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Synthesis of New-2- Quinolone Sulfonphthalimide Derivatives

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Abstract: ***Series of new different 2-quinolone derivatives linked to phthalimide sulphonyl moiety were performed via the following steps: different prepared coumarins were converted to corresponding 2-quinolones by treating them with hydrazine hydrate then these 2-quinolones were treated with sulfonphthalimide derivative which was synthesized by two steps: first step was performed by fusion of phthalic anhydride with aniline to produce 2-phenyl-isoindole-1,3-dione , the later product treated with chloro sulfonic acid at cold condition to prouduce (1,3-dioxo-1,3-dihydro-isoindol-2-yl) which was treated with the different synthesized 2-quinolones to produce new 2- quinolone Sulfonphthalimide derivatives. The synthesized compounds were characterized by FT-IR, ^{1}H-NMR, ^{13}C-NMR spectra and by measuring some of their physical properties***

Keywords: 2-quinolones, coumarin, sulfonphthalimide, **2**-Phenyl-isoindole-1,3-dione

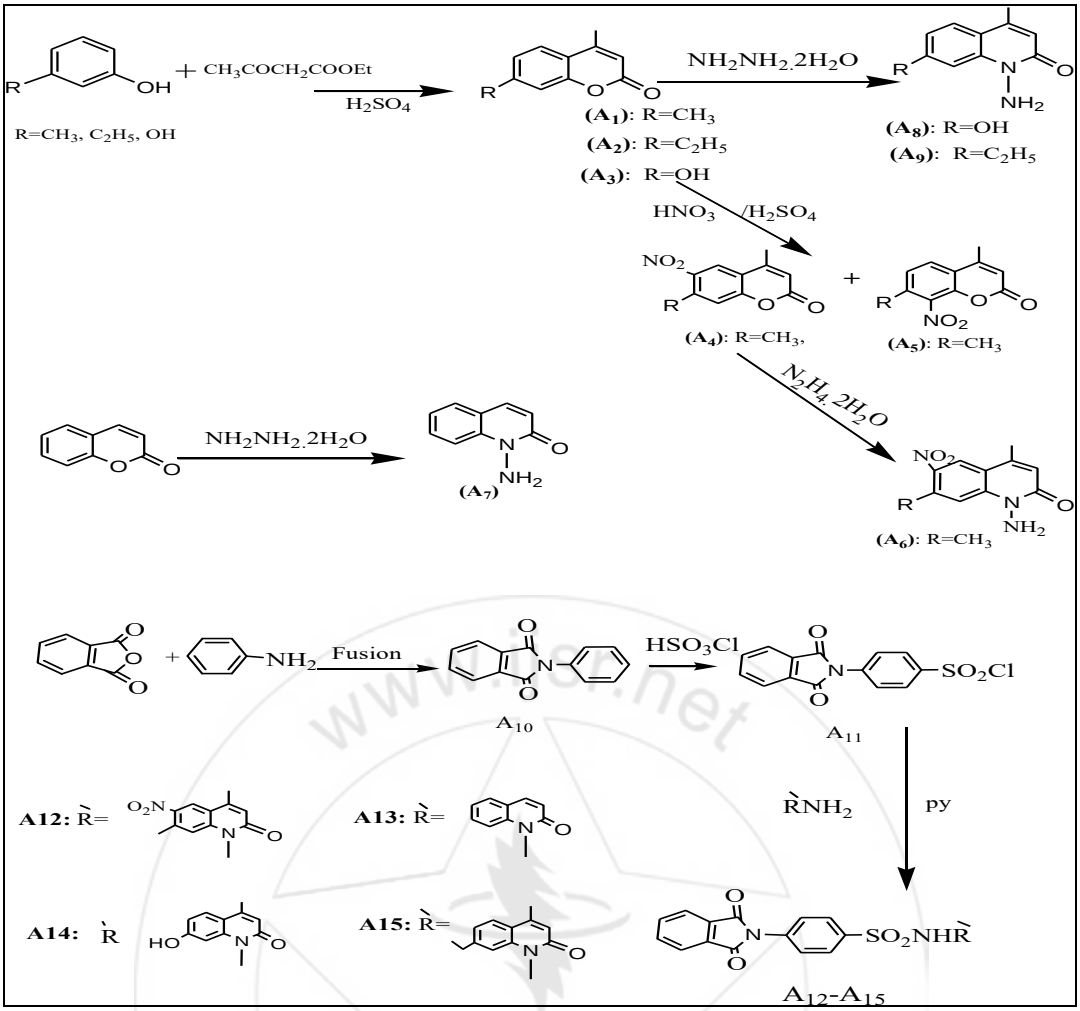
1. Introduction

Quinolone, is classified as a number of the benzopyridone family compounds, all of which compose of a fused benzene moiety with pyridone ring [1]. Many quinoline-2-one derivatives have a wide range of biological activities such as antimutageniuc activity [2], anti-gastritis and anti-ulcer agent in gastro-esophageal reflux disease (GERD) patients with chronic gastritis [3] antihistamine properties[4], and antibacterial[5] . Cyclic imides are considered as N-diacyl derivatives of ammonia or amine. These cyclic imides are oxidative stable, heat retardant, solvent resistant and have superior mechanical properties. Cyclic imide compounds possess better resistance to corrosion and high temperatures than linear cyclic imides [6]. Most cyclic imides are used as plastic modifiers [7] to improve heat-resistant [8] antioxidant [9], and anti foulant [10]. Heterocycles containing sulfonamido moieties have attracted obvious attention due to their significant biological properties and their role as pharmacophores [11]. Therefore, in this work we were so interested to combine the three of 2-quinolones, sulfonamido and phthalimide moieties together in one molecule as shown in scheme1.

2. Materials and Methods

Instruments:
The FT-IR spectra in the range (4000–400) cm^{-1} were recorded on a Shimadzu FT-IR 8300 Spectrophotometer. ^{1}H-NMR and ^{13}C-NMR spectra (solvent DMSO-d6) were recorded on a Bruker-DPX 400 MHz spectrometer with TMS as internal standard at Isfahan University. Melting points were determined on a Gallen-kamp MFB-600 melting point apparatus and were uncorrected. Analytical thin layer chromatography (TLC) in (7:3 ratio of hexane: ethyl acetate) as the mobile phase was performed on plates precoated with silica gel (Merck 60 F254, 0.25 mm) and was visualized with ultraviolet light.

