Phosphorus, Sulfur, and Silicon, 179:1907–1922, 2004 Copyright © Taylor & Francis Inc. ISSN: 1042-6507 print / 1563-5325 online DOI: 10.1080/10426500490466869



CHLOROSULPHONATION OF 2-ANILINO-1,4-NAPHTHOQUINONE AND SYNTHESIS OF NEWER SULPHONYL DERIVATIVES

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(Received November 26, 2003; accepted January 25, 2004)

Synthesis of 2-anilino-1,4-napthoquinone-3-sulphonyl chloride (2) was achieved from the reaction of the title compound with chlorosulphonic acid. The interesting derivative **2** was used as a building block for synthesis of the sulphonyl derivatives **3–24**. All these sulphonyl derivatives were characterized by the physical and spectral data (IR, Mass, ¹H- and ¹³C NMR spectra).

Keywords: 2-Anilino-1,4-naphthoquinone; chlorosulphonation; sulphonylpyrazole; sulphonylpyrazolone; sulphonylthiazolidinaone; sulphonyltriazole

INTRODUCTION

2,3-Disubstituted-1,4-naphthoquinones posseses biological importance.¹⁻⁵ On the other hand, the biological activity of certain pyrazoles,^{6.7} thiazolidinones,^{8.9} and sulphonyl derivatives^{10,11} have been studied. In view of these results and in continuation of our studies on 1,4-naphthoquinones,¹²⁻¹⁶ we considered it more attractive to chlorosulphonate a naphthoquinonoide compound so that it has a reactive position toward electrophiles. The chlorosulphonation of such compounds is not yet quoted in the chemical literature. 2-Anilino-1,4-nahthoquinone (1) used as a starting material for this reaction and synthesis of naphthoquinonoid systems contain sulphonamides, sulphonyl pyrazoles, sulphonyl thiazolidinones, and sulphonyl triazoles of expected biologiacal activity.

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RESULTS AND DISCUSSION

Chlorosulphonation of 1 was accomplished by using excess of chlorosulphonic acid to give 2-anilino-1,4-naphthoquinone-3-sulphonyl chloride 2. Then, compound 2 on refluxing with ammonium hydroxide yielded primary sulphonamide derivative 3a. The secondary sulphonamide derivatives 3b-d were achieved when 2 was reacted with aniline, *P*-toulidine, and *P*-anisidine, respectively. When 2 was treated with piperidine, morpholine, N-methyl piperazine, and N-phenyl piperazine, teriary sulphonamide derivatives 4a-d were produced, respectively (Scheme 1).

When **3a** was reacted with an appropriate aromatic aldehyeds namely benzaldehyde, *O*-anisaldehyde, and *P*-chlorobenzaldehyd under reflux in acetic acid and in the prescence of anhydrous sodium acetate, Shiff's base of types **4a–c** were obtained. Reaction of 4a with thioglycolic acid in dry benzine thiazolidinone derivative **5** was produced. Mannich's reaction of **5** with formaldehyde and in the prescence of morpholine gave 5-morpholinomethyl derivative **6**. Moreover, **5** was condensed with benzaldehyde to give benzylidene derivative **7** (Scheme 2).

On the other hand, sulphonylhydrazine derivative **9** was produced in about 80% yield from the reaction of **2** with hydrazine hydrate in prescence of pyridine. In ethanolic solution, the corresponding hydrazone **10** was obtained from the reaction of **9** with ethyl acetoacetate. Refluxing **10** in acetic acid yielded the cyclized product **11**, while the cyclized product **12a** was formed directly from reaction of **9** with acetylacetone in acetic acid. In a similar manner, **9** was reacted with chalcone, which was synthesized from benzaldehyde and acetophenone¹⁷ when **12b** was obtained (Scheme 3).

Similarly, reaction of **9** with 2-(hydroxymethylene) cyclohexanone¹⁸ afforded tetrahydro indazole derivative 13 as an alone product (TLC). Hydrazone **14** was furnished from condensation of **9** with acetophenone in ethanol with traces of acetic acid. On reaction with phosphrous oxychloride and dimethylformamide, this hydrazone lead to the formation of 4-formyl-3-phenyl-1-pyrazolyl derivative **15** (Scheme 3).

