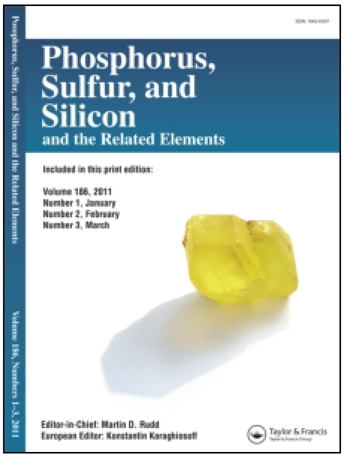


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

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

Moged A. Berghot[a]; Nayef S. Almuaikel[b]
[a] Chemistry Department, Faculty of Science, Mansoura University, Mansoura, Egypt [b] Aljouf, Teachers College, Skaka Aljouf, Saudia Arabia

To cite this Article Berghot, Moged A. and Almuaikel, Nayef S.(2004) 'CHLOROSULPHONATION OF 2-ANILINO-1,4-NAPHTHOQUINONE AND SYNTHESIS OF NEWER SULPHONYL DERIVATIVES', Phosphorus, Sulfur, and Silicon and the Related Elements, 179: 10, 1907 — 1922

To link to this Article: DOI: 10.1080/10426500490466869

URL: http://dx.doi.org/10.1080/10426500490466869

Phosphorus, Sulfur, and Silicon, 179:1907–1922, 2004

ISSN: 1042-6507 print / 1563-5325 online
DOI: 10.1080/10426500490466869

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

Moged A. Berghot[a] *and Nayef S. Almuaikel*[b]
Chemistry Department, Faculty of Science, Mansoura University, Mansoura, Egypt;[a] *and Aljouf, Teachers College, Skaka Aljouf, Saudia Arabia*[b]

(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 ^{13}C 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.

Address correspondence to Moged A. Berghot, Chemistry Department, Faculty of Science, Mansoura University, Mansoura, Egypt. E-mail: dal_mag@hotmail.com

RESULTS AND DISCUSSION

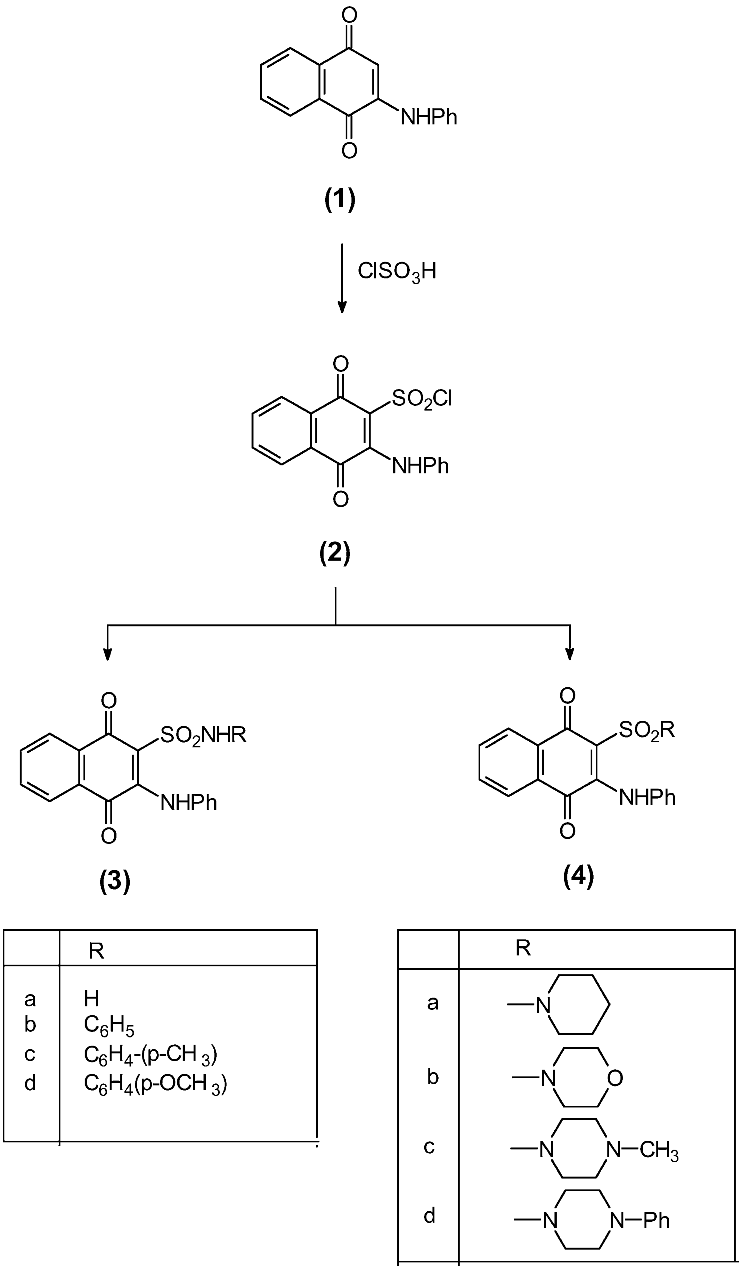
Chlorosulphonation of **1** was accomplished by using excess of chlorosulphonic acid to give 2-anilino-1,4-naphthoquinone-3-sulphonyl chloride **2**. Then, compound **2** on refluxing with ammonium hydroxide yielded primary sulphonamide derivative **3a**. The secondary sulphonamide derivatives **3b–d** 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).