Chemicals
Starting chemical compounds were obtained from BDH, Sigma Aldrich and Fluka and were used as received without further purification



Scheme 1: Synthesis of new-2- quinolone Sulfonphthalimide derivatives

1- Synthesis of 4, 7-dimethyl coumarin and 4 –methyl-7-ethyl coumarin (A1&A2)[12]

Titled compounds were synthesized according to literature **[12].** Their physical properties are listed in Table 1.

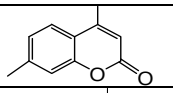
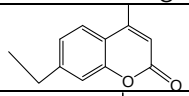
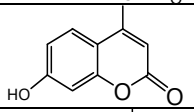
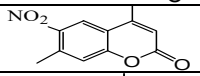
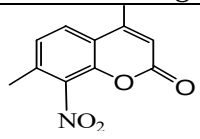
2 -Synthesis of 4 –methyl-7-hydroxy coumarin (A3)[13]

Titled compound was synthesized according to literatures **[13].** The physical properties of this compound are listed in Table 1

3-Synthesis of 4,7- dimethyl -6-nitro coumarin and 4,7-dimethyl -8-nitro coumarin : (A4 and A5) [14]

The titled compounds were synthesized according to literature **[14]** All physical properties are listed in Table 1

Table 1: Physical properties of compounds (A1-A5)

Comp .No.	Structures	M.P.°C	color	Purification solvent	Yield%	R_f in hexane:etheyl acetate 7:3
A1		131-133	white	Ethanol:H_20 4:1	70	0.6
A2		70-72	white	Benzene	75	0.64
A3		188-190	Creamy	Ethanol:H_20 2:1	80	0.45*
A4		259-260	Pale yellow	Ethyl acetate	60	0.5
A5		242-243	yellow	Ethyl acetate	20	0.4

*benzene: ethylacetate(4:1)

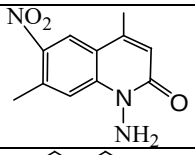
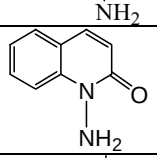
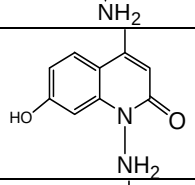
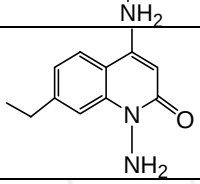
4 Synthesis of 1- amino-4, 7-dimethyl -6-nitro-1H-quinoline-2-one: (A6) [14]

The titled compound was synthesized according to literature [14] the physical properties of compound A6 are listed in Table 2.

5. Synthesis of 1- amino -1H-quinoline-2-one derivatives: (A7–A9) [15]

To the solution of (0.02mole) coumarin /4-methyl 7- ethyl coumarin A2/ 4-methyl -7-hydroxy coumarin A3 in absolute ethanol (25mL), hydrazine hydrate(80%) (0.2mole ,19 mL) was added then refluxed (1-6) days the progress of the reaction was monitored by T.L.C hexane :ethyl acetate (7:3) after complete the period of time , the solvent was concentrated and added another amount of ethanol 25 mL. to the concentrated mixture, after that the mixture was concentrated again. Finally the separated solid product was filtered off and washed with cold ethanol .The formed precipitate was recrystallized from a suitable solvent. The physical properties of compounds (A7-A9) are listed in Table 2.

Table 2: Physical properties of compounds (A6-A9)

Comp No.	Structures	M.P.^{0}C	Color	Purification solvent	Yield%	R.$_f$ in hexane:etheyl acetate 7:3
A6		265-267	Pale yellow	toluene	87	0.16
A7		129-130	Pale yellow	Chloroform	70	0.19*
A8		130-132	Yellow	Ethanol: H_2O 2:1	55	0.06
A9		179-180	Off white	Benzene or toluene	60	0.298

***chloroforme: methanol (9:1)**

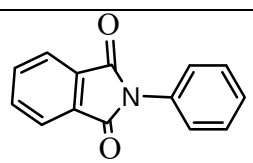
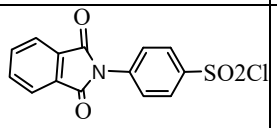
6. Synthesis of 2-Phenyl-isoindole-1,3-dione (A10) [16]

A mixture of phthalic anhydride(4.5gm, 0.03) and aniline (5mL) was heated at 190C^o on sand bath for about 0.5h. with stirring until the resulting product became dry. Then the crud product was recrystallized from acetone as white product. The physical properties are listed in Table 3

7. Synthesis of 4-(1,3-Dioxo-1,3-dihydro-isoindol-2-yl)-benzenesulfonyl chloride A11 [17]

The compound A11 was synthesized by using a well known procedure according to literature with some modification To solution of compound A10 (0.02mL, 5g) in (6mL) of chloroform , chloro sulfonic acid (10mL) was added drop wise by dropping funnel during one hours with stirring and keeping temperature at(-5C^0), stirring was continued for 15h. at room temperature, then the mixture was poured into ice/water the produced ppt. was filtered in Buchner funnel ,washed with acetone :cold water(1:1), dried at room temperature and recrystallized from acetone . The physical properties of compound (A10) are listed in Table 3

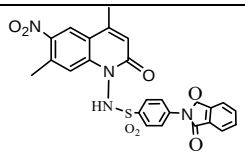
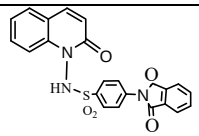
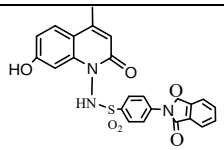
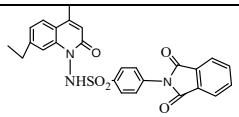
Table 3: Physical properties of compounds (A10-A11)

Comp .No.	Structures	M.P.^{0}C	color	Purification solvent	Yield%	R.$_f$ in MeOH:etheyl acetate 7.5:2.5
A10		205-210	Off white	acetone	85	0.86
A11		240-245 Dec.	white	acetone	80	0.319 **in hexane:etheyl acetate 7:3**