Moreover, refluxing of **9** with α -cyanoacetophenone¹⁹ in the presence of ethanole-acetic acid gave 5-amino-pyrazolyl derivative **16**, while 3amino-pyrazolyl derivative **17** was yielded under the same conditions from reaction of **9** with benzoylacetamide.²⁰ Analogously, **9** was reacted with benzoylacetic acid hydrazide²¹ to get 3-hydrazino-pyrazolyl derivative **18**, which was acetylated to achieve triazolo-pyrazole derivative **19**. The latter derivative **19** was also synthesized from reaction of **9** with N-acetyl benzoylacetic acid hydrazide in acetic acid-sodium acetate (Scheme 4).







Furthermore, treatment of **9** with phenylisothiocyanate afforded the corresponding thiocarbamoyl hydrazino derivative **20**, which was cyclized with phenacyl bromide to produce thiazoline derivative **21**. Compound **20** was also reacted with ethyl chloroacetate to give thiazolidinone derivative **22**. Condensation of **22** with *o*-anisaldehyde in the presense of triethylamine afforded **23** (Scheme 5).

Finally, triazole derivative **24** was yeilded from the reaction of **9** with benzoyl cyanide²² in molat ratio 2:1. The formation of **24** involves a somewhat similar pathway to that reported for the formation of sugar osatriazoles from osazone.²⁰ The probable reaction mechanism is shown in Scheme 6. The reaction between benzoyl cyanide and **9** apparently involves formation of the intermediate A, which immediately cyclized to **24** by loses a molecule of sulphonamide derivative **3a**.

The physical, IR, ¹H and ¹³C NMR data of the newly synthesized compounds are given in Tables I, II, III, and IV respectively.







EXPERIMENTAL

All melting points are uncorrected and were determined in capillary tube and Gallenkamp melting points apparatus. IR spectra were recorded in KBr on a Backman Infrared spectrophotometer PU, 9712 using KBr discs. ¹H and ¹³C NMR spectra were obtained on a Bruker AC 200(H:300, C:75 MHz) spectrometer with TMS as internal standard. The solvent were DMSO-d6 and CDCl3. δ -values are given in ppm. Mass spectra were recorded on SSQ, 7000 mass spectrometer at 70 eV. Microanalysis were performed at the microanalytical unit at Cairo University.



2-Anilino-1,4-napthoquinone-3-sulphonyl Chloride (2)

To a solution of 1 (2.4 g, 0.01 mol) in chloroform (100 ml), excess of chlorosulphonic acid (11.6 ml, 0.1 mol) was added with stiring for 2 h The mixture was kept at $80-100^{\circ}$ C for 20 h and then cooled. The solid product was filtered off and crystallized from dimethyformamide to give **2**.

2-Anilino-1,4-napthoquinone-3-sulphonamide (3)

A mixture of 2 (3.5 g, 0.01 mol), ammonium hydroxide (5 ml), or the proper amino compound (0.01 mol), namely aniline, p-toluidine, p-anisidine, piperidine, morpholine, N-methylpiperazine, and



N-phenylpiperazine in absolute ethanol (100 ml) and in the presence of pyridine (1 ml) was heated under reflux for 8 h. Then it was cooled, filtered off, and crystallized from acetic acid to give 3a-d and 4a-d, respectively.

2-Anilino-1,4-napthoquinone-3-benzylidine Sulphonamide (5)

A mixture of sulphonamide 3a (3.2 g, 0.01 mol) and benzaldehyde (1 ml, 0.01 mol) was refluxed in ethanol (50 ml) for 5 h. The solid was

