Synthesis and Biological Activity of Some New Diarylsulphides and Diarylsulphones Containing Amino Acid Moieties, Part I

M. A. Abbady* and M. M. Kandeel

Chemistry Department, Faculty of Science, Assiut University, Assiut, Egypt, A.R.E.

Z. Naturforsch. **34b**, 1149–1153 (1979); received March 29, 1979

Diarylsulphides, Diarylsulphones, Amino Acid Moieties

4'-Nitro-4-aminodiphenylsulphide (**1a**) and/or 2'-nitro-4-amino-diphenylsulphide (**1b**) react with chloroacetylchloride giving 4-chloroacetyl-amino-diarylsulphides (**2a, b**) which undergo facile reaction with different amines and hydrazine yielding the 4-glycylamino and 4-hydrazinoacetylaminodiphenylsulphides (**3**) and (**5**). Two moles of **2** react with one mole of piperazine and/or hydrazine to give 1,4-Bis(*p*-N-(*p*'-nitrodiphenylsulphido)(aminocarbonylmethylene)piperazine (**4**) and 1,2-Bis(*p*-N-(*o*'-nitro-diphenylsulphido)(aminocarbonylmethylene)hydrazine (**6**). On condensation of **5** with aromatic aldehydes yielded new Schiff bases (**7**). Oxidation of **3**, **4**, **6** and **7** using H₂O₂/CH₃COOH mixtures furnished the corresponding diarylsulphones **8**, **9**, **10** and **11**, respectively. The biological activity of some of the prepared compounds were screened against some strains of bacteria.

Introduction

In view of the fact that amino acids or its derivatives possess a very important role in biological aspects [1], it was of interest to incorporate these molecules into the well known antimicrobial fragments (diarylsulphides and/or diarylsulphones) which have a wide application in the therapy of functional diseases as an antileprotic and antituberculous [2–5] to evaluate those for the pharmacological activity. Recently, considerable study has been directed in our laboratory toward the synthesis of new diarylsulphides and diarylsulphones containing variable moieties as well as their pharmacological evaluation [5–7].

Results and Discussion

In the present investigation efforts were made to prepare different types of the hitherto unreported diarylsulphides and diarylsulphones derivatives containing amino acid moieties. Thus, the starting compounds for the forthcoming synthesis and studies **1a** and **1b** were prepared in moderate yield by condensation of *p*-aminothiophenol with *p*- and/or *o*-chloronitrobenzenes in aqueous alkaline medium [5, 13] when **1** reacted with chloroacetyl chloride in dry toluene gave 4-chloroacetyl-amino-diphenylsulphides (**2a, 2b**).

The importance of ephedrine and piperazine

derivatives as local anesthetic [8–10] was aroused us to prepare 4-N-glycylaminodiphenylsulphide derivatives containing these and other amines. Thus **2** reacted readily with morpholine, piperidine, ephedrine and dimethylaniline in toluene giving **3**.

Interaction of two moles of **2** with one mole of piperazine yielded 1,4-Bis(*p*-N-(*p*'-nitrodiphenylsulphido)(aminocarbonylmethylene)piperazine (**4a**) and 1,4-Bis(*p*-N-(*o*'-nitrodiphenylsulphido)(aminocarbonylmethylene)piperazine (**4b**).

1a, 2a, 3a, 4a x = NO₂, x' = H;
1b, 2b, 3b, 4b x = H, x' = NO₂.

The structure of **2**, **3** and **4** were established on the basis of their elemental analysis and IR spectra (ν C=O at 1700–1685 cm⁻¹). Condensation of one mole of **2** with one mole of hydrazine hydrate afforded 4-substituted hydrazinoacetyldiphenyl sulphides (**5**), while condensation of two moles of **2** with one mole of hydrazine hydrate furnished 1,2-Bis(N-(*p*'-nitrodiphenylsulphido)(aminocarbonylmethylene)hydrazine (**6a**) and 1,2-Bis(N-(*o*'-nitrodiphenylsulphido)(aminocarbonylmethylene)hydrazine (**6b**).

