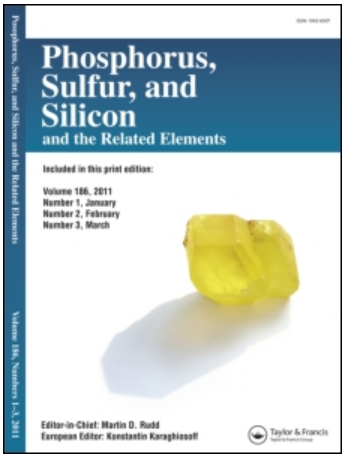

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Maymona M. Kandeel[a]
[a] Chemistry Department, Faculty of Science, Assiut University, Assiut, Egypt

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SYNTHESIS OF 4′-NITROPHENYL-BENZTHIAZOL-6-YL SULFIDES AND 4′-NITROPHENYL-BENZTHIAZOL-6-YL SULFONES CONTAINING THIAZOLIDINONES

MAYMONA M. KANDEEL

Chemistry Department, Faculty of Science, Assiut University, Assiut, Egypt

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2-Amino-6 (p-nitrophenylthio)benzthiazol (**1**) reacted with carbon disulfide in the presence of aqueous sodium hydroxide in N,N-dimethylformamide as solvent, to form the sodium salt of the dithiocarbonimidic acid. Without further purification, this salt was alkylated with sodium chloroacetate and treated with HCl to give the corresponding thiazolidinone (**2**). The thiazolidinone (**2**) underwent oxidation to the corresponding sulfone (**3**) when treated with $AcOH/H_2O_2$ and condensed easily with aromatic aldehydes, to give the corresponding 5-arylidinethiazolidinones (**4**), which after oxidation with H_2O_2/AcOH gave the sulfones (**7**). Sulfone (**3**), condensed with aromatic aldehydes, led to the same compounds (**7**). Thiazolidinone (**2**) reacted with either one or two equivalents of an aromatic amine producing compounds **5** and **6**, respectively. The latter were oxidized with H_2O_2/AcOH to give the sulfones **8** and **9**.

Key words: Synthesis; thiazolodiaryl sulfides and diarylsulfones; arylthiobenzthiazol and thiazolidinones.

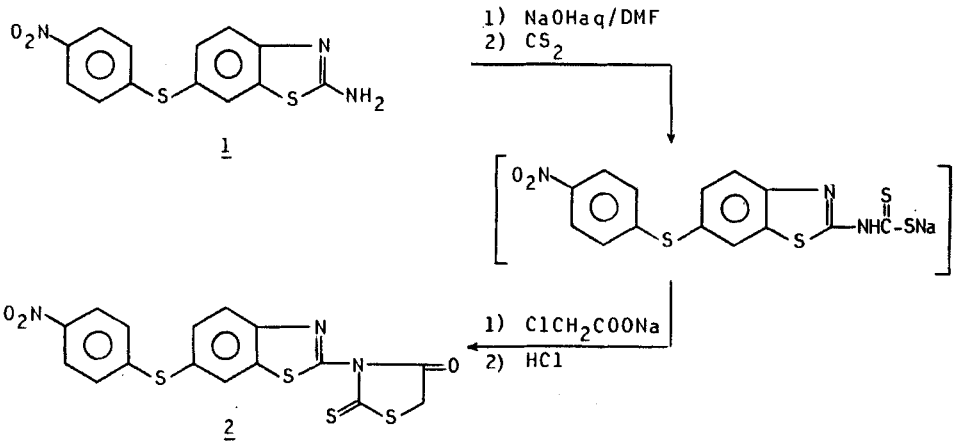
INTRODUCTION

According to Rout et al., the fungicidal activity of many heterocyclic organo sulfur compounds might be attributed to the presence of an N—C—S linkage, as found in thiazoline and thiazolidinones.[1] Hence, it was of interest to incorporate these functional moieties into the well known antimicrobial diarylsulfides and diarylsulfones, which have found wide application in the therapy of functional diseases as antileprotics and antituberculouses.[2–5] Furthermore, substituted rhodanines are reported to exhibit fungicidal and bactericidal activities.[6] In the hope that they might have a useful biological application, and in continuation of our previous work,[7–11] we therefore synthesized some heterocyclic compounds containing diarylsulfides and diarylsulfones with thiazol and thiazolidinone moieties.

RESULTS AND DISCUSSION

2-Amino-6-(p-nitrophenylthio)benzthiazol (**1**) was reacted with carbon disulfide in concentrated aqueous sodium hydroxide and N,N-dimethylformamide to the corresponding dithiocarbamate. Strong basic medium was necessary to allow the poorly nucleophilic amide to react.[12] Rhodanine 2 was then prepared according to the method described in the literature[13] by cyclization of the produced dithiocarbimidate salt without isolation using sodium chloroacetate in the presence of hot concentrated hydrochloric acid. Rhodanine (**2**) was easily condensed with aromatic

aldehydes at the active methylene group to give the corresponding 2-(5-arylidine-2-thioxo-4-thiazolidinon-3-yl)-6-(p-nitrophenylthio)benzthiazoles ($\mathbf{4}_{a-e}$).