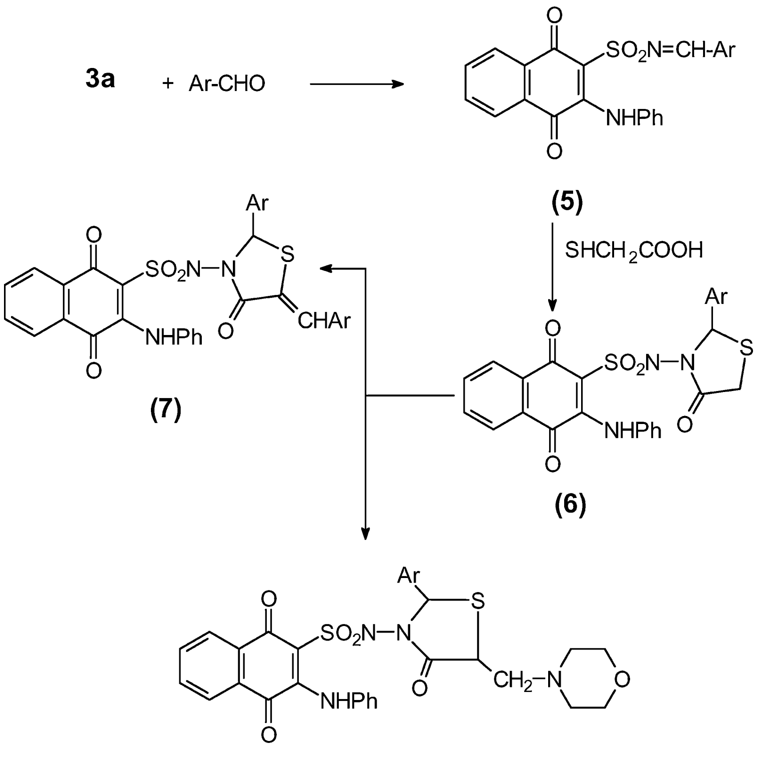
On the other hand, sulphonylhydrazine derivative **9** was produced in about 80% yield from the reaction of **2** with hydrazine hydrate in prescence of pyridine. In ethanolic solution, the corresponding hydrazone **10** was obtained from the reaction of **9** with ethyl acetoacetate. Refluxing **10** 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 acetophenone[17] when **12b** was obtained (Scheme 3).

Similarly, reaction of **9** with 2-(hydroxymethylene) cyclohexanone[18] 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-cyanoacetophenone[19] in the presence of ethanole-acetic acid gave 5-amino-pyrazolyl derivative **16**, while 3-amino-pyrazolyl derivative **17** was yielded under the same conditions from reaction of **9** with benzoylacetamide.[20] Analogously, **9** was reacted with benzoylacetic acid hydrazide[21] to get 3-hydrazino-pyrazlolyl 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).