* Reprint requests to Dr. M. A. Abbady.
0340-5087/79/0800-1149/\$ 01.00/0

Condensation of **5** with aromatic aldehydes in glacial acetic acid furnished new Schiff bases (**7**) in good yields.

Oxidation of **3**, **4**, **6** and **7** with H_2O_2 (30%) in gl.-acetic acid for at least 7 days at room temperature led to the formation of the corresponding diaryl-sulphones **8**, **9**, **10** and **11** in fairly moderate yields, respectively. The obtained sulphones were highly crystalline compounds with melting points higher than that of the corresponding sulphides in most cases.

8a, **9a**, **10a**, **11a**, **12a** $x = NO_2$, $x' = H$;
8b, **9b**, **10b**, **11b**, **12b** $x = H$, $x' = NO_2$.

The structures **5**–**12** were established on the basis of elemental analysis, IR data ν_{max} 3410, 3252 cm^{-1} for NH_2 and NH [**11**] ν_{max} at 1135 and 1330 cm^{-1} , for the sulphone group, and the synthesis by an alternative route in which compounds **11a** and **11b** (as a representative example) were obtained by

Table I. Physical data of compounds **2**–**6**.

Compound	X	X'	Ar or -N <	m.p. [°C]	Yield [%]	Molecular formula	Analysis calcd (found) [%]			
							C	H	N	S
2a	$-NO_2$	H		110	75	$C_{14}H_{11}N_2O_3S$	52.09 (52.15)	3.41 (3.52)	8.68 (8.74)	9.92 (9.70)
2b	H	$-NO_2$		124	71	$C_{14}H_{11}N_2O_3S$	52.09 (52.20)	3.41 (3.65)	8.68 (8.70)	9.92 (10.04)
3a₁	$-NO_2$	H	$C_5H_{10}N$	209	90	$C_{19}H_{21}N_3O_3S$	61.45 (61.52)	5.66 (5.73)	11.32 (11.45)	8.62 (8.70)
3a₂	$-NO_2$	H	C_4H_8NO	119	85	$C_{18}H_{19}N_3O_4S$	57.90 (58.30)	5.09 (5.31)	11.26 (11.32)	8.58 (8.93)
3a₃	$-NO_2$	H	C_2H_6N	127	92	$C_{16}H_{17}N_3O_3S$	58.01 (58.32)	5.13 (5.38)	12.68 (12.28)	9.66 (9.92)
3a₄	$-NO_2$	H	$C_{10}H_{14}NO$	103	80	$C_{24}H_{25}N_3O_4S$	63.45 (63.30)	5.54 (5.40)	9.31 (9.62)	7.09 (7.30)
3b₁	H	$-NO_2$	$C_5H_{10}N$	110	83	$C_{19}H_{21}N_3O_3S$	61.45 (61.35)	5.66 (5.71)	11.32 (11.21)	8.62 (8.80)
3b₂	H	$-NO_2$	C_4H_8NO	207	87	$C_{18}H_{19}N_3O_4S$	57.90 (57.75)	5.09 (5.20)	11.26 (11.31)	8.85 (8.70)
3b₃	H	$-NO_2$	C_2H_6N	126	93	$C_{16}H_{17}N_3O_3S$	58.01 (58.31)	5.13 (5.02)	12.68 (12.75)	9.66 (9.42)
3b₄	H	$-NO_2$	$C_{10}H_{14}NO$	97	84	$C_{24}H_{25}N_3O_4S$	63.35 (63.51)	5.54 (5.28)	9.31 (9.51)	7.09 (7.32)
4a	$-NO_2$	H		210	62	$C_{32}H_{30}N_6O_6S_2$	58.35 (58.41)	4.55 (4.60)	12.76 (12.65)	9.72 (9.61)
4b	H	$-NO_2$		193	60	$C_{32}H_{30}N_6O_6S_2$	58.35 (58.41)	4.55 (4.60)	12.76 (12.60)	9.72 (9.90)
5a	$-NO_2$	H		112	70	$C_{14}H_{14}N_4O_3S$	52.83 (52.90)	4.40 (4.55)	17.61 (17.80)	10.06 (10.14)
5b	H	$-NO_2$		124	73	$C_{14}H_{14}N_4O_3S$	52.83 (52.71)	4.40 (4.51)	17.61 (17.75)	10.06 (10.30)
6a	$-NO_2$	H		152	67	$C_{28}H_{24}N_6O_6S_2$	55.62 (55.50)	3.97 (3.80)	13.90 (14.02)	10.59 (10.71)
6b	H	$-NO_2$		156	68	$C_{28}H_{24}N_6O_6S_2$	55.62 (55.71)	3.97 (3.71)	13.90 (14.21)	10.59 (10.80)