1

2

It has been reported that rhodanine can be easily converted to 2-imino-4-thiazolidinone[14] by reaction with aniline. Applying this reaction to compound 2, with one equivalent of different aromatic amines, the expected 2-(2-arylimino-4-thiazolidinone-3-yl)-6-(p-nitrophenylthio)benzthiazoles ($\mathbf{5}_{a-d}$) were obtained. However, when two equivalents of aromatic amines were used in the previous reaction, condensation at both reactive centers in position 2 and 4 of the rhodanine ring took place, thus giving 2-(2,4-diaryliminothiazolin-3-yl)-6-(p-nitrophenylthio)benzthiazoles ($\mathbf{6}_{a-d}$).

Oxidation of compounds $\mathbf{4}_{a-e}$, $\mathbf{5}_{a-d}$ and $\mathbf{6}_{a-d}$ by using a mixture of hydrogen peroxide and glacial acetic acid for 2–7 days at room temperature gave the corresponding sulfones $\mathbf{7}_{a-e}$, $\mathbf{8}_{a-d}$ and $\mathbf{9}_{a-d}$ respectively.

The sulfones $\mathbf{7}_{a-e}$ could also be obtained by an alternative route comprising oxidation of compound **2** with H_2O_2/AcOH mixture and subsequent condensation of the produced sulfone 3 with aromatic aldehydes. The compounds prepared by the two routes are identical in all respects (mp, mmp, IR, and TLC).

EXPERIMENTAL

The time allowed for the completion of the reaction and the purity of the prepared compounds were controlled by means of T.L.C. Melting points were determined on Fisher-Jhones melting point apparatus and were uncorrected. Elemental analysis were performed on a Perkin-Elmer 240 C elemental analyser. IR spectra were taken on a Pye-Unicam infrared spectrophotometer using KBr Wafer technique. ^1H NMR spectra were recorded by 90 MHz Varian NMR spectrophotometer in a suitable deutrated solvent using TMS as internal standard.

2-(Sodium dithiocarbamate)-6-(p-nitrophenylthio)benzthiazole. To the well stirred solution of the corresponding 2-amino-6-(p-nitrophenylthio)benzthiazol 1 (0.05 mole 15.15 gm) in dimethyl formamide (50 ml) cooled with an ice/water bath, consecutively were added dropwise: (a) aqueous 20 molar NaOH (2 ml); (b) carbondisulfide (6 ml); (c) aqueous 20 molar NaOH (3 ml). The mixture was stirred for 30 minutes and then directly used for the next step.