8. Synthesis of 4-(1,3-dioxo-1,3-dihydro-isoindol-2-yl)-N-(substitution -2-oxo-2H-quinolin-1-yl)-benzenesulfonamide derivative A12-A15:

Substituted quinolin-2-one **)A6-A9)** (0.002mole) was dissolved in dry pyridine (25mL) then compound A11 (0.002mole, 0.742gm) was added portion wise at 5C°. The resulting solution was stirred at room temperature (6h.) and for (4-6h.) at (40-50 C°) in water bath then at the end of the reaction, the mixture was poured on ice/water. The formed precipitate was filtered off, washed with water and dried at room temperature. The purification of these compounds was carried out by recrystallization from suitable solvents. Physical properties of compounds (A12-A15) are listed in Table 4

Table 4: Physical Properties of compounds (A12-A15)

Comp .No.	Structures	M.P.^{0}C	Color	Purification solvent	Yield%	R.F in hexane:etheyl acetate 7:3
A12		160 dec.	Brown	Acetone	53	0.1
A13		180 dec.	Yellow	Acetone	62	0.127
A14		198-200	Pale red	MeOH	71	0.1 in E.A:hexane1:1
A15		140-142	Pale yellow	EtOH	65	0.13 in E.A:MeOH 7.5:2.5

3. Result and Discussions

The condensation of ethyl acetoacetate with an equimolar amount of substituted phenol in the presence of conc. sulfuric acid under Pechemann condensation reaction produced coumarin derivatives (A_1 and A_2). The substitution of phenol at the meta position with electron donating groups (-CH_3, -C_2H_5,) cause an increase in the reactivity of the carbon at the ortho position to the hydroxyl group and at para position of the substituent.

The FT-IR spectrum of compounds (A1and A2) showed the appearance of characteristic absorption very strong band at (1716-1731) cm^{-1} due to (C=O) band of the lactone ring as shown in Table (5) [18][19]. The ^{1}H-NMR spectrum of compound (A1) showed the proton signals due to two groups of CH_3 were recorded at 2.4 and 2.6 ppm also showed three signals appeared in (7.2-7.7) ppm for three aromatic protons and singlet signal at (6.3)ppm for one proton of the lactone ring Table(6). While the ^{13}C-NMR spectrum for the same compound showed signal at (17.9) and (20.9) ppm for two groups of CH_3, the signal at (116.4, 117,125,125.3, 142.7, 152.9, and 153.2 ppm) belong to aromatic carbons and (159.9) ppm for carbonyl carbon as shown in Table (7). The ^{1}H-NMR spectrum of compound (A2) showed the proton a signal due to two groups of CH_3 were recorded at (1.2) and (2.5) ppm, a signal at 2.8 ppm due to CH_2 and signals at (7.3-7.8) ppm due to three aromatic protons and singlet signal at (6.3) ppm for one proton of the lactone ring as shown in Table (6). While the ^{13}C-NMR spectrum for the same compound showed signal at (15.1, 18 and 27.9) ppm for two groups of CH_3,and a group of CH_2 the signal at (113.3, 115.2 ,117.3 , 124.2 ,125.1 ,148.8,153.2 and 153.9) ppm due to aromatic carbons and (159.9) ppm for carbonyl carbon as shown in Table (7). The nitration of compound (A1) using concentrated nitric acid in the presence of sulphric acid at (0^{O}C) by electrophilic substitution reaction gave a mixture from (60%) 4,7-dimethyl- 6-nitro coumarin (A4) m.p259-260 ,and (20%) 4,7-dimethyl- 8-nitro coumarin (A5) m.p 242-243.TheFTIR spectrum of compound (A4) showed the appearance of absorption band for C=O of the lactone ring at 1734 cm^{-1} and the appearance of new absorption band at 1527cm^{-1} and 1354cm^{-1} belonging to asymmetric and symmetric to the NO_2 group as shown in Table(5). The ^{1}H-NMR spectrum of (A4) showed signal at 2.4ppm for three protons of the methyl of lactone ring, signals at 2.6ppm for three protons of methyl of benzene ring; signals at 6.525 for proton of the lactone ring, 7.56 and 8.375 ppm for two aromatic protons of the benzene ring as shown in Table (6). While ^{13}C-NMRspecrum showed signals at (17.8 and 19.7 ppm) for carbons of two methyl groups, 154.8 (C-O), 152.3 (C-NO_2), (122.2-115.3ppm) for three aromatic ring carbons and 158.8 ppm for carbonyl carbon of the lactone ring (O-C=O) as shown in Table (7).

Another isomer of nitro coumarin derivatives was 4,7-dimethyl -8-nitro coumarin compound (A5) showed difference solubility in hot ethanol , melting point and R_f of TLC from compound (A4) 4,7- dimethyl -6-nitro coumarin. FTIR of compound (A5) showed the strong band at 1737 cm^{-1} for carbonyl compound and two strong bands at 1518 and 1348 cm^{-1} for asymmetric and symmetric of NO_2 group respectively Table (5).

Table 5: FT-IR Spectral data cm^{-1} of compounds (A1-A4)

Comp. No	υ CH arom	υ CH aliph	υ C=O	υ C=C arom	Other bands
A1	3055	2983, 2945	1701	1620	-
A2	3078, 3059	2960, 2930	1731	1620	-
A3	3053	2925	1716	1622	1220 υ (OH)
A4	3095	2960	1734	1622	1354, 1527 υ NO_2
A5	3086	2950	1737	-	1348, 1518 υ NO_2

Table 6: ^{1}H-NMR spectra of some synthesized compounds (A1, A2,and A3)

Comp.No.	^{13}C-NMR (ppm)
A1	17.9(7-CH_3), 20.9(4-CH_3), 153.2 (C-O), 113,117,125,125.3,142,153(aromatic ring), 159.9 (C=O) , 116, 152 (for lactone ring)
A2	15.1(4-CH_3), 18.0(CH_2), 27.9($\underline{CH_3}$-CH_2), (C-O), 159.9(C=O)113, 117,1254.125,148,153(aromatic ring), 115,153(for lactone ring)
A4	17.8(7-CH_3),19.7(4-CH_3) , 144.9(C-NO_2), 154.8(C-O), 158.8(C=O),118,120,122,137,154(aromatic ring), 115,152(for lactone ring)