condensation of **12a** and **12b** with aromatic aldehydes under similar conditions. The compounds **11a** and **11b** prepared by two routes were identical (m.p., m.m.p. and IR data).

Antimicrobial Activities

The antimicrobial activities of the prepared compounds against a variety of microbes were determined. These microorganisms include Gram-positive and Gram-negative bacteria (**12**). The bacteria used are: *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus* and *Escherichia coli*.

The results showed that most of the prepared compounds **3**, **4**, **6**, **8**, **9**, **10** and **11** show from a little to a strong activity on the Gram-positive and the Gram-negative bacteria. The activity expressed in percent range from 35 to 60% inhibition was found at concentration 10^{-3} M. Compounds derived from

1a are more active than those derived from **1b** in most tests.

The more strong active compounds against *pseudomonas aeruginosa* and *Staphylococcus aureus* are **8a₃**, **8b₃**, **8b₁**, **9b**, **8a₁** and **8b₂** A and against *Bacillus subtilis* and *Escherichia coli* are **10b**, **12b**, **8a₄** and **8b₄**, respectively.

Experimental

The time allowed for the completion of the reaction, and the purity of the prepared compounds was controlled by means of T.L.C. Melting points were uncorrected. The infrared absorption spectra were determined with a Unicam SP 200 G spectrophotometer using KBr wafer technique.

4'-Nitro-4-aminodiphenylsulphide (**1a**) and 2'-nitro-4-aminodiphenylsulphide (**1b**)

These were prepared according to the methods given in literature [5, 13].

Table II. 4-Arylidenglycylaminodiarylsulfides (**7**).