Comp. no.	m.p. (°C)	Mol. formula (mol. wt.)	Yield (%)	MS. M ⁺	Calcd/Found analysis(%)			
					С	Η	Ν	S
2	220-221	$C_{16}H_{10}NO_4SCl$ (347.8)	70	347	55.25/ 54 91	2.89/ 3.13	4.03/	9.22/
3a	280	$C_{16}H_{12}N_2O_4S$ (328.4)	62	328	58.52/ 58.38	3.69/ 3.88	8.53/ 8.28	9.77/
3b	263–264	$C_{22}H_{16}N_2O_4S$ (404.4)	75	404	65.34/ 65.06	3.99/ 4.13	6.92/ 7.09	7.93/ 7.71
3c	271–272	$C_{23}H_{18}H_2O_4S$ (418.5)	71	—	66.01/ 65.90	4.34/ 4.45	6.70/ 6.89	7.66/ 7.43
3d	258	$\substack{C_{23}H_{18}N_2O_5S\\(434.5)}$	67	—	63.57/ 63.75	4.18/ 4.32	6.45/ 6.61	7.38/ 7.21
4a	293–295	$\substack{C_{21}H_{20}N_2O_4S\\(396.5)}$	65	396	$63.61/\ 63.51$	5.09/ 4.89	7.07/ 6.69	8.09/ 7.81
4b	298	$\substack{C_{20}H_{18}N_2O_5S\\(398.4)}$	65	398	60.29/ 60.46	4.55/ 4.73	7.03/ 6.91	8.05/ 8.31
4c	>300	$\begin{array}{c} C_{21}H_{21}N_{3}O_{4}S\\ (411.5)\end{array}$	61	—	61.29/ 61.01	5.16/ 5.34	10.21/ 10.40	7.79/ 7.51
4d	>300	$\substack{ C_{26}H_{23}N_3O_4S\\(473.5) }$	70	473	65.95/ 66.21	4.90/ 5.12	8.87/ 9.03	6.77/ 6.89
5	233–234	$\begin{array}{c} C_{23}H_{16}N_2O_4S \\ (416.5) \end{array}$	64	416	66.33/ 66.61	3.87/ 3.99	6.73/ 6.96	7.70/ 7.49
6	281	$C_{25}H_{18}N_2O_5S_2 \ (490.5)$	68	490	61.21/ 60.91	3.70/ 3.93	5.71/ 5.38	13.07/ 12.81
7	>300	$C_{31}H_{22}N_2O_5S_2$ (566.6)	70	_	65.71/ 65.88	3.91/ 4.11	4.94/ 4.69	11.32/ 11.58
8	255	$C_{30}H_{27}N_3O_6S_2$ (589.7)	75	489	61.10/ 60.87	4.62/ 4.51	7.13/ 6.92	10.87/
9	243-244	$C_{16}H_{12}N_3O_4S$ (342.4)	80	342	56.12/ 55.88	3.23/ 3.71	12.27/	9.37/ 9.61
10	210-212	$C_{22}H_{21}N_3O_6S$ (455.5)	68	400	58.01/ 57.80	4.65/ 4.91	9.23/ 8.98	7.04/ 6.83
11	200-201	(409.4)	00 79	409	58.43	3.09/ 3.91	10.20/	7.84/ 8.03
12a 19h	213-213	(407.4)	95	407 591	61.68	4.21/ 3.96	10.51/ 10.58	8.03
120	211-210	(531.6)	66	551	69.81	4.18	8.11	5.83
13	250_260	(401.5)	57	- 445	69.03	4.51	10.41/ 10.69	8.18 7.20/
15	202 204	(445.5)	68	440	64.43	4.50/ 4.57 2.55/	9.43/ 9.71	6.92
16	>300	$C_{26}H_{17}N_{3}O_{5}S$ (483.5) $C_{25}H_{18}N_{4}O_{4}S$	77	400 —	64.79 63.82/	3.77 3.85/	8.41 11.91/	6.84 6.82/
		(470.5)			64.03	4.11	12.09	6.58

TABLE I Physical and Analytical Data of the Newly Synthesized Compounds 2-24

(Continued on next page)

Comp. no.	m.p. (°C)	Mol. formula (mol. wt.)	Yield (%)	MS. M ⁺	Calcd/Found analysis (%)			
					С	Η	Ν	S
17	>300	$\mathrm{C}_{25}\mathrm{H}_{18}\mathrm{N}_{4}\mathrm{O}_{4}\mathrm{S}$	61	470	63.82/	3.85/	11.91/	6.82/
		(470.5)			63.99	3.61	11.73	7.10
18	290 - 292	$\mathrm{C}_{25}\mathrm{H}_{19}\mathrm{N}_{5}\mathrm{O}_{4}\mathrm{S}$	78	485	61.84/	3.94/	14.43/	6.61/
		(485.5)			62.01	4.19	14.62	6.82
19	263	$C_{27}H_{19}N_5O_4S$	68	509	63.64/	3.76/	13.75/	6.29/
		(509.5)			63.83	3.92	13.92	6.51
20	>300	$C_{23}H_{18}N_4O_4S_2$	76	478	57.73/	3.79/	11.71/	13.40/
		(478.5)			57.52	3.93	11.51	13.21
21	243	$C_{31}H_{22}N_4O_4S_2$	68	578	64.35/	3.83/	9.68/	11.08/
		(578.6)			64.16	3.99	9.42	10.91
22	266	$C_{25}H_{18}N_4O_5S_2$	57	518	57.90/	3.50/	10.80/	12.37/
		(518.5)			58.13	3.83	11.03	12.21
23	275	$C_{33}H_{24}N_4O_6S_2$	81	_	62.25/	3.80/	8.80/	10.07/
		(636.7)			62.39	3.99	8.62	9.89
24	>300	$\mathrm{C}_{24}\mathrm{H}_{17}\mathrm{N}_{5}\mathrm{O}_{4}\mathrm{S}$	72	471	61.13/	3.64/	14.85/	6.81/
		(471.5)			60.91	3.82	15.09	7.03