Comp.No.	^{1}H-NMR(ppm)
A_1	2.4(s,3H,CH_3), 2.6(s,3H,CH_3), 6.3 (s,1H,H lactone ring), 7.11-7.6 (m,3H,Ar- H)
A_2	1.2(t,3H,CH_3), 2.5(s,3H,CH_3), 2.8(q,2H,CH_2), 6.3(s,1H, H lactone ring), 7.3-7.8(m,3H,Ar-H),
A_4	2.4(s,3H,CH_3), 2.6(s,3H,CH_3), 6.5(s,1H, H-lactam ring), 7.5 (s,1H, Ar-H), 8.3(s,1H, Ar-H),

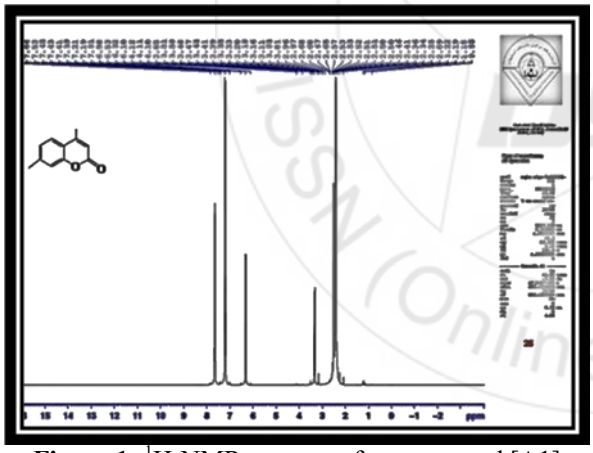


Figure 1: ^{1}H-NMR spectrum for compound [A1]

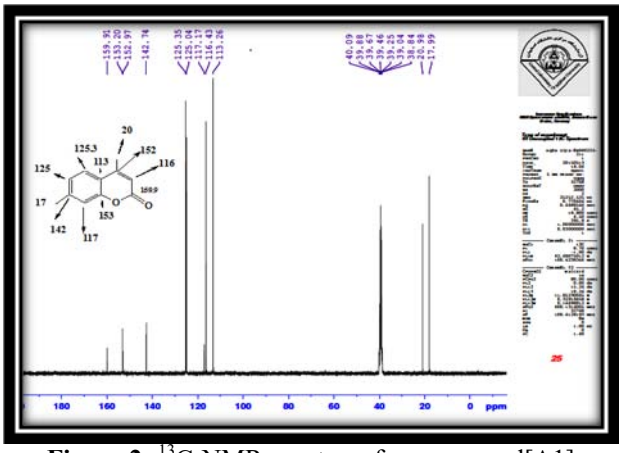


Figure 2: ^{13}C-NMR spectrum for compound[A1]

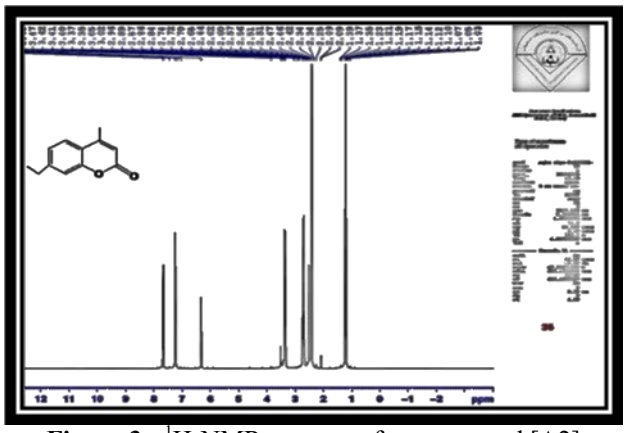


Figure 3: ^{1}H-NMR spectrum for compound [A2]

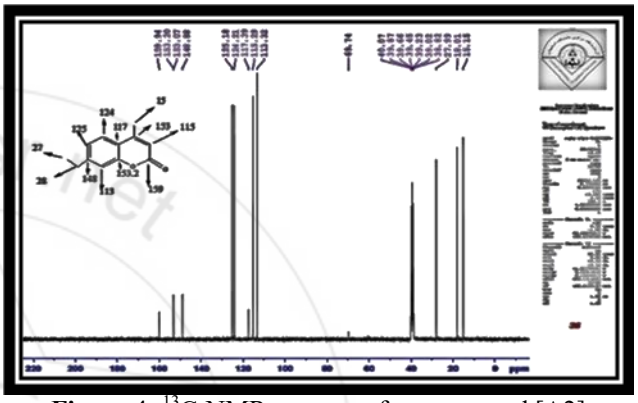


Figure 4: ^{13}C-NMR spectrum for compound [A2]

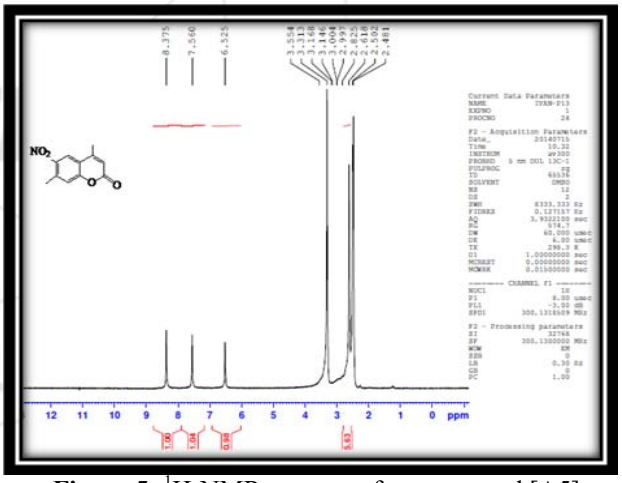


Figure 5: ^{1}H-NMR spectrum for compound [A5]