Compound	X	X'	m.p. [°C]	Yield [%]	Ar	Molecular formula	Analysis calcd (found) [%]			
							C	H	N	S
7a₁	NO ₂	H	135	90	C ₆ H ₅	C ₂₁ H ₁₈ N ₄ O ₃ S	62.06 (61.58)	4.43 (4.61)	13.79 (14.85)	7.88 (8.07)
7a₂	NO ₂	H	126	81	C ₆ H ₄ -NO ₂ (<i>m</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (55.91)	3.77 (3.65)	15.52 (15.70)	7.09 (7.15)
7a₃	NO ₂	H	131	88	C ₆ H ₄ -NO ₂ (<i>p</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (55.94)	3.77 (3.41)	15.52 (15.40)	7.09 (7.15)
7a₄	NO ₂	H	119	80	C ₆ H ₄ -NO ₂ (<i>o</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (55.71)	3.77 (3.95)	15.52 (15.61)	7.09 (7.25)
7a₅	NO ₂	H	142	95	C ₆ H ₄ -OH(<i>o</i> -)	C ₂₁ H ₁₈ N ₄ O ₄ S	59.71 (59.60)	4.26 (4.31)	13.27 (13.35)	7.28 (7.61)
7a₆	NO ₂	H	138	87	C ₆ H ₄ -Cl(<i>p</i> -)	C ₂₁ H ₁₇ N ₄ O ₃ SCl	57.20 (57.31)	3.85 (3.90)	12.71 (12.61)	7.26 (7.02)
7a₇	NO ₂	H	128	73	C ₆ H ₄ -OCH ₃ (<i>p</i> -)	C ₂₂ H ₂₀ N ₄ O ₄ S	60.55 (60.40)	4.58 (4.40)	12.84 (12.61)	7.33 (7.51)
7a₈	NO ₂	H	125	92	C ₆ H ₄ -N(CH ₃) ₂ (<i>p</i> -)	C ₂₃ H ₂₃ N ₅ O ₃ S	61.46 (61.51)	5.12 (5.25)	15.59 (15.80)	7.12 (7.02)
7a₉	NO ₂	H	145	77	C ₈ H ₇	C ₂₃ H ₂₀ N ₄ O ₃ S	63.89 (63.61)	4.62 (4.80)	12.96 (12.75)	7.40 (7.65)
7b₁	H	NO ₂	129	91	C ₆ H ₅	C ₂₁ H ₁₈ N ₄ O ₃ S	62.06 (61.92)	4.43 (4.52)	13.79 (13.85)	7.88 (8.02)
7b₂	H	NO ₂	137	79	C ₆ H ₄ -NO ₂ (<i>m</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (55.71)	3.77 (3.60)	15.52 (15.42)	7.09 (7.18)
7b₃	H	NO ₂	119	89	C ₆ H ₄ -NO ₂ (<i>p</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (56.01)	3.77 (3.60)	15.52 (15.40)	7.09 (6.85)
7b₄	H	NO ₂	128	78	C ₆ H ₄ -NO ₂ (<i>o</i> -)	C ₂₁ H ₁₇ N ₅ O ₅ S	55.87 (55.75)	3.77 (3.95)	15.52 (15.71)	7.09 (7.20)
7b₅	H	NO ₂	134	93	C ₆ H ₄ -OH(<i>o</i> -)	C ₂₁ H ₁₈ N ₄ O ₄ S	59.71 (59.81)	4.26 (4.01)	13.27 (13.51)	7.58 (7.70)
7b₆	H	NO ₂	124	86	C ₆ H ₄ -Cl(<i>p</i> -)	C ₂₁ H ₁₇ N ₄ O ₃ SCl	57.20 (57.40)	3.85 (3.71)	12.71 (13.01)	7.26 (7.01)
7b₇	H	NO ₂	135	70	C ₆ H ₄ -OCH ₃ (<i>p</i> -)	C ₂₂ H ₂₀ N ₄ O ₄ S	60.55 (60.61)	4.58 (4.45)	12.84 (12.71)	7.33 (7.51)
7b₈	H	NO ₂	157	88	C ₆ H ₄ -N(CH ₃) ₂ (<i>p</i> -)	C ₂₃ H ₂₃ N ₅ O ₃ S	61.46 (61.38)	5.12 (5.38)	15.59 (15.61)	7.12 (7.30)
7b₉	H	NO ₂	170	74	C ₈ H ₇	C ₂₃ H ₂₀ N ₄ O ₃ S	63.89 (63.70)	4.62 (4.70)	12.96 (12.72)	7.40 (7.61)

Table III. Diarylsulfones containing aminoacid moiety **8**, **9**, **10**, **11** and **12**.