TABLE I Physical and Analytical Data of the Newly Synthesized

 Compounds 2–24 (Continued)

separated on cooling, filtered off, and recrystallized from ethanol to give 5.

2-Anilino-1,4-napthoquinone-3-sulphonyl Hydrazine (9)

A mixture of $\mathbf{2}$ (3.4 g, 0.01 mol) and hydrazine hydrate (0.5 ml, 0.01 mol) in ethanol (50 ml) was refluxed for 10 h. The formed solid after cooling was filtered off and crystallized from methanol to give $\mathbf{9}$.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-(ethyl-2'oxo-butyrate) Hydrazone (10)

A mixture of **9** (0.3 g, 0.01 mol) and ethyl acetoacetate (2 ml, 0.01 mol) in ethanol (50 ml) was heated at 80° C for 3 h. The mixture was cooled, and the formed solid was filtered off and crystallized from ethanol to give **10**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3'-methyl-5'pyrazolone (11)

A mixture of hydrazone 10 (4.5 g, 0.01 mol) and acetic acid (50 ml) was heated under reflux for 3 h. The mixture was left to cool. The formed solid was filtered off and crystallized from acetic acid to give 11.

TABLE II IR Spectral Data of the Compounds 2–24

Comp. no.	ν , cm ⁻¹
9	3910 (NH) 1686 (C-O) 1696 (C-C) 1335 (-NSO) 1905 (-SO)
2 39	$3426 \ 3110 \ (\text{NH}_2 \ \text{NH}) \ 1688 \ (C=0) \ 1614 \ (C=C) \ 1325 \ (-\text{NSO}_2 \) \ 1220 \ (-\text{SO}_2 \)$
Ja Sh	3320, 3180 (NH) 1683 (C-O) 1623 (C-C) 1320 (-NSO ₂ -) 1214 (-SO ₂ -)
30	$3223, 3100$ (NH), $1003(C=0), 1023(C=C), 1320(-NSO_2), 1214(-SO_2)$
34 34	$3215, 3200 \text{ (NH)}, 1666 \text{ (C=O)}, 1604 \text{ (C=C)}, 1326 \text{ (NSO}_2, 1266 \text{ (SO}_2, 1266 \text{ (NSO}_2, 1266 \text{ (SO}_2, 1266 $
Ju An	$3313, 3200$ (NII), 1000 (C=O), 1012 (C=O), 1303 (NOO ₂), 1210 (OO_2) 3313 (NH) 2010 2805 (CH ₂) 1683 (C=O) 1690 (C=C) 1392 (-NSO ₂ -) 1208
4a	$(-SO_2^{-})$
4b	3173 (NH), 2854 (CH ₂), 1681 (C=O), 1623 (C=C), 1326 (-NSO ₂ -), 1223 (-SO ₂ -)
4 c	$(-SO_2-)$ (NH), 2936, 2812 (CH ₂), 1683 (C=O), 1613 (C=C), 1328 (-NSO ₂ -), 1210 (-SO ₂ -)
4d	3278 (NH), 2913, 2808 (CH ₂), 1686 (C=O), 1623 (C=C), 1322 (-NSO ₂ -), 1208 (-SO ₂ -)