O
NHPh
O
(1)
ClSO3H
O
SO2Cl
NHPh
O
(2)
O
SO2NHR
NHPh
O
(3)
O
SO2R
NHPh
O
(4)
R
a H
b C6H5
c C6H4-(p-CH3)
d C6H4(p-OCH3)
R
a
b
c
d
N
N O
N N–CH3
N N–Ph

SCHEME 1



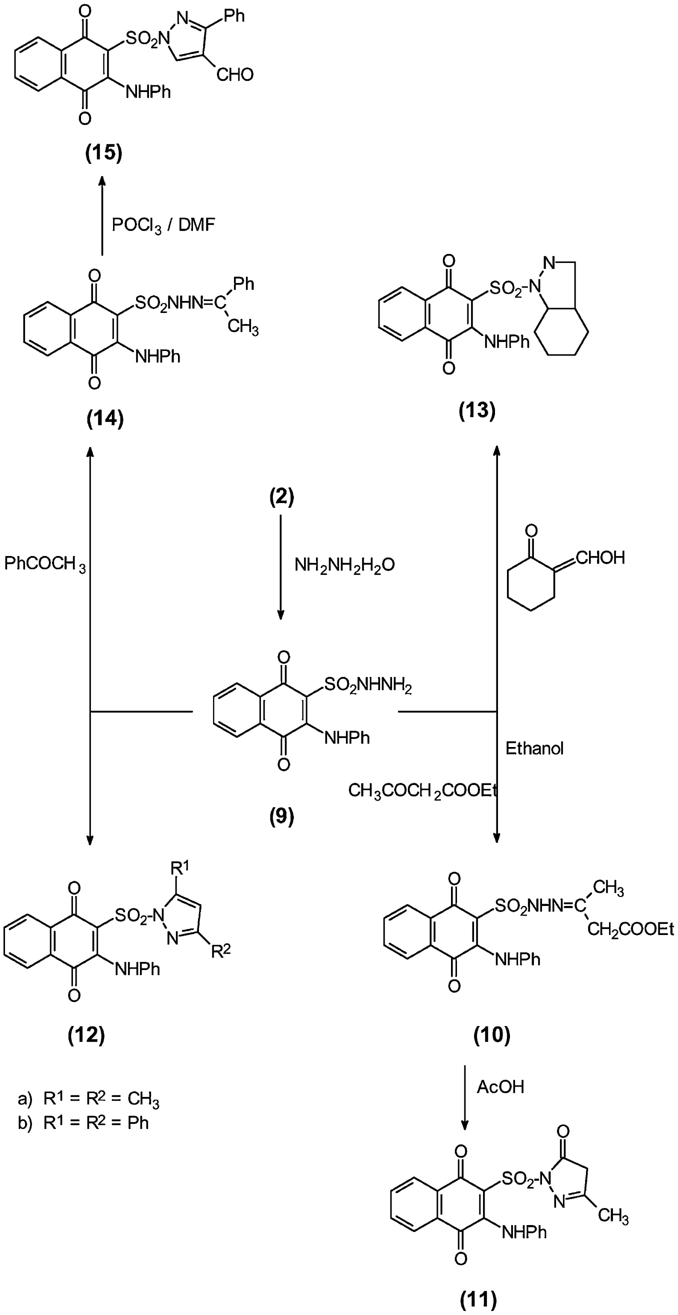
(8)

SCHEME 2

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).