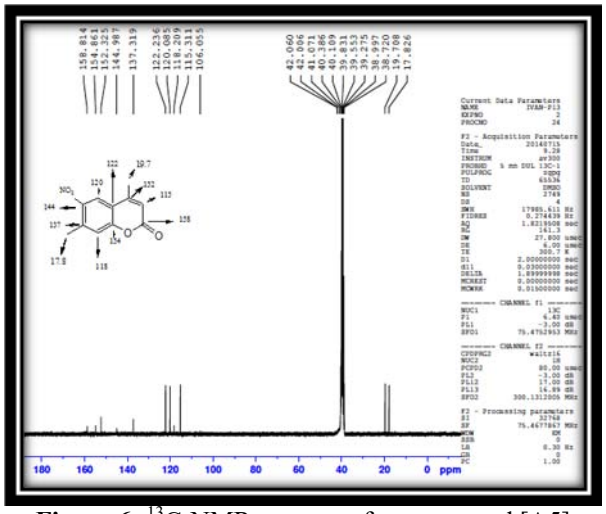


Figure 6: ^{13}C-NMR spectrum for compound [A5]

Synthesis of 1-Amino-4,7-dimethyl-6-nitro-1H-quinolin-2-one A6 , 1-Amino1H-quinolin-2-one A7, and 7-substituted -4-methyl 1H-quinolin-2-one A8-A9

The treatment of compounds (A2-A4) / coumarin with the hydrazine hydrate 80% produced N-amino quinoline -2-one derivatives (A6-A9)

The reaction of compound A4 with hydrazine hydrate in pyridine as a solvent was proceeded by nucleophilic attack of hydrazine on carbonyl group of the lactone ring through leading to the ring opening of the lactone ring and reclousing with losing a water molecule gives the corresponding N-amino quinolone (A6).

In these mechanism the nitro substituent as electron withdrawing group plays a very important role to stabilize the transition state and shorter time with high yield than in case of benzene ring or in presence of electron releasing group e.g (ethyl,hydroxyl) that was noted when 7-ethyl-4-methyl coumarin (A2) and 7-hydroxy-4-methyl coumarin (A3) was used instead of compound A4 in the other hands, the solvent pyridine plays a very important role to reduce the time of reaction may be because of its high boiling point that provides the high reaction temperature compared with ethanol.

The FTIR spectrum of compound (A6) showed the appearance of characteristic absorption bands at 3293 and 3196 cm^{-1} which belonged to the NH_2 and 1672cm^{-1} due to amid carbonyl of lactam group υ C=O Table8 Figure 7.

The ^{1}H-NMR spectrum of compound (A6) showed signals at 2.4 ppm and 2.6 ppm for two methyl groups (CH_3), a signal at 5.85 ppm for the two protons of NH_2, a signal at 6.71 ppm for the proton of the lactam ring, and signals at 7.91 and 8.41 ppm for two aromatic protons. See Table 9, and Figure 8

^{13}C-NMR spectrum of compound (A6) showed signals at 18.5 and 20.5 ppm for two methyl groups ($2CH_3$) and showed signals at 117.6, 134.7, 135.4, and 141.8 ppm for aromatic carbons, 142.6 ppm for C-N-NH_2 carbon, 145.6 ppm for C-NO_2 carbon and 159.6 ppm for the carbonyl carbon of the lactam ring. See Table 10 Figure 9

The FTIR spectrum of compounds (A7-A9) showed the appearance of characteristic absorption bands at (3288-3267) and (3265-3198) cm^{-1} which belonging to asymmetric and symmetric to the NH_2 and band at (1681-1645) cm^{-1} due to the carbonyl lactam group υ C=O. Table 8 Figures 10, 11,and 12

The ^{1}H-NMR spectrum of compound (A9) showed triplet signal at 1.1ppm for three protons of methyl groups (CH_2-$C\underline{H_3}$) , singlet signal at 2.7 ppm for methyl groups of lactam ring (Ar-CH_3),quartet signal at 2.5ppm for methylene group(CH_2), singlet signal at 5.9 ppm for two protons of (NH_2), and signals at 6.6-9.3 ppm for four aromatic protons. Table 9 Figure 13. ^{13}C-NMR spectrum of compound (A9) showed signals at 15, 24.7 and 27.65ppm for aliphatic protons and showed signals at 113, 115.5, 115.6, 118.1, 125.7, 126.9,143.7 and 155.3ppm for aromatic carbons, and 155.5 ppm for carbonyl group. See Table 10, and Figure 14

Table 8: FTIR Spectral data cm^{-1} of compounds (A6-A9)

Comp. No	υ NH_2	υ CH arom	υ CH aliph	υ C=O lactam	υ C=Carom	υ C-N	other bands
A6	3293 3196	3086	2983 2929	1672	1637	1344	1519 as. 1317 sy.υNO_2
A7	3288 3201	3036	-	1681	1635 1595	1381	
A8	3286 3265	3001	2966 2928	1645	1597	1346	3290 υ OH broad
A9	3267 3198	3053	2991 2961	1664	1622	1346	

Table 9: ^{1}H-NMR spectral data of some synthesized compounds (A6 and A9)

Comp. No.	^{1}H-NMR (ppm)
A6	2.4(s,3H,CH_3),2.6(s,3H,CH_3),5.8(s,2H,$N\underline{H_2}$),6.7(s,1H,H-lactam ring), 7.9(s, 1H, Ar-H),8.4(s,1H,Ar-H)
A9	1.1(t,3H,CH_3), 2.5(q,2H,CH_2), 2.7(s,3H, Ar-CH_3), 5.9(s, 2H, NH_2), 6.6-9.3(m, 4H, Ar-H)

Table10: ^{13}C-NMR for some preparing compounds (A6 and A9)

Comp. No.	^{13}C-NMR(ppm)
A6	19.1,21.1, 117.8,121.1, 123.1,134.7, 135.4, 141.7, 142.6, 145.8,159.6
A9	15.4, 24.7, 27.6, 113, 115.5, 115.6, 118.1, 125.7, 126.9, 143.7, 155.3, 155.5