5	3122 (NH), 1683 (C=O), 1643 (C=N), 1611 (C=C), 1328 (-NSO ₂ -), 1226 (-SO ₂ -
6	3208 (NH), 1682, 1665 (C=O), 1603 (C=C), 1329 (-NSO ₂ -), 1180 (-SO ₂ -)
7	3180 (NH), 1683, 1677 (C=O), 1628, 1618 (C=C), 1324 (-NSO ₂ -), 1220 (-SO ₂ -)
8	3210(NH), 2932, 2893 (CH ₂), 1680, 1676 (C=O), 1616 (C=C), 1328(-NSO ₂ -), 1207 (-SO ₂ -)
9	3450, 3253, 3182 (NH ₂ , NH), 1688 (C=O), 1622 (C=C), 1325(-NSO ₂ -), 1223 (-SO ₂ -)
10	3110, 3050 (NH), 1686 (C=O), 1663 (C=N), 1621 (C=C), 1320 (-NSO ₂ -), 1225 (-SO ₂ -)
11	3212 (NH), 1682 (C=O), 1650 (C=N), 1613 (C=C), 1326 (-NSO ₂ -), 1222 (-SO ₂ -)
12a	3250 (NH), 1688 (C=O), 1643 (C=N), 1603 (C=C), 1332 (-NSO ₂ -), 1208 (-SO ₂ -)
12b	3192 (NH), 1680 (C=O), 1635 (C=N), 1612 (C=C), 1326 (-NSO ₂ -), 1225 (-SO ₂ -)
13	3210 (NH), 2912, 2906 (CH ₂), 1680 (C=O), 1644 (C=N), 1610 (C=C), 1338
	$(-NSO_2-)$, 1223 $(-SO_2-)$
14	3286, 3205 (NH), 1686 (C=O), 1644 (C=N), 1610 (C=C), 1325 (-NSO ₂ -), 1225
	$(-SO_2-)$
15	3128 (NH), 1685, 1680 (C=O), 1632 (C=N), 1606 (C=C), 1332 (-NSO ₂ -), 1230 (-SO ₂ -)
16	(302) (NH ₂ NH) 1686 (C=0) 1641 (C=N) 1606 (C=C) 1325 (-NSO ₂ -)
10	$1220(-SO_{2}-)$
17	3322, 3288, 3112 (NH ₂ , NH) 1688 (C=O) 1635 (C=N) 1611 (C=C) 1330
1.	$(-NSO_{2}-)$ 1208 $(-SO_{2}-)$
18	3405 3392 3238 3131 (NH ₂ NH) 1686 (C=0) 1648 (C=N) 1620 (C=C) 1332
10	$(-NSO_{2})$ 1990 $(-SO_{2})$
19	(10002), $1220(1002)3295$, 3116 (NH), 1682 (C=O), 1640 , 1632 (C=N), 1611 (C=C), 1326 (-NSO ₂ -)
15	$1220(-SO_{})$
20	3450 3320 (302) 3450 3320 3183 (NH) 1680 (C-O) 1613 (C-C) 1582 (N C-S) 1320 ($-NSO_{2}$)
20	1994 (_SO)
91	$1224 (-502^{-})$ 2995 2120 (NH) 1682 (C-O) 1696 (C-C) 1642 (C-N) 1238 (-NSO2-) 1996
21	$(-SO_{-})$
9 9	(-502^{-}) 2905 2110 (NH) 1622 (C-O) 1625 (C-N) 1612 (C-O) 1226 (-NSO ₂ -) 1226
44	$(-SO_{})$ (101), 1000 ((-0), 1000 ((-1)), 1013 ((-0), 1320 (-10002-), 1220
99	(302) (302) (NH) 1689 (C-O) 1686 (C-N) 1616 (C-C) 1999 (-NGO) 1995
40	$(-SO_2-)$ (1011), 1002 (C-O), 1000 (C-N), 1010 (C-O), 1000 (CNSO_2-), 1220
24	3330, 3128 (NH ₂ , NH), 1683 (C=O), 1642, 1637 (C=N), 1611 (C=C), 1335 (-NSO ₂), 1226 (-SO ₂)