Compound	X	X'	m.p. [°C]	Yield [%]	Ar or -N <	Molecular formula	Analysis calcd (found) [%]			
							C	H	N	S
8a₁	NO ₂	H	182	51	C ₅ H ₁₀ N	C ₁₉ H ₂₁ N ₃ O ₅ S	56.57 (57.01)	5.21 (5.35)	10.42 (10.52)	7.94 (7.80)
8a₂	NO ₂	H	231	45	C ₄ H ₈ NO	C ₁₈ H ₁₉ N ₃ O ₆ S	53.33 (53.01)	4.69 (4.70)	10.37 (10.50)	7.90 (8.00)
8a₃	NO ₂	H	225	39	C ₂ H ₆ N	C ₁₆ H ₁₇ N ₃ O ₅ S	52.89 (52.61)	4.68 (4.77)	11.57 (11.60)	8.81 (9.01)
8a₄	NO ₂	H	229	38	C ₁₀ H ₁₄ NO	C ₂₄ H ₂₅ N ₃ O ₆ S	59.62 (59.52)	5.17 (5.28)	8.69 (8.71)	6.62 (6.92)
8b₁	H	NO ₂	187	47	C ₅ H ₁₀ N	C ₁₉ H ₂₁ N ₃ O ₅ S	56.57 (56.41)	5.21 (5.40)	10.42 (10.51)	7.94 (8.05)
8b₂	H	NO ₂	190	40	C ₄ H ₈ NO	C ₁₈ H ₁₉ N ₃ O ₆ S	53.33 (53.12)	4.69 (4.42)	10.37 (10.52)	7.90 (7.81)
8b₃	H	NO ₂	202	41	C ₂ H ₆ N	C ₁₆ H ₁₇ N ₃ O ₅ S	52.89 (52.71)	4.68 (4.52)	11.57 (11.67)	8.81 (8.95)
8b₄	H	NO ₂	219	32	C ₁₀ H ₁₄ NO	C ₂₄ H ₂₅ N ₃ O ₆ S	59.62 (59.50)	5.17 (5.35)	8.69 (8.75)	6.62 (6.81)
9a	NO ₂	H	170	30		C ₃₂ H ₃₀ N ₆ O ₁₀ S ₂	53.18 (53.21)	4.15 (4.25)	11.63 (11.80)	8.86 (8.90)
9b	H	NO ₂	160	31		C ₃₂ H ₃₀ N ₆ O ₁₀ S ₂	53.18 (53.24)	4.15 (4.20)	11.36 (11.50)	8.86 (8.92)
10a	NO ₂	H	176	50		C ₂₈ H ₂₄ N ₆ O ₁₀ S ₂	50.29 (50.01)	3.59 (3.70)	12.57 (12.40)	9.58 (9.61)
10b	NO ₂	H	152	52		C ₂₈ H ₂₄ N ₆ O ₁₀ S ₂	50.29 (50.40)	3.59 (3.41)	12.57 (12.80)	9.58 (9.70)
11a₁	NO ₂	H	176	47	C ₆ H ₅	C ₂₁ H ₁₈ N ₄ O ₅ S	57.53 (53.41)	4.10 (4.30)	12.78 (12.52)	7.30 (7.40)
11a₂	NO ₂	H	165	36	C ₆ H ₄ -NO(<i>m</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.05)	3.51 (3.40)	14.49 (14.31)	6.62 (6.78)
11a₃	NO ₂	H	174	42	C ₆ H ₄ -NO ₂ (<i>p</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.29)	3.51 (3.71)	14.49 (14.56)	6.62 (6.70)
11a₄	NO ₂	H	170	40	C ₆ H ₄ -NO ₂ (<i>o</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.30)	3.51 (3.60)	14.49 (14.52)	6.62 (6.51)