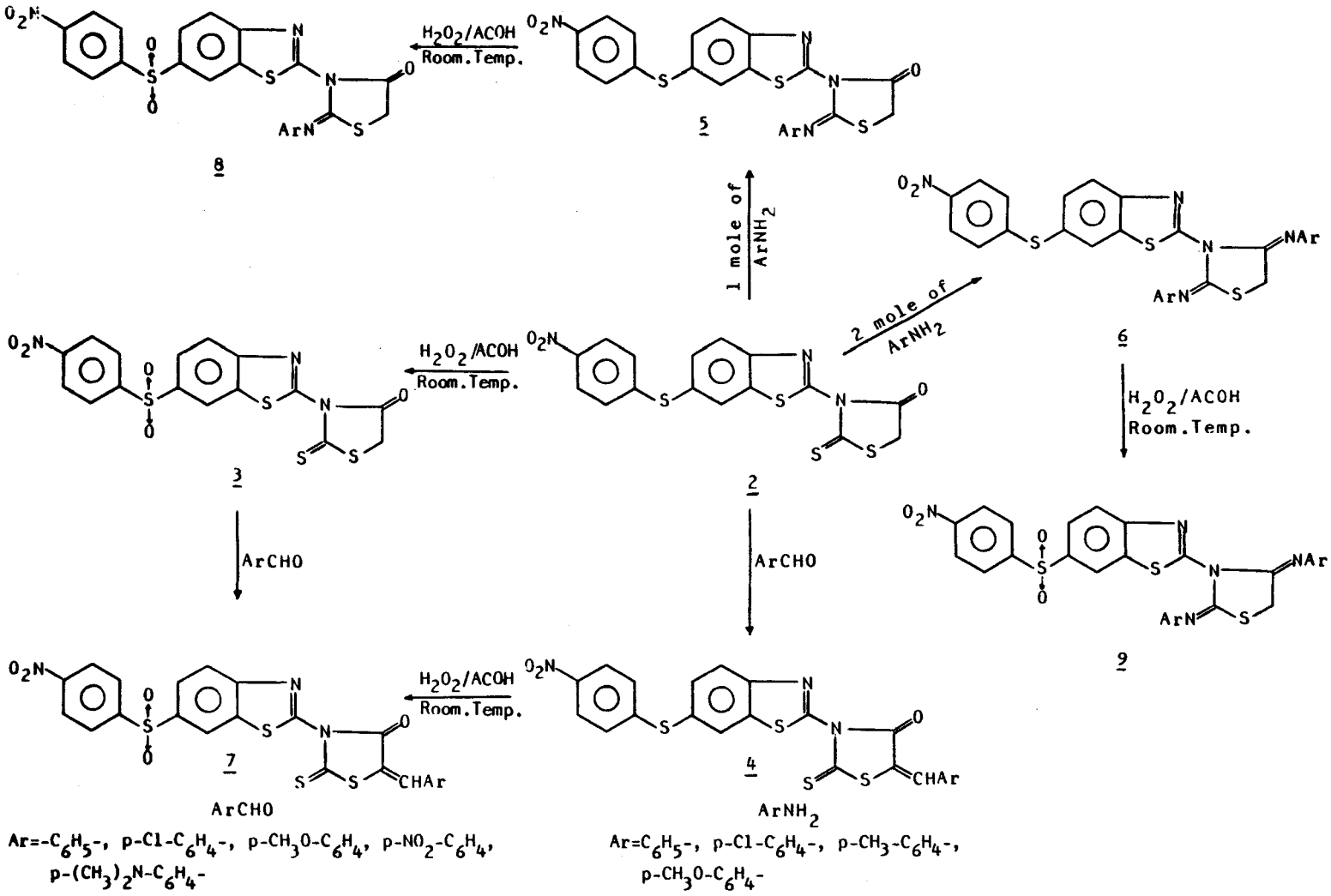


TABLE I

Physical constants and IR spectra of compounds (2)–(9)

Compound No.	M.P °C	Yield %	Molecular Formula	Analytical data Calcd/found C	H	N	S	Cl	IR spectra
2	205	88	$C_{16}H_9N_3O_3S_4$	45.82	2.14	10.02	30.54	-	1720 cm^{-1} (C=O), 1570, 860 cm^{-1} (C=S) and 1540,
				45.36	2.43	11.92	30.08	-	1350 cm^{-1} (NO_2).
3	225	63	$C_{16}H_9N_3O_5S_4$	42.57	1.99	9.31	28.38	-	1720 cm^{-1} (C=O), 1570, 860 cm^{-1} (C=S), 1535,
				42.23	2.17	9.72	28.64	-	1320 cm^{-1} (NO_2) and 1340, 1160 cm^{-1} (SO_2).
4_a	138	73	$C_{23}H_{13}N_3O_3S_4$	54.43	2.56	8.28	25.24	-	1710 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1570, 860 cm^{-1}
				54.58	2.37	8.64	25.44	-	(C=S) and 1530, 1340 cm^{-1} (NO_2).
4_b	163	76	$C_{23}H_{12}N_3O_3S_4Cl$	50.96	2.21	7.75	23.63	6.55	1720 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1560, 860 cm^{-1}
				50.72	2.49	7.55	23.96	6.12	(C=S), 1530, 1350 cm^{-1} (NO_2), 750 cm^{-1} (C-Cl).
4_c	156	74	$C_{24}H_{15}N_3O_4S_4$	53.63	2.79	7.82	23.83	-	1710 cm^{-1} (C=O), 1600 cm^{-1} (C=C), 1525, 1340 cm^{-1}
				53.48	2.94	7.52	23.44	-	(NO_2) and 1570, 860 cm^{-1} (C=S).
4_d	149	69	$C_{23}H_{12}N_4O_5S_4$	50.00	2.17	11.77	23.18	-	1720 cm^{-1} (C=O), 1600 cm^{-1} (C=C), 1530, 1340 cm^{-1}
				50.18	2.43	11.52	22.84	-	(NO_2) and 1570, 860 cm^{-1} (C=S).
4_e	125	78	$C_{25}H_{18}N_4O_3S_4$	54.54	3.27	10.18	23.27	-	1715 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1530, 1340 cm^{-1}
				54.16	3.38	10.52	23.61	-	(NO_2) and 1570, 860 cm^{-1} (C=S).
5_a	98	63	$C_{22}H_{14}N_4O_3S_3$	55.23	2.92	11.71	20.08	-	1710 cm^{-1} (C=O), 1625 cm^{-1} (C=N) and 1540,
				55.38	3.17	11.95	20.33	-	1340 cm^{-1} (NO_2).
5_b	115	68	$C_{22}H_{13}N_4O_3S_3Cl$	51.51	2.53	10.92	18.73	6.92	1710 cm^{-1} (C=O), 1620 cm^{-1} (C=N), 1535, 1350 cm^{-1}
				51.94	2.46	11.35	18.28	6.63	(NO_2) and 750 cm^{-1} (C-Cl).
5_c	105	65	$C_{23}H_{16}N_4O_3S_3$	56.09	3.25	11.38	19.51	-	1710 cm^{-1} (C=O), 1600 cm^{-1} (C=N) and 1510,
				56.37	3.68	11.82	19.91	-	1340 cm^{-1} (NO_2).