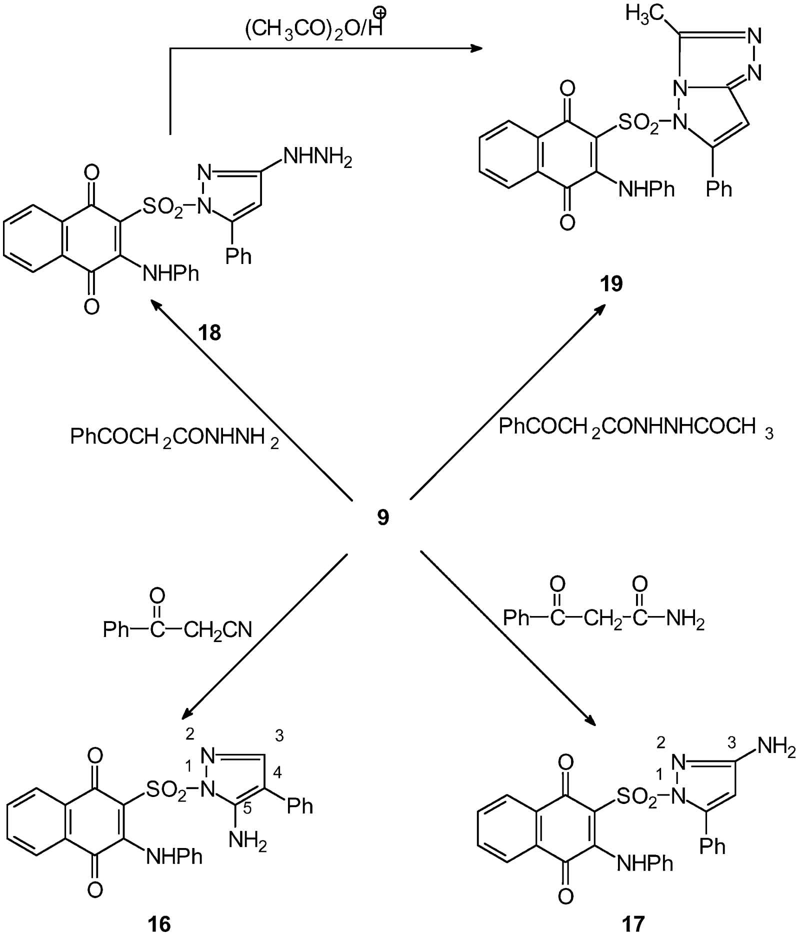
Finally, triazole derivative **24** was yeilded from the reaction of **9** with benzoyl cyanide[22] in molat ratio 2:1. The formation of **24** involves a somewhat similar pathway to that reported for the formation of sugar osatriazoles from osazone.[20] The probable reaction mechanism is shown in Scheme 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, ^{1}H and ^{13}C NMR data of the newly synthesized compounds are given in Tables I, II, III, and IV respectively.



(15)
POCl3 / DMF
(14)
(13)
(2)
NH2NH2H2O
PhCOCH3
Ethanol
CH3COCH2COOEt
(9)
(12)
(10)
AcOH
(11)
SO2N
NHPh
CHO
Ph
SO2NHN=C
CH3
SO2-N
SO2NHNH2
CHOH
R1
R2
CH2COOEt
a) R1 = R2 = CH3
b) R1 = R2 = Ph

