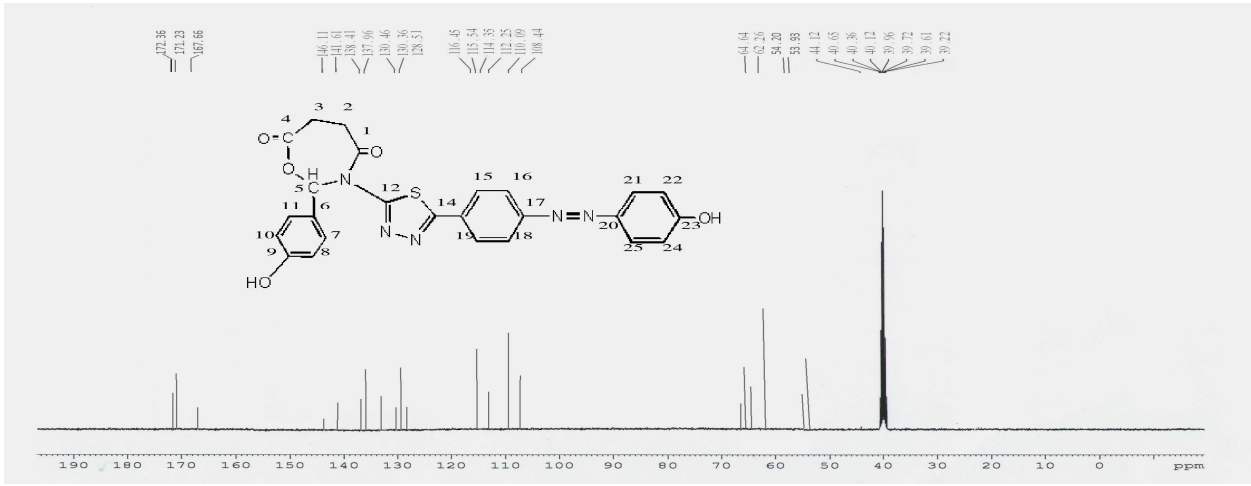




compound(14) (E)-2-(4-hydroxyphenyl)-3-(5-(4-((4-hydroxyphenyl) diazenyl) phenyl)-1,3,4-thiadiazol-2-yl)-6-methylene-1,3-oxazepane-4,7-dione

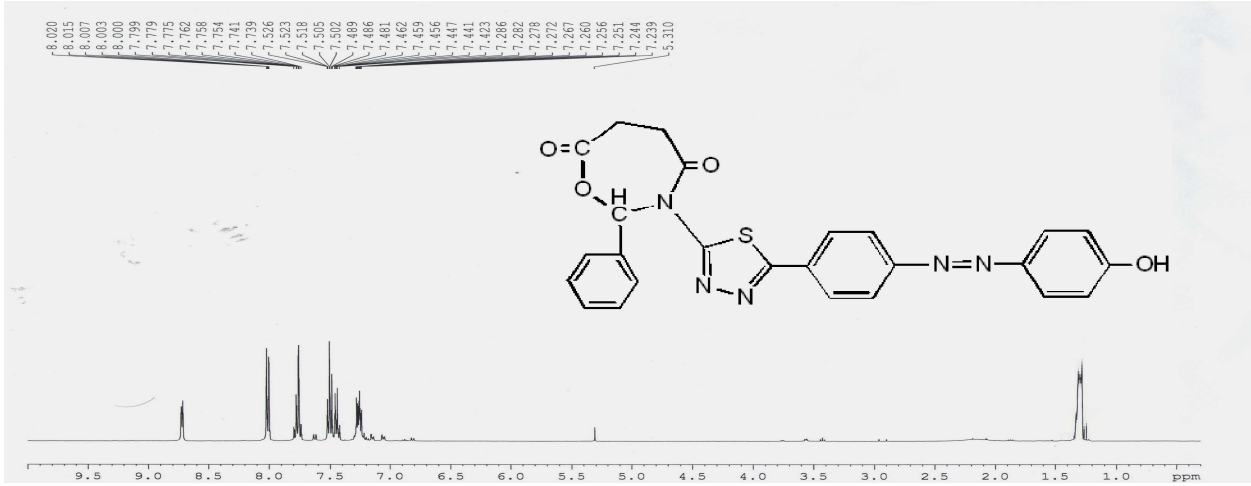
Golden solid, yield =78% ,Rf =0.4 , M.P(99)^{O}C.The infrared spectrum data of compound (14) show absorption at (3023) cm^{-1} for (Ar-H),(3320) cm^{-1} (O-H),and show new band at (1715) cm^{-1} for C=O ,(1286) cm^{-1} for C-O , (2854-2931) cm^{-1} for (C-H)CH_2. The^{1}H-NMR(DMSO) spectrum data of compound (14) show δ:6.97 -7.8(m , 8H , Ar-H) ,6.96 (m , 1H , OH) ,1.3 (m , 4H,CH_2) , 9.88 (m,1H, OH). The^{13}C-NMR(DMSO) spectrum data of compound (14) show δ:44 (C2) , 53, (C3) ,62(C5) , 172.3(C4) ,171.2(C1) ,167.6(C13) , 146.1(C12) ,141.6(C23), 138.4(C9) , 137(C17), 130.4(C20), 108-130 (carbon for aromatic ring).