11a₅	NO ₂	H	180	34	C ₆ H ₄ -OH(<i>o</i> -)	C ₂₁ H ₁₈ N ₄ O ₆ S	55.50 (55.42)	3.96 (3.81)	12.33 (12.25)	7.04 (7.25)
11a₆	NO ₂	H	155	35	C ₆ H ₄ -Cl(<i>p</i> -)	C ₂₁ H ₁₇ N ₄ O ₅ SCl	55.33 (55.02)	3.59 (3.65)	11.85 (11.91)	6.77 (6.51)
11a₇	NO ₂	H	184	33	C ₆ H ₄ -OCH ₃ (<i>p</i> -)	C ₂₂ H ₂₀ N ₄ O ₆ S	56.41 (56.55)	4.27 (4.40)	11.96 (11.75)	6.83 (6.92)
11a₈	NO ₂	H	205	39	C ₆ H ₄ -N(CH ₃) ₂ (<i>p</i> -)	C ₂₃ H ₂₃ N ₅ O ₅ S	57.38 (57.50)	4.78 (4.82)	14.55 (14.70)	6.65 (6.72)
11a₉	NO ₂	H	192	40	C ₈ H ₇	C ₂₃ H ₂₀ N ₄ O ₅ S	59.48 (59.23)	4.31 (4.02)	12.06 (12.38)	6.89 (6.72)
11b₁	H	NO ₂	164	42	C ₆ H ₅	C ₂₁ H ₁₈ N ₄ O ₅ S	57.53 (57.40)	4.10 (4.40)	12.78 (12.90)	7.30 (7.50)
11b₂	H	NO ₂	160	35	C ₆ H ₁₄ -NO ₂ (<i>m</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.32)	3.51 (3.40)	14.49 (14.31)	6.62 (6.80)
11b₃	H	NO ₂	148	38	C ₆ H ₄ -NO ₂ (<i>p</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.40)	3.51 (3.65)	14.49 (14.38)	6.62 (6.72)
11b₄	H	NO ₂	204	39	C ₆ H ₄ -NO ₂ (<i>o</i> -)	C ₂₁ H ₁₇ N ₅ O ₇ S	52.17 (52.05)	3.51 (3.32)	14.49 (14.30)	6.62 (6.40)
11b₅	H	NO ₂	193	40	C ₆ H ₄ -OH(<i>o</i> -)	C ₂₁ H ₁₈ N ₄ O ₆ S	55.50 (50.61)	3.96 (4.08)	12.33 (12.40)	7.04 (7.21)
11b₆	H	NO ₂	182	39	C ₆ H ₄ -Cl(<i>p</i> -)	C ₂₁ H ₁₇ N ₄ O ₅ SCl	55.33 (55.60)	3.59 (3.65)	11.85 (11.72)	6.77 (6.82)
11b₇	H	NO ₂	187	37	C ₆ H ₄ -OCH ₃ (<i>p</i> -)	C ₂₂ H ₂₀ N ₄ O ₆ S	56.41 (56.20)	4.27 (4.41)	11.96 (12.21)	6.83 (6.72)
11b₈	H	NO ₂	201	48	C ₆ H ₄ -N(CH ₃) ₂ (<i>p</i> -)	C ₂₃ H ₂₃ N ₅ O ₅ S	57.38 (57.51)	4.78 (4.90)	14.55 (14.21)	6.65 (6.41)
11b₉	H	NO ₂	202	49	C ₈ H ₇	C ₂₃ H ₂₀ N ₄ O ₅ S	59.48 (59.30)	4.31 (4.41)	12.06 (12.21)	6.89 (6.75)
12a	NO ₂	H	146	52		C ₁₄ H ₁₄ N ₄ O ₅ S	48.00 (48.30)	4.00 (4.31)	16.00 (16.81)	9.14 (8.85)
12b	H	NO ₂	192	54		C ₁₄ H ₁₄ N ₄ O ₅ S	48.00 (47.85)	4.00 (3.95)	16.00 (15.78)	9.14 (9.41)