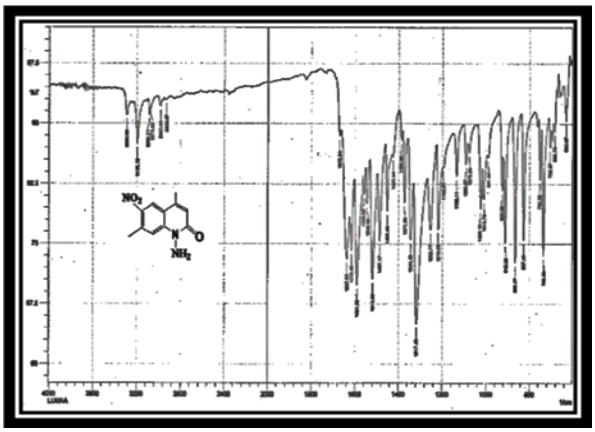


Figure 7: FTIR spectrum for compound [A6]

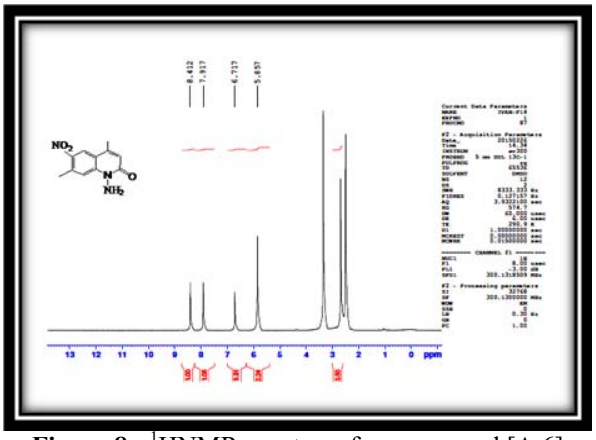


Figure 8: [1]HNMR spectrum for compound [A 6]

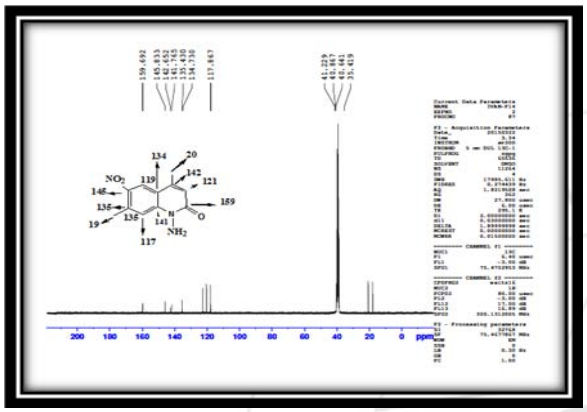


Figure 9: 13CNMR spectrum for compound [A6]

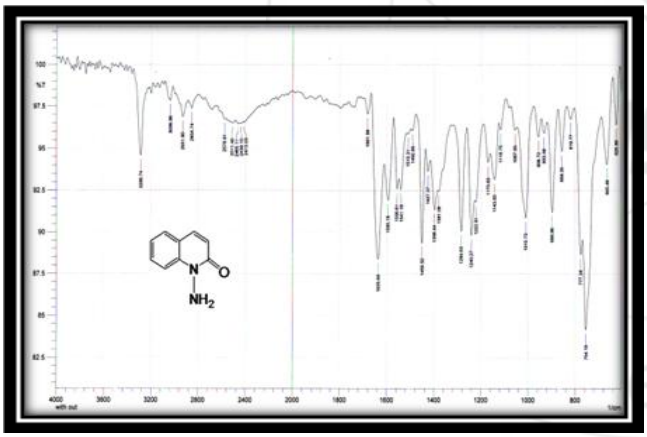


Figure 10: FTIR spectrum for compound [A 7]

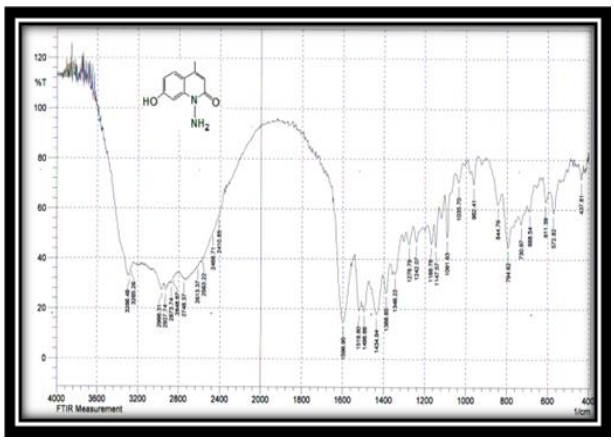


Figure 11: FTIR spectrum for compound [A 8]

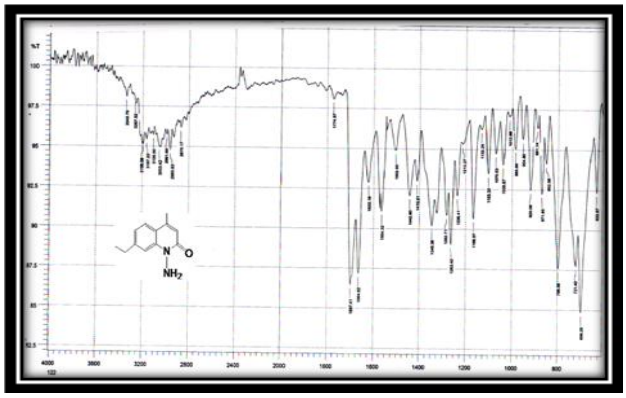


Figure 12: FTIR spectrum for compound [A9]

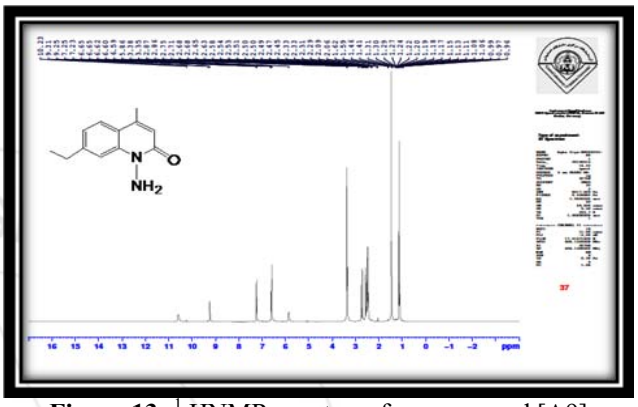


Figure 13: [1] HNMR spectrum for compound [A9]