Comp. no.	δ , ppm						
3a	9.8 (s, 2H, NH ₂), 7.3–7.9 (m, 9H, Ar-H), 6.1 (s, 1H, NH, D ₂ O exchangeable)						
3b	$9.1 (s, 1H, NH), 7.0-7.5 (m, 14H, Ar-H), 6.3 (s, 1H, NH, D_2O exchangeable)$						
3c	$2.2~(\rm{s},3H,Ar\text{-}CH_3),5.8~(\rm{s},1H,NH),7.1\text{-}7.8~(m,13H,Ar\text{-}H),9.2~(\rm{s},1H,NH,D_2O~exchangeable)$						
3d	$3.5\ (s, 3H, Ar-OCH_3), 5.9\ (s, 1H, NH), 6.9–7.8\ (m, 13H, Ar-H), 9.7\ (s, 1H, NH, D_2O\ exchangeable)$						
4a	1.9–2.5 (m, 10H, pipridine-H), 6.2 (s, 1H, NH, $\rm D_2O$ exchangeable), 7.1–7.8 (m, 9H, Ar-H)						
4b	3.5–3.8 (m, 8H, morpholine-H), 6.0 (s, 1H, NH, D ₂ O exchangeable), 7.0–7.3 (m, 9H, Ar-H)						
4c	2.2–2.4 (m, 8H, piprazine-H), 3.4 (s, 3H, N-CH ₃), 5.8 (s, 1H, NH, D ₂ O exchangeable), 7.3–7.6 (m, 9H, Ar-H)						
4d	3.1–3.3 (m, 8H, piprazine-H), 6.1 (s, 1H, NH, D ₂ O exchangeable), 6.9–7.7 (m, 4H, Ar-H)						
5	5.8 (s, 1H, NH, D ₂ O exchangeable), 6.3 (s, 1H, N=CH), 7.1–7.4 (m, 14H, Ar-H), 8.9 (s, 1H, NH)						
10	1.3 (t, 3H, CH ₂ C <u>H₃</u>), 2.2 (s, 3H, CH ₃ -C=N), 3.4 (s, 2H, CH ₂ CO), 4.1 (q, 2H, CH ₂ CH ₃), 5.6 (s, 1H, NH), 7.1–7.6 (m, 9H, Ar-H), 11.1 (br, 1H, NH)						
11	2.3 (s, 3H, CH ₃ –C=N), 3.5 (s, 2H, CH ₂ CO), 5.6 (s, 1H, NH), 6.8–7.3 (m, 9H, Ar-H)						
12a	$2.5\ ({\rm s},6{\rm H},2{\rm CH}_3),4.1\ ({\rm s},1{\rm H},{\rm C}_4{-}{\rm H}$ pyrazole), $5.8\ ({\rm s},1{\rm H},{\rm NH}),7.1{-}7.5\ ({\rm m},9{\rm H},{\rm Ar-H})$						
12b	$3.8 (s, 1H, C_4-H pyrazole), 5.7 (s, 1H, NH), 6.9-7.8 (br, 19H, Ar-H)$						
13	1.7–2.0, 2.4–2.8 (m, 8H, 4CH ₂), 6.6 (s, 1H, C ₃ -H pyrazole), 5.8 (s, 1H, NH), 7.0–7.4 (m, 9H, Ar-H)						
14	$3.1 (s, 3H, CH_3 - C = N), 5.6 (s, 1H, NH), 6.8 - 7.7 (m, 14H, Ar-H), 9.7 (br, 1H, NH)$						
15	5.6 (s, 1H, NH, D ₂ O exchangeable), 7.2–8.5 (m, 15H, Ar-H, C ₅ –H pyrazole), 10.2 (s, 1H, C <u>H</u> O)						
16	5.8 (s, 1H, NH), 6.5 (s, 1H, C ₃ –H pyrazole), 7.3–7.6 (m, 14H, Ar-H), 8.9 (br, 2H, NH ₂)						
17	3.9 (s, 1H, C ₄ -H pyrazole), 5.6 (s, 1H, NH), 7.1–7.5 (m, 14H, Ar-H), 9.3 (br, 2H, NH ₂)						
18	3.6 (s, 1H, C ₄ -H pyrazole), 5.5 (s, 1H, NH), 5.8 (s, 2H, NH ₂), 7.0–7.8 (m, 14H, Ar-H), 9.1 (s, 1H, NH)						
19	2.8 (s, 3H, CH ₃ -C=N), 5.1 (s, 1H, NH), 7.2–7.7 (m, 14H, Ar-H)						
21	3.4 (br, 1H, NH), 5.1 (s, 1H, C ₅ –H thiazoline), 5.8 (s, 1H, NH), 6.7–7.6 (m, 19H, Ar-H)						
22	$3.9 (s, 2H, C_5-H \text{ thiazolidinone}), 4.1 (s, 1H, NH), 5.7 (s, 1H, NH), 7.1-7.3 (m, 1H, NH), 7.1-7.3 (m, 1H, NH)$						

TABLE III ¹H-NMR Spectral Data of Some New Synthesized Compounds

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3', 5'-dimethyl Pyrazole (12a)

 $5.8~(s,\,1H,\,NH),\,6.2~(br,\,2H,\,NH_2),\,6.8\text{--}7.9~(m,\,14H,\,Ar\text{-}H)$

14H, Ar-H)

 $\mathbf{24}$

A mixture of **9** (3.4 g, 0.01 mol) and acetylacetone (2 ml, 0.02 mol) in acetic acid (50 ml) was refluxed for 5 h. The mixture was left to cool.