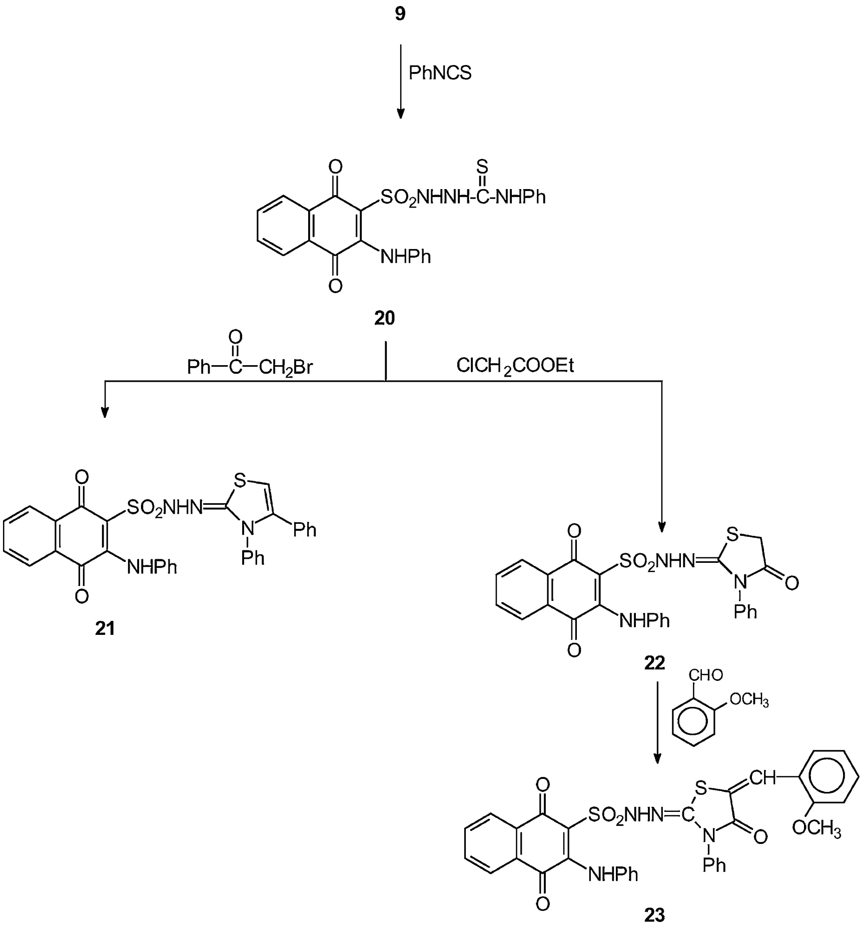
SCHEME 3



SCHEME 4

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 ^{13}C 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.



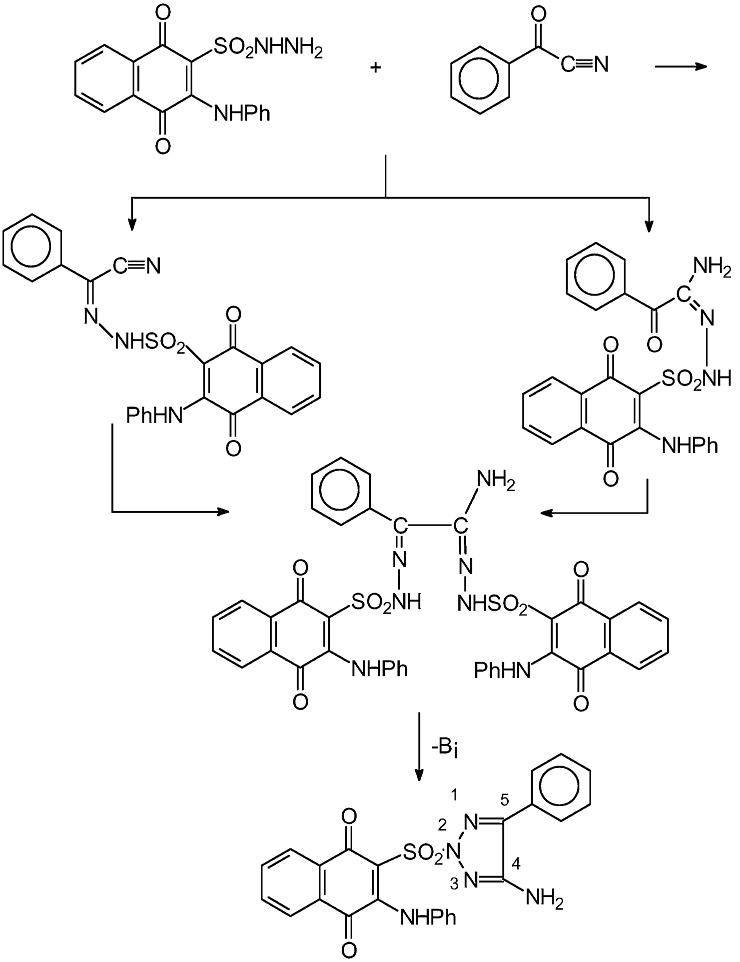
SCHEME 5

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°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