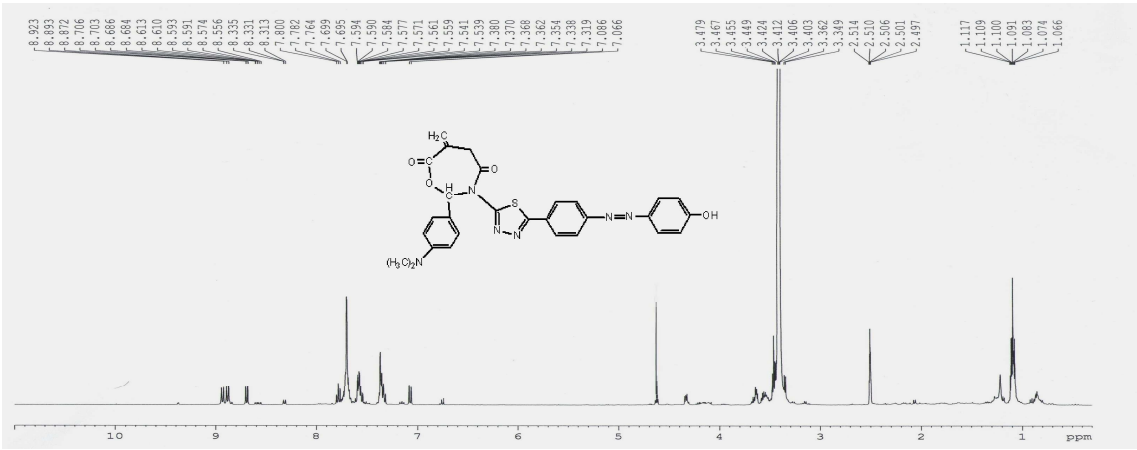
compound(15)(E)-3-(5-(4-((4-hydroxyphenyl)diazenyl)phenyl)-1,3,4-thiadiazol-2-yl)-2-phenyl -1,3-oxazepane-4,7-dione

Brown solid, yield =70% ,Rf =0.37 , M.P(112)^{O}C. The infrared spectrum data of compound (14) show absorption at (3078) cm^{-1} for (Ar-H),(3378) cm^{-1} (O-H)and show new band at (1720) cm^{-1} for C=O ,(1211) cm^{-1} for C-O , (2923) cm^{-1} for (C-H)CH_2. The^{1}H-NMR(DMSO) spectrum data of compound (15) show δ:7.23 -8(m , 13H , Ar-H) ,5.31 (m , 1H , OH) ,1.3-1.7 (m , 4H,CH_2). The^{13}C-NMR(DMSO) spectrum data of compound (15) show δ:54(C3) , 62, (C5) ,44(C2) , 160.1(C1) ,152(C14) ,147(C13) , 145(C4) ,133(C23), 132(C12) , 118-131 (carbon for aromatic ring).



compound(16)(E)-2-(4-(dimethylamino)phenyl)-3-(5-(4-((4-hydroxyphenyl)diazenyl) phenyl) -1,3,4-thiadiazol-2-yl)-2,3-dihydro-1,3-oxazepine-4,7-dione