4-Chloroacetyl amino derivative of diarylsulphides (2)

Chloroacetyl chloride (0.01 mole) was added slowly to a solution of **1** (0.015 mole) in dry toluene (150 ml) and the reaction mixture was refluxed for 3 h. Toluene was removed under reduced pressure, the residue was filtered and crystallized from the proper solvent (see Table I).

4-Glycylaminodiarylsulphides (3)

A mixture of **2** (0.01 mole) and the appropriate amine in 20 ml of dry toluene was refluxed for 3 h. The amine hydrochloride was filtered and the organic layer extracted with 1 N HCl (3 × 30 ml). The acidic extract was neutralized with sodium carbonate solution and the precipitated solid filtered, washed, with sodium carbonate solution and crystallized from the proper solvent to give **3** (Table I).

1,4-Bis(p-N-(p'-nitro-diphenylsulphido)amino-carbonylmethylene)piperazine (4a) and 1,4-Bis(p-N-(o'-nitro-diphenylsulphido)amino-carbonylmethylene)piperazine (4b)

A mixture of **2** (0.02 mole) and piperazine (0.01 mole) in dry toluene was refluxed for 3 h and the reaction mixture worked-up as described above. The obtained product was crystallized from ethanol to give **4** in 60–68% yield (see Table I).

4-N-Hydrazinoacetylaminodiarylsulphides (5)

A mixture of **2** (0.01 mole) and hydrazine hydrate (99–100%, 0.01 mole) in 15 ml of ethanol was refluxed for 3 h. The reaction mixture was allowed

to cool, diluted with water and crystallized from the proper solvent to give **5** (Table I).

1,2-Bis(N-(p'-nitro-diphenylsulphido)amino-carbonylmethylene)hydrazine (6a) and 1,2-Bis(N-(o'-nitro-diphenylsulphido)amino-carbonylmethylene)hydrazine (6b)

A mixture of **2** (0.02 mole) and hydrazine hydrate (0.01 mole) in 20 ml of ethanol was refluxed for 3 h. The reaction mixture was cooled, diluted with water and the precipitated solid filtered, washed with cold water and crystallized from the proper solvent to give **6a** and **6b** in > 60% yield (Table I).

Preparation of Schiff bases (7)

To a solution of equimolecular quantities of **5a** and/or **5b** and the appropriate aldehyde in glacial acetic acid was refluxed for 2–3 h. The reaction mixture was cooled, poured into crushed ice and the deposited solid was collected, washed several times with cold water and then crystallized from the proper solvent to give **7** (Table II).

Conversion of sulphides 3, 4, 6, 7, and 11a to corresponding sulphones 8, 9, 10, 11 and 12 (Table III)

A diarylsulphide (0.01 mole) was dissolved in gl. acetic acid (50 ml) and the solution was warmed if required, left to cool, filtered and hydrogen-peroxide (30 ml), (30%) was added to it. The mixture was kept at room temperature for 7 d and the deposited crystalline sulphone was collected and purified as usual (Table III).

- [1] A. Burger, Medicinal Chemistry, 2nd. ed., Interscience Publishers, Inc., N. Y. 1960.
- [2] N. Rist, C. R. Soc. Biol. **130**, 972 and 976 (1939).
- [3] N. Rist, F. Bloch, and V. Hamon, Ann. Inst. Pasteur **64**, 203 (1940).
- [4] E. Marshall, K. A. Hardin, and O. D. Turner, Am. Rev. Tuberc. **68**, 103 (1933).
- [5] M. A. Abbady, Indian J. Chem., accepted 1977.
- [6] M. A. Abbady, Kh. M. Hassan, and M. A. El-Maghraby, Indian J. Chem. **16b**, 499 (1978).
- [7] A. M. Osman, M. A. Abbady, and F. M. Atta, Bulletin of Science and Technology, Assiut University Faculty of Science, communicated.
- [8] T. Klosa, German Patent 1,093,800 (1900); J. Prakt. Chem. **17**, 340 (1962).
- [9] R. Daklbom and A. Misorny, Acta Chem. Scand. **15**, 1367 (1961).
- [10] a) A. Larizza and G. Brancaccis, Farm. Ed. Sci. **16**, 701 (1961).
b) W. O. Foye, H. B. Levine, and W. L. McKenzie, J. Med. Chem. **9**, 61 (1966).
- [11] L. J. Bellamy, The infrared spectra of complex molecules, Methuen, London 1956.
- [12] J. G. Vincent and W. H. Vincent, Prac. Exptl. Biol. Nil. **55**, 162 (1944).
- [13] Kehrmann, Bauer, Ber. Dtsch. Chem. Ges. **29**, 2363 (1896).