24

SCHEME 6

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

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

Comp. no.	m.p. (°C)	Mol. formula (mol. wt.)	Yield (%)	MS. M^+	Calcd/Found analysis(%)			
					C	H	N	S
2	220–221	$C_{16}H_{10}NO_4S\,Cl$ (347.8)	70	347	55.25/ 54.91	2.89/ 3.13	4.03/ 3.82	9.22/ 8.93
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/ 9.62
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	$C_{23}H_{18}N_2O_5S$ (434.5)	67	—	63.57/ 63.75	4.18/ 4.32	6.45/ 6.61	7.38/ 7.21
4a	293–295	$C_{21}H_{20}N_2O_4S$ (396.5)	65	396	63.61/ 63.51	5.09/ 4.89	7.07/ 6.69	8.09/ 7.81
4b	298	$C_{20}H_{18}N_2O_5S$ (398.4)	65	398	60.29/ 60.46	4.55/ 4.73	7.03/ 6.91	8.05/ 8.31
4c	>300	$C_{21}H_{21}N_3O_4S$ (411.5)	61	—	61.29/ 61.01	5.16/ 5.34	10.21/ 10.40	7.79/ 7.51
4d	>300	$C_{26}H_{23}N_3O_4S$ (473.5)	70	473	65.95/ 66.21	4.90/ 5.12	8.87/ 9.03	6.77/ 6.89
5	233–234	$C_{23}H_{16}N_2O_4S$ (416.5)	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/ 10.61
9	243–244	$C_{16}H_{12}N_3O_4S$ (342.4)	80	342	56.12/ 55.88	3.23/ 3.71	12.27/ 12.00	9.37/ 9.61
10	210–212	$C_{22}H_{21}N_3O_6S$ (455.5)	68	455	58.01/ 57.80	4.65/ 4.91	9.23/ 8.98	7.04/ 6.83
11	280–281	$C_{20}H_{15}N_3O_5S$ (409.4)	65	409	58.67/ 58.43	3.69/ 3.91	10.26/ 10.01	7.84/ 8.03
12a	273–275	$C_{21}H_{17}N_3O_4S$ (407.4)	72	407	61.90/ 61.68	4.21/ 3.96	10.31/ 10.58	7.87/ 8.03
12b	277–278	$C_{31}H_{21}N_3O_4S$ (531.6)	85	531	70.04/ 69.81	3.98/ 4.18	7.90/ 8.11	6.03/ 5.83
13	230	$C_{23}H_{19}N_3O_2S$ (401.5)	66	—	68.80/ 69.03	4.77/ 4.51	10.47/ 10.69	7.99/ 8.18
14	259–260	$C_{24}H_{19}N_3O_4S$ (445.5)	57	445	64.70/ 64.43	4.30/ 4.57	9.43/ 9.71	7.20/ 6.92
15	293–294	$C_{26}H_{17}N_3O_5S$ (483.5)	68	483	64.58/ 64.79	3.55/ 3.77	8.69/ 8.41	6.63/ 6.84
16	>300	$C_{25}H_{18}N_4O_4S$ (470.5)	77	—	63.82/ 64.03	3.85/ 4.11	11.91/ 12.09	6.82/ 6.58

(*Continued on next page*)

TABLE I Physical and Analytical Data of the Newly Synthesized Compounds **2–24** (*Continued*)

Comp. no.	m.p. (°C)	Mol. formula (mol. wt.)	Yield (%)	MS. M^+	Calcd/Found analysis (%) C	H	N	S
17	>300	$C_{25}H_{18}N_4O_4S$ (470.5)	61	470	63.82/ 63.99	3.85/ 3.61	11.91/ 11.73	6.82/ 7.10
18	290–292	$C_{25}H_{19}N_5O_4S$ (485.5)	78	485	61.84/ 62.01	3.94/ 4.19	14.43/ 14.62	6.61/ 6.82
19	263	$C_{27}H_{19}N_5O_4S$ (509.5)	68	509	63.64/ 63.83	3.76/ 3.92	13.75/ 13.92	6.29/ 6.51
20	>300	$C_{23}H_{18}N_4O_4S_2$ (478.5)	76	478	57.73/ 57.52	3.79/ 3.93	11.71/ 11.51	13.40/ 13.21
21	243	$C_{31}H_{22}N_4O_4S_2$ (578.6)	68	578	64.35/ 64.16	3.83/ 3.99	9.68/ 9.42	11.08/ 10.91
22	266	$C_{25}H_{18}N_4O_5S_2$ (518.5)	57	518	57.90/ 58.13	3.50/ 3.83	10.80/ 11.03	12.37/ 12.21
23	275	$C_{33}H_{24}N_4O_6S_2$ (636.7)	81	—	62.25/ 62.39	3.80/ 3.99	8.80/ 8.62	10.07/ 9.89
24	>300	$C_{24}H_{17}N_5O_4S$ (471.5)	72	471	61.13/ 60.91	3.64/ 3.82	14.85/ 15.09	6.81/ 7.03