Brown solid, yield =70% ,Rf =0.37 , M.P(155)^{O}C.The infrared spectrum data of compound (16) show absorption at (3070) cm^{-1} for (Ar-H),(3172) cm^{-1} (O-H)and show new band at (1687) cm^{-1} for C=O ,(1220) cm^{-1} for C-O , (2933) cm^{-1} for (C-H)CH_3. The^{1}H-NMR(DMSO) spectrum data of compound (16) show δ:7-8.9(m , 12H , Ar-H) ,4.8 (m , 1H , OH) ,1.1 (m , 6H,CH_3),3.3(2H,CH_2) ,3.4(1H,CH), 4.2(2H,=CH_2). The^{13}C-NMR(DMSO) spectrum data of compound (16) show δ:25.2(C13,C14) , 62, (C2) ,172(C1) , 171(C5) ,167(C16) ,141(C15) , 83(C6) 108-141 (carbon for aromating ring)[15-20]



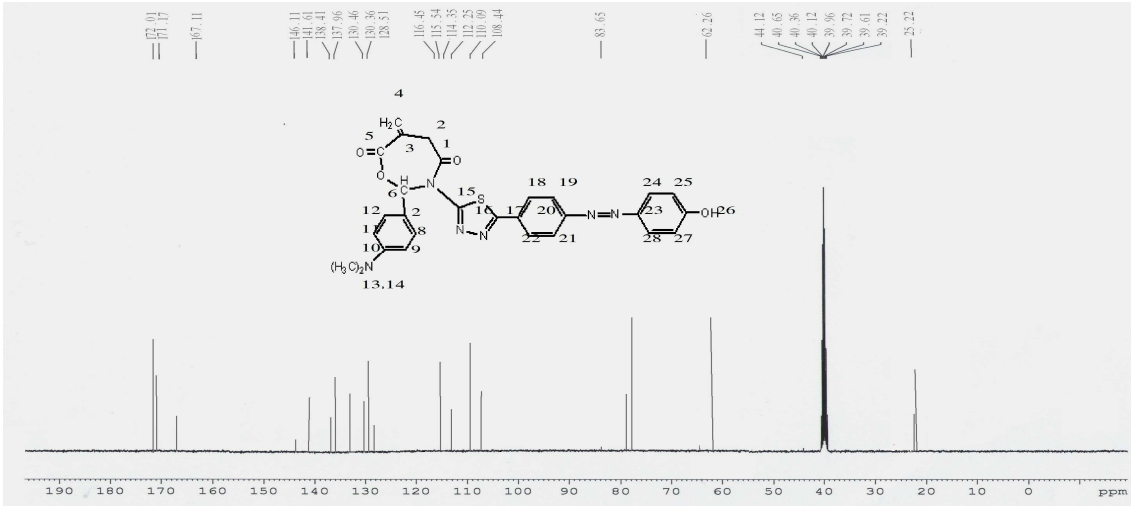
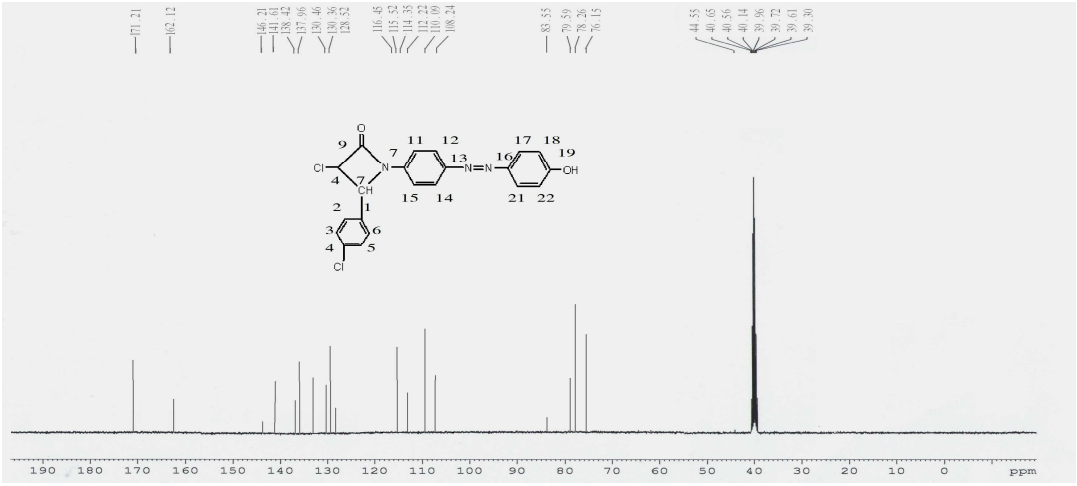


Table (4) infrared spectrum data for imidazolidn-4-one derivatives compounds (3-16) cm^{-1}