Comp. no.	δ , ppm
3c	182.3, 181.6, 152.0, 151.8, 140.0, 138.1, 133.9, 132.8, 128.1, 126.7, 126.3, 126.2,
3d	125.9, 125.7, 125.3, 125.2, 124.8, 124.6, 124.3, 124.2, 124.0, 123.8, 222.3 181.6, 181.0, 151.7, 151.2, 140.3, 137.8, 133.8, 132.7, 127.9, 126.6, 126.3, 126.1, 126.0, 125.8, 125.6, 125.5, 125.3, 125.2, 124.8, 124.5, 124.1, 35.6
4a	181.8, 181.2, 152.2, 151.8, 140.3, 133.9, 133.4, 131.1, 126.5, 125.8, 125.4, 125.2, 124.8, 124.6, 124.1, 123.7, 37.8, 34.9, 29.6, 26.5, 25.3
4b	182.3, 181.6, 153.1, 151.6, 140.1, 134.2, 133.8, 131.6, 126.8, 125.1, 125.0, 124.8, 124.6, 124.5, 124.0, 123.7, 39.6, 38.2, 37.7, 37.3
4c	181.6, 181.0, 152.8, 152.0, 140.9, 134.8, 133.7, 132.1, 127.1, 126.2, 125.6, 125.3, 124.7, 124.6, 124.3, 123.9, 41.0, 39.8, 35.6, 34.8, 22.8
4d	$182.1, 181.8, 152.5, 149.8, 140.4, 136.6, 133.8, 133.1, 126.8, 126.4, 125.8, 125.7, \\125.5, 125.1, 124.6, 124.4, 124.6, 123.9, 123.8, 123.5, 123.4, 123.1, 41.3, \\40.1, 36.5, 35.8$
11	181.9, 180.8, 170.3, 156.3, 154.2, 123.8, 141.3, 134.9, 134.6, 131.6, 127.3, 125.8, 125.8, 124.8, 124.5, 124.2, 123.9, 122.4, 44.6
13	182.1, 181.7, 154.0, 153.8, 141.1, 140.2, 134.6, 134.0, 131.5, 126.3, 125.2, 124.9, 124.7, 124.6, 124.4, 124.1, 123.8, 120.9, 24.0, 23.3, 22.6, 20.8
22	182.3, 181.6, 170.4, 154.3, 154.1, 153.6, 141.0, 134.5, 134.1, 131.8, 127.0, 126.1, 124.9, 124.6, 124.2, 124.0, 123.9, 120.8, 43.0

TABLE IV¹³C-NMR Spectral Data of the Compounds 3c, 3d, 4a-d, 11, 13,and 22

The formed solid was filtered off and crystallized from acetic acid to give **12a**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3',5'diphenyl Pyrazole (12b)

A mixture of 9 (3.4 g, 0.01 mol), benzal actophenone (2 g, 0.01 mol) and a few drops of pipridine in ethanol (50 ml) was refluxed for 9 h. The mixture was left to cool. The formed solid was filtered off and crystallized from ethanol to give **12b**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-4',5',6',7'tetrahydro-1H-indazole (13)

A mixture of 9 (3.4 g, 0.01 mol) and 2-hydroxymethylene cyclohexanone (1.2 g, 0.01 mol) in ethanol (50 ml) containing a few drops of hydrochloric acid was refluxed for 3 h. The mixture was concentrated and was left to cool. The formed solid was filtered off and crystallized from ethanol to give **13**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-(acetophenono)hydrazone (14)

A mixture of 9 (3.4 g, 0.01 mol) and acetophenone (1.2 ml, 0.01 mol) in ethanol (50 ml) containing a few drops of acetic acid was refluxed for 6 h. The mixture was concentrated and was left to cool. The formed solid was filtered off and crystallized from ethanol to give 14.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3'-phenyl-4'formyl-pyrazole (15)