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

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

A mixture of **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 **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}
2	3210 (NH), 1686 (C=O), 1626 (C=C), 1335 (—NSO_2—), 1205 (—SO_2—)
3a	3426, 3110 (NH_2, NH), 1688 (C=O), 1614 (C=C), 1325 (—NSO_2—), 1220 (—SO_2—)
3b	3329, 3180 (NH), 1683 (C=O), 1623 (C=C), 1320 (—NSO_2—), 1214 (—SO_2—)
3c	3224, 3110 (NH), 1683 (C=O), 1604 (C=C), 1326 (—NSO_2—), 1205 (—SO_2—)
3d	3315, 3200 (NH), 1686 (C=O), 1612 (C=C), 1305 (—NSO_2—), 1218 (—SO_2—)
4a	3212 (NH), 2910, 2895 (CH_2), 1683 (C=O), 1620 (C=C), 1322 (—NSO_2—), 1208 (—SO_2—)
4b	3173 (NH), 2854 (CH_2), 1681 (C=O), 1623 (C=C), 1326 (—NSO_2—), 1223 (—SO_2—)
4c	3208 (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	3310, 3206 (NH_2, NH), 1686 (C=O), 1641 (C=N), 1606 (C=C), 1325 (—NSO_2—), 1220(—SO_2—)
17	3322, 3288, 3112 (NH_2, NH), 1688 (C=O), 1635 (C=N), 1611 (C=C), 1330 (—NSO_2—), 1208 (—SO_2—)
18	3405, 3392, 3238, 3131 (NH_2, NH), 1686 (C=O), 1648 (C=N), 1620 (C=C), 1332 (—NSO_2—), 1220 (—SO_2—)
19	3225, 3116 (NH), 1682 (C=O), 1640, 1632 (C=N), 1611 (C=C), 1326 (—NSO_2—), 1220 (—SO_2—)
20	3450, 3320, 3183 (NH), 1680 (C=O), 1613 (C=C), 1582 (N-C=S), 1320 (—NSO_2—), 1224 (—SO_2—)
21	3225, 3130 (NH), 1683 (C=O), 1626 (C=C), 1643 (C=N), 1338 (—NSO_2—), 1226 (—SO_2—)
22	3205, 3110 (NH), 1683 (C=O), 1635 (C=N), 1613 (C=C), 1326 (—NSO_2—), 1226 (—SO_2—)
23	3205, 3132 (NH), 1682 (C=O), 1636 (C=N), 1616 (C=C), 1333 (—NSO_2—), 1225 (—SO_2—)
24	3330, 3128 (NH_2, NH), 1683 (C=O), 1642, 1637 (C=N), 1611 (C=C), 1335 (—NSO_2—), 1226 (—SO_2—)

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

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_2O 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 (s, 3H, Ar-CH_3), 5.8 (s, 1H, NH), 7.1–7.8 (m, 13H, Ar-H), 9.2 (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, 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_2O 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_2O exchangeable), 7.3–7.6 (m, 9H, Ar-H)
4d	3.1–3.3 (m, 8H, piprazine-H), 6.1 (s, 1H, NH, D_2O exchangeable), 6.9–7.7 (m, 4H, Ar-H)
5	5.8 (s, 1H, NH, D_2O 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, $CH_2C\underline{H}_3$), 2.2 (s, 3H, CH_3-C=N), 3.4 (s, 2H, CH_2CO), 4.1 (q, 2H, $C\underline{H}_2CH_3$), 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_2CO), 5.6 (s, 1H, NH), 6.8–7.3 (m, 9H, Ar-H)
12a	2.5 (s, 6H, $2CH_3$), 4.1 (s, 1H, C_4—H pyrazole), 5.8 (s, 1H, NH), 7.1–7.5 (m, 9H, 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_2O exchangeable), 7.2–8.5 (m, 15H, Ar-H, C_5—H pyrazole), 10.2 (s, 1H, $C\underline{H}O$)
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 thiazolidinone), 4.1 (s, 1H, NH), 5.7 (s, 1H, NH), 7.1–7.3 (m, 14H, Ar-H)
24	5.8 (s, 1H, NH), 6.2 (br, 2H, NH_2), 6.8–7.9 (m, 14H, Ar-H)

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

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.