Comp.	υAr-H	υN-H	υC=O	υOH
13	3070	3132	-	**3386**
14	3023	-	1715	**3320**
15	3078	-	1720	**3378**
16	**3070**	**-**	**1687**	**3172**

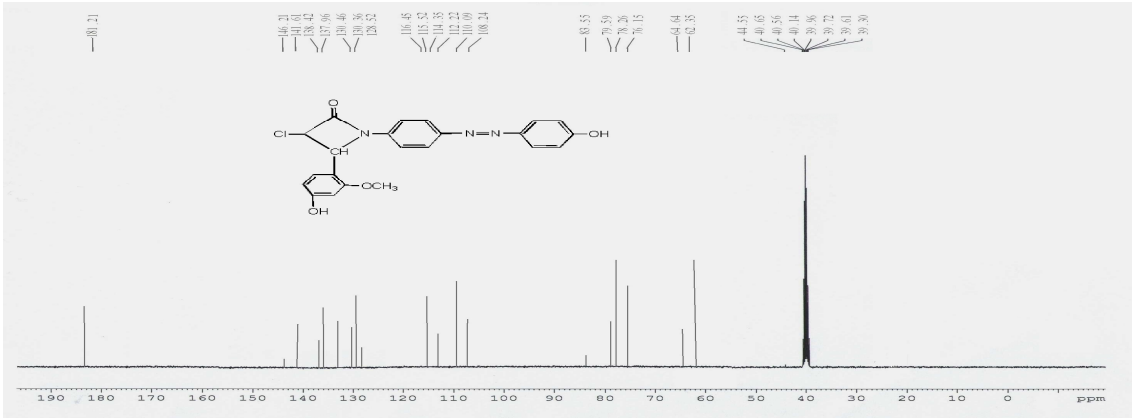
compound(17) (E)-3-chloro-4-(4-chlorophenyl)-1-(5-(4-((4-hydroxyphenyl) diazenyl) phenyl)-1,3,4-thiadiazol-2-yl)azetidin-2-one

Golden solid, yield =73% ,Rf =0.53,M.P(185)^{O}C. The infrared spectrum data of compound (17)show absorption at (3088) cm^{-1} for(Ar-H),(1710) cm^{-1} for C=O ,(1272) cm^{-1} for C-O ,(2939) cm^{-1} for (C-H)CH_3,(848) cm^{-1} for (C-Cl) . The^{1}H-NMR(DMSO) spectrum data of compound (17) show δ:7.1-8.1(m , 12H , Ar-H) ,3.4 (m , 1H , CH -N) ,1.2 (m , 1H,CH-Cl),6.3(1H,OH). The^{13}C-NMR(DMSO) spectrum data of compound (17) show δ:171.2(C9) , 162.1 (C19) ,78.2(C8) , 108-146 (carbon for aromating ring).



compound(18)(E)-3-chloro-4-(4-hydroxyphenyl)-1-(5-(4-((4-hydroxyphenyl)diazenyl)phenyl)-1,3,4-thiadiazol-2-yl)azetidin-2-one

Brown solid, yield=77%,Rf =0.33,M.P(148)^{O}C. The infrared spectrum data of compound (18) show absorption at (3077) cm^{-1} for (Ar-H),(3433) cm^{-1} (O-H)and show new band at (1697) cm^{-1} for C=O ,(1226) cm^{-1} for C-O , (2993,2885) cm^{-1} for (C-H)CH_3. The^{1}H-NMR(DMSO) spectrum data of compound (18) show δ:6.9-8.2(m , 11H , Ar-H) ,3.4 (m , 1H , CH -N) ,3.3 (m , 1H,CH-Cl),5.2(1H,OH) , 8.56(1H,OH),1.05(3H,CH_3). The^{13}C-NMR(DMSO) spectrum data of compound (18) show δ:181.2(C10) , 62.1 (C7) ,79.2(C8) ,141(C20) , 108-138 (carbon for aromatic ring).