To the Vilsmeir Huck Complex, prepared from dimethylformamide (10 ml) and phosphrous oxychloride (1.5 g, 0.01 mol) at 0°C, the hydrazone 14 (4.4 g, 0.02 mol) was added and the reaction mixture was heated for 2 h. The reaction mixture was cooled and poured into ice-cold water. The product which separated on neutralization with sodium bicarbonate was filtered off and crystallized froom ethanol/dimethylformamide to give 15.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-5'-amino-4'phenyl-pyrazole (16)

A mixture of **9** (3.4 g, 0.01 mol) and α -cyano-acetophenone (1.4 g, 0.01 mol) was refluxed in ethanol (50 ml) containing acetic acid (50 ml) for 5 h. The reaction mixture was left to cool. The formed solid was filtered off, washed with water, and crystallized from ethanol to give **16**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3'-amino-5'phenyl-pyrazole (17)

A mixture of 9 (3.4 g, 0.01 mol) and benzoylacetamide (1.6 g, 0.01 mol) was refluxed in ethanol (50 ml) containing acetic acid (50 ml) for 3 h. The reaction mixture was left to cool. The formed solid was filtered off, washed with water, and crystallized from acetic acid to give 17.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3'hydrazino-5'-phenyl-pyrazole (18)

A mixture of **9** (3.4 g, 0.01 mol) and benzoylacetic acid hydrazide (1.7 g, 0.01 mol) was refluxed in ethanol (50 ml) containing acetic acid (50 ml) for 3 h. The reaction mixture was left to cool. The formed solid was filtered off, washed with water, and crystallized from ethanol to give **18**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-3'-methyl-5'phenyl-1',2',4'-triazolo[4,5-b]pyrazole (19)

a) A mixture of 18 (4.8 g, 0.01 mol) in acetic anhydride (50 ml) was heated for 3 h and then left to cool. The formed solid was filtered off and crystallized from ethanol to give 19.

b) A mixture of 9 (3.4 g, 0.01 mol) and N-acetyl benzoylacetic acid hydrazide (2.2 g, 0.01 mol) in ethanol (100 ml) containing aceti acid (5 ml) was refluxed for 5 h and then left to cool. The formed solid was filtered off and crystallized from ethanol to give **19**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-Nthiocarbamoyl Hydrazine (20)

A solution of **9** (3.4 g, 0.01 mol) in ethanol (100 ml) was stirred with phenyl isothiocyanate (1.3 ml, 0.01 mol) for 1 h at room temperature and then water (5 ml) was added. The formed solid was filtered off and crystallized from methanol to give **20**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-(3',4'diphenyl thiazolin-2'-ylidene) Hydrazine (21)

To a solution of 20 (4.7 g, 0.01 mol) in chloroform (50 ml) phenacyl bromide (2 g, 0.01 mol) was added. The mixture was stirred for 1 h. The solvent was removed under reduced pressure. The residue was dissolved in ethanol and then treated with a solution of saturated sodium acetate (20 ml). The formed solid was filtered and crystallized from methanol to give 21.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-(3'-phenyl-4'-thiazolidinon-2'-ylidene) Hydrazine (22)

A mixture of 20 (4.7 g, 0.01 mol) in absolute ethanol (50 ml), ethyl chloroacetate (1.2 g, 0.01 mol) and anhydrous sodium acetate (1.7 g, 0.02 mol) was refluxed for 2 h. Water (20 ml) was added. The formed solid was filtered off and crystallized from methanol to give **22**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-[(3'-phenyl-5'-benzylidene-4'-thiazolidinon-2'-ylidene)] Hydrazine (23)

A mixture of **22** (5.1 g, 0.01 mol) in methanol, *O*-anisaldehyde (1.3 g, 0.01 mol) and triethylamine (1 ml) was heated under reflux for 10 h. The formed solid was filtered and recrystallized from ethanol to give **23**.

2-Anilino-1,4-napthoquinone-3-sulphonyl-N-5'-phenyl-4'amino-2H-1',2',3'-triazole (24)

To benzoyl cyanide (1.3 g, 0.01 mol) was added **9** (3.4 g, 0.01 mol) during 10 min. The reaction mixture was stirred for 2 h. The mixture was refluxed at 80°C for 3 h, left to cool, and washed with diluted hydrochloric acid $(2 \times 5 \text{ ml})$. The formed solid was filtered off and recrystallized from ethanol to give **24**.

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