TABLE IV ^{13}C-NMR Spectral Data of the Compounds **3c, 3d, 4a–d, 11, 13,** and **22**

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, 125.9, 125.7, 125.3, 125.2, 124.8, 124.6, 124.3, 124.2, 124.0, 123.8, 222.3
3d	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

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-N-thiocarbamoyl 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 × 5 ml). The formed solid was filtered off and recrystallized from ethanol to give **24**.

REFERENCES

[1] R. S. Venkata, G. M. Omprakash, and C. L. Subrahmanyam, *Indian J. Chem.*, **35**(B), 1349–1350 (1996).

[2] D. A. AL Sammerrai and S. Salih, *J. Chem. Eng. Data*, **32,** 390–29 (1987).

[3] D. A. AL Sammerrai, J. T. Ralph, and D. E. West, *J. Hetecyc. Chem.*, **17,** 1705–1707 (1980).

[4] A. B. Combs, T. H. Porter, and K. Folkers, *Res. Commun. Chem. Pathol. Pharmacol.*, **13,** 109–110 (1976).

[5] M. J. Weiss, G. S. Redin, G. R. Allen, A. C. Dornbush, H. L. Lindsay, J. F. Polleto, W. A. Remers, R. H. Roth, and A. E. Sloboda, *J. Med. Chem.*, **11,** 742–743 (1968).

[6] M. B. El-Kashef, M. A. Abdallah, B. E. Bayoumi, and A. M. El-Tamaruy, *J. Chem. Tech. Biotechnol.*, **56,** 249 (1983).

[7] E. A. Kira and H. Fahmy, *J. Pharm. Belgique*, **33,** 303 (1978).

[8] M. S. Shingare, *Indian J. Chem.*, **22B,** 714–715 (1983).

[9] P. Kumar, C. Nath, K. P. Bhargava, and K. Shanker, *Indian J. Chem.*, **21**(B), 1128–1129 (1982).

[10] M. A. Hanna, M. M. Girges, and M. A. Berghot, *Phosphorus Sulfur Silicon*, **61,** 239 (1991).

[11] J. A. Picard and P. O. Brien, *J. Med. Chem*, **39,** 1243 (1996).

[12] M. A. Berghot, H. H. Zoorob, M. M. Abou-Elzahab, and F. A. Amer, *Mansoura Science Bull.*, **27**(1), 91 (2000).

[13] M. A. Berghot, H. H. Zoorob, M. M. Abou-Elzahab, and F. A. Amer, *Mansoura Science Bull.*, **29**(2), 129 (2002).

[14] M. A. Berghot, *Phosphrous Sulpher Silicon*, **178**(2), 624 (2003).

[15] M. A. Berghot and M. M. Girges, *Chemicke-Zvesti*, **22,** 369 (1995).

[16] M. A. Berghot, *Chem. Pap.*, **56**(3), 202–207 (2002).

[17] B. S. Furniss, A. J. Hannaford, V. Rogers, P. W. G. Smith, and A. R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 4th ed. (ELBS, 1980).

[18] C. Ainsworth, *Org. Synth.*, **536** (1963).

[19] H. K. Gakhar, G. S. Gill, and J. S. Multani, *J. Indian Chem. Soc.*, **48,** 953 (1971).

[20] K. C. Joshi, V. N. Pathak, and S. J. Bhargava, *J. Inorg. Nuclear Chem.*, **39,** 803 (1974).

[21] E. H. Cordes and H. G., Bull. *Chem. Rev.*, **74,** 581 (1974).

[22] J. F. Normat and C. Pieckuchi, *Bull. Soc. Chim. Fr.*, **2402** (1972).