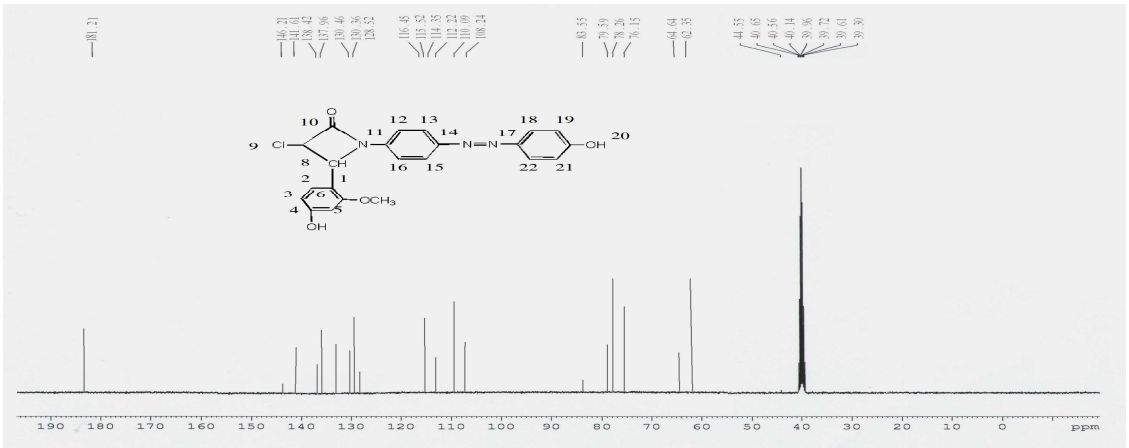


Table (4) infrared spectrum data for(10-15) compounds cm^{-1}

Comp.	υAr-H	υC-H aleph.	υC=O	υC-Cl
17	3088	2939	1710	**848**
18	**3077**	**2993**	**1697**	**840**

Table (5): Analytical and physical data of compounds

No.	Molecular formula	Color	M.P°C	Yield%	R_f	CHN		
						C	H	N
1	$C_{13}H_{10}N_2O3$ (242.2230)	Brown	202-204	78	0.4	64.46	4.16	11.56
						64.24	4.14	11.19
2	$C_{14}H_{11}N_5O_5$ (297.335)	Brown	215-216	83	0.36	56.55	3.73	23.55
						56.19	3.32	23.37
3	$C_{21}H_{14}N_6\ O_3S$ (430.439)	Brown	101-102	79	0.32	58.60	3.28	19.52
						58.11	3.21	19.22
4	$C_{21}H_{15}N_5O_2S$ (401.441)	Brown	90-91	73	0.42	62.83	3.77	17.45
						62.89	3.43	17.88
5	$C_{21}H_{14}BrN_5O_5$ (464.338)	purple	133-114	80	0.31	54.32	3.04	15.08
						54.37	3.16	15.31
6	$C_{21}H_{15}N_5O_2s$ (401.441)	Brown	128	82	0.45	62.83	3.77	17.45
						62.74	3.81	17.32
7	$C_{21}H_{15}N_5OS$ (385.442)	Brown	seram	75	0.31	65.44	3.92	18.17
						65.78	3.52	18.11
8	$C_{23}H_{20}N_6OS$ (428.510)	Brown	seram	87	0.43	64.47	4.70	19.61
						64.83	4.63	19.66
9	$C_{21}H_{14}ClN_5OS$ (419.887)	Brown	seram	82	0.42	60.07	3.36	16.68
						60.11	3.32	16.85
10	$C_{22}H_{17}N_5O_3s$ (431.467)	Brown	seram	80	0.52	61.24	3.97	16.23
						61.22	3.93	16.62
11	$C_{32}H_{28}N_8O_4S$ (620.681)	purple	123	83	0.32	61.92	4.55	18.05
						61.88	4.31	18.26
12	$C_{27}H_{26}N_6O_3S$ (514.599)	Brown	177	85	0.33	63.02	5.09	16.33
						63.31	5.12	16.14
13	$C_{21}H_{12}N_6OS$ (264.079)	Brown	106	80	0. 4	49.71	2.98	22.09
						49.55	2.91	22.17
14	$C_{26}H_{19}N_5O_5S$ (513.525)	Golden	99	78	0.44	60.81	3.73	13.64
						60.84	3.65	13.48
15	$C_{25}H_{19}N_5O_4S$ (485.514)	Brown	112	70	0.37	61.85	3.94	14.42
						61.92	3.69	14.33
16	$C_{27}H_{22}N_6O_4S$ (526.566)	Brown	155	69	0.41	61.59	4.21	15.95
						61.53	4.11	15.88
17	$C_{23}H_{15}Cl_2N5O_2S$ (485.514)	Golden	185	73	0.53	55.65	3.05	14.11
						55.34	3.02	14.34
18	$C23H16ClN_5O_3S$ (485.514)	Brown	148	77	0.33	57.80	3.37	14.65
						57.67	3.16	14.49

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