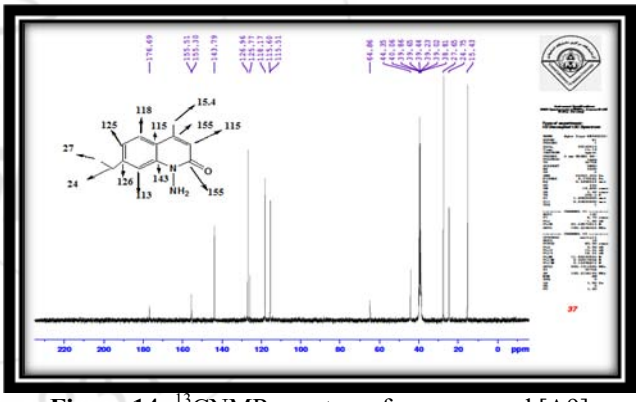


Figure 14: [13]CNMR spectrum for compound [A9]

Synthesis of 2-Phenyl-isoindole-1,3-dione (A10)

Synthesis of compoundA was achieved by using the simplest and solvent free method. The reaction was done simply by the fusion of phthalic anhydride with aniline without using any solvent or catalyst in a short time and good yield. The mechanism of the reaction is carried out through a nucleophilic attack of the amino group to the carbonyl carbon of anhydride. Initially, it was expecting an open chain structure of carboxylate but the characterization confirmed the presence of cyclic imides no absorption bands for (O-H) and (N-H) confirming dehydration and the formation of 5 membered ring containing nitrogen[20].

The FTIR spectrum of compound A10showed two bands at 1732 cm^{-1} and 1703 cm^{-1} due to the asymmetric and symmetric carbonyl bands of imid respectively and absorption band at 1591 cm^{-1} due to C=C aromatic . The FTIR spectrum of compound A10 was shown in Table 11 Figure 15

Synthesis of 4-(1,3-dioxo-1,3-dihydro-isoindol-2-yl)-benzenesulfonyl chloride[A11]

Compound A10 was reacted with chloro sulphonic acid at cold condition to give compound A11. The mechanism of the reaction involved an electrophilic attack on para position of phenyl ring by chloro sulphonic acid The FTIR spectrum of compound A11 showed clear absorption bands at 1744 cm^{-1} and 1715 cm^{-1} due to asymmetric and symmetric (υ C=O) imide,1375 cm^{-1} and 1186 cm^{-1} absorption bands due to asymmetric and symmetric (υ SO_2) respectively, 1587 cm^{-1} and 1298 cm^{-1} due to υ C=C aromatic and υ C-N respectively . All spectral data of compound A11 are listed in Table 11 Figure11

Table 11: FTIR data of synthesized compounds (A10and A11)

Comp. No	υ(C-H) Ar.	υ(C=O) imide	υ(C=C) Ar	υ (C-N)	υ (SO_2) asym.	υ (SO_2) sym.
A10	3068	1732 1703	1591	1383	-	-
A11	3102	1744 1715	1587	1298	1375	1186

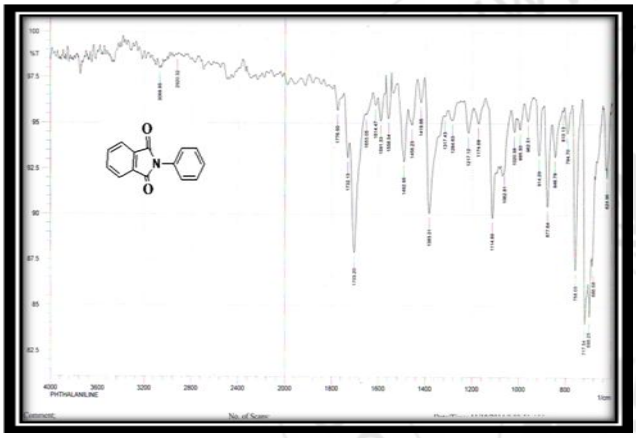


Figure 15: FTIR spectrum for compound [A10]

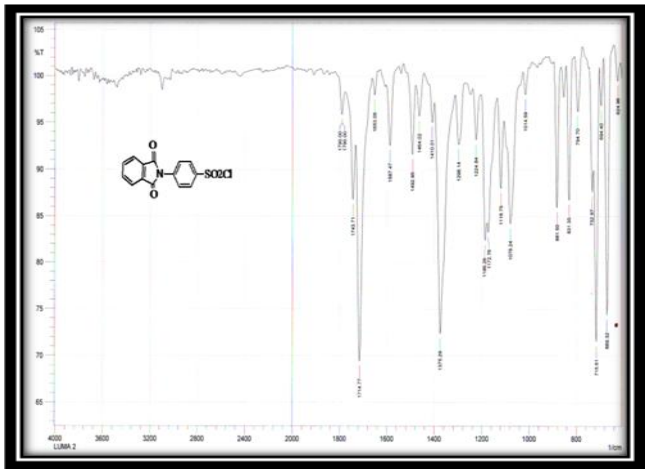


Figure 16: FTIR spectrum for compound [A11]

Synthesis of N-(substituted-2-oxo-2H-quinolin-1-yl)-benzenesulfonamide derivatives A12-A15:

Synthesized compound (A11) was treated with different substituted quinolone derivatives in pyridine as a solvent to give compounds (A12-A15)

The reaction represents nucleophlic substutition reaction and its mechanism involves nucleophilic attack of amino group of quinolone derivatives on sulfur atom in compound [A11] followed by discard of HCl molecule. Compound [A11] is a very important compound that contains sulfonyl group and introduced to synthesized compounds (A12-A15) in the next step using pyridine as solvent and catalyst, producing the desired compounds which containing both phthalimide and hetero rings of qunoline derivative linked together through sulphonamido group.

The FTIR spectra of compounds [A12-A15] showed absorption bands at (3350-3454) cm^{-1} due to υ(NH) amide, (1712-1741) and (1638-1683) cm^{-1} due to υ(C=O) imide and υ(C=O) amide respectivley, (1622-1500) cm^{-1} due to υ(C=C) aromatic, (1371-1400) cm^{-1} due to υ(SO_2)asym. , and (1161-1206) cm-1 due to υ(SO_2) sym. All FTIR spectral data are shown in Table 12. Figures17, 18, 20, and 21

The ^{1}HNMR spectrum of the compound [A13] showed signals at 6.3-9 ppm belong to aromatic protons and signal at 9.4ppm due to (NH) proton Table12 Figure19

Table 12: FTIR data of synthesized compounds (A12-A15)

Comp. No	υ(NH)	υ (C-H) Ar.	υ (C-H) Aliph	υ (C=O) imide	υ (C=O) lactam	υ (C=C) aromatic	υ(SO_2) asym.	υ(SO2) sym.	C-N	Other bands
A12	3350	3101	2873 2930	1741 1718	1683	1622 1593	1371	1166	1378	υNO_2 1525 1326
A13	3370	3050	-	1738 1716	1651	1633 1595	1373	1161	1328	-
A14	3451	3069	2950	1740 1714	1638	1500	1393	1206	1375	3450 υ (OH)
A15	3454	3105 3090	2950 2850	1712	1670	1595	1400	1163	1378	1328

Table12: ^{1}H-NMR of synthesized compound A13

Comp. No.	^{1}H-NMR
A13	(6.3-9) (m,14H,Ar-H), 9.4(s,1H,NH,)

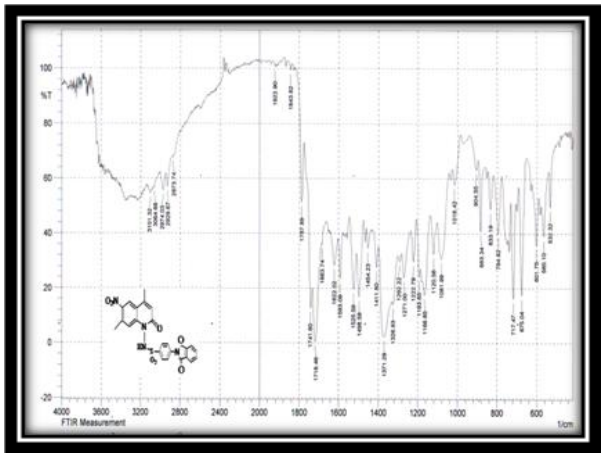


Figure 17: FTIR spectrum for compound [A12]

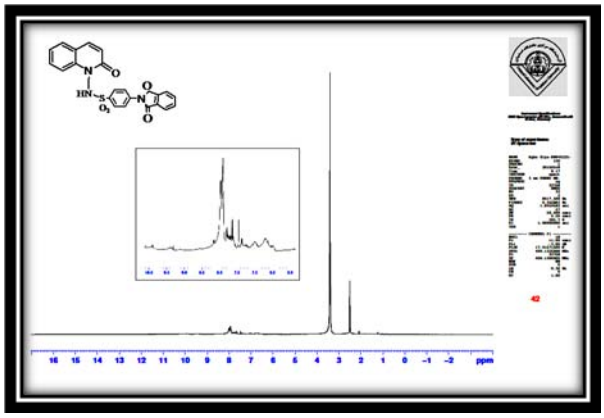


Figure 19: HNMR spectrum for compound [A13]

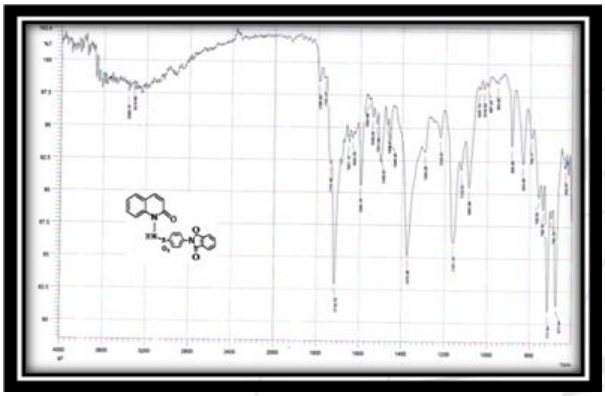


Figure 18: FTIR spectrum for compound [A14]

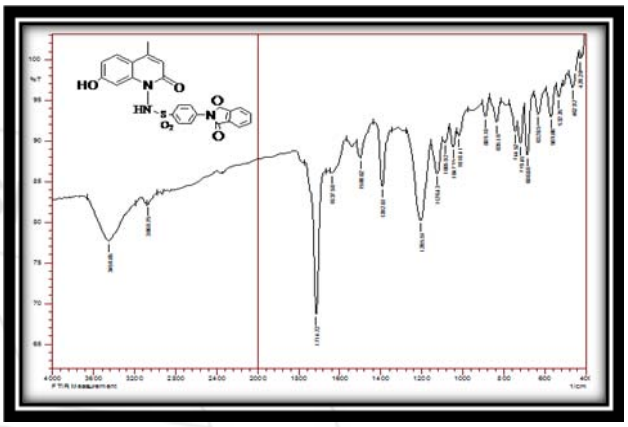


Figure 20: FTIR spectrum for compound[A14]

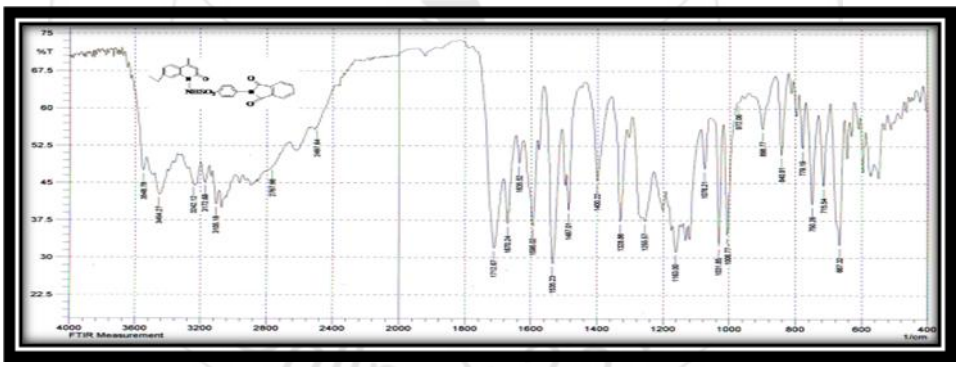


Figure 21: FTIR spectrum for comp ound [A15]

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