TABLE I (*Continued*)

Compound No.	M.P °C	Yield %	Molecular Formula	Analytical data Calcd/found C	H	N	S	Cl	IR spectra
5_d	85	61	$C_{23}H_{16}N_4O_4S_3$	54.33	3.14	11.02	18.89	-	1705 cm^{-1} (C=O), 1610 cm^{-1} (C=N) and 1535,
				54.73	2.87	10.74	18.57	-	1340 cm^{-1} (NO_2).
6_a	210	59	$C_{28}H_{19}N_5O_2S_3$	60.75	3.43	12.65	17.35	-	3300 cm^{-1} (NH), 1600 cm^{-1} (C=N), and 1510,
				61.13	3.59	12.45	17.68	-	1340 cm^{-1} (NO_2).
6_b	165	66	$C_{28}H_{17}N_5O_2S_3Cl_2$	54.100	2.73	11.27	15.45	11.27	3300 cm^{-1} (NH), 1600 cm^{-1} (C=N), 1510, 1345 cm^{-1}
				53.86	2.32	11.05	15.61	11.47	(NO_2) and 750 cm^{-1} (C-Cl).
6_c	175	67	$C_{30}H_{23}N_5O_2S_3$	61.96	3.95	12.04	16.52	-	3300 cm^{-1} (NH), 1600 cm^{-1} (C=N),and 1520,
				62.34	3.78	11.65	16.29	-	1340 cm^{-1} (NO_2).
6_d	225	62	$C_{30}H_{23}N_5O_4S_3$	58.72	3.75	11.41	15.66	-	3300 cm^{-1} (NH), 1605 cm^{-1} (C=N) and 1520,
				58.43	3.48	11.85	16.04	-	1340 cm^{-1} (NO_2).
7_a	221	72	$C_{23}H_{13}N_3O_5S_4$	51.20	2.41	7.79	23.74	-	1710 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1530, 1310
				51.58	2.17	7.82	23.93	-	(NO_2), 1570, 860 (C=S) and 1340,1160 cm^{-1} (SO_2).
7_b	205	75	$C_{23}H_{12}N_3O_5S_4Cl$	48.12	2.09	7.32	22.31	6.19	1720 cm^{-1} (C=O), 1600 cm^{-1} (C=C), 1540,1320 cm^{-1}
				48.47	2.14	7.82	22.17	6.53	(NO_2),1570,860 cm^{-1}(C=S),1350,1160 cm^{-1} (SO_2) and 750 cm^{-1} (C-Cl).
7_c	235	68	$C_{24}H_{15}N_3O_6S_4$	50.61	2.63	7.38	22.49	-	1710 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1520,1315 cm^{-1}
				50.32	2.87	7.49	22.65	-	(NO_2), 1570, 860 cm^{-1} (C=S)and 1350,1170cm^{-1}(SO_2).
7_d	195	65	$C_{23}H_{12}N_4O_7S_4$	47.26	2.05	9.58	21.91	-	1720 cm^{-1} (C=O), 1610 cm^{-1} (C=C), 1530,1310 cm^{-1}
				47.49	2.26	9.41	22.35	-	(NO_2), 1570,860 cm^{-1}(C=S) and 1350,1170 cm^{-1}(SO_2).
7_e	212	73	$C_{25}H_{18}N_4O_5S_4$	51.54	3.09	9.62	21.99	-	1710 cm^{-1}(C=O),1615 cm^{-1}(C=C),1540,1320 cm^{-1}(NO_2),
				51.15	3.46	9.37	22.29	-	1570, 860 cm^{-1}(C=S) and 1340, 1170 cm^{-1}(SO_2).

TABLE I (*Continued*)

Compound No.	M.P °C	Yield %	Molecular Formula	Analytical data Calcd/found C	H	N	S	Cl	IR spectra
8_a	197	72	$C_{22}H_{14}N_4O_5S_3$	51.76 51.28	2.74 2.65	10.98 11.24	18.82 18.32	- -	1710 cm^{-1} (C=O), 1580 cm^{-1} (C=N), 1530, 1325 cm^{-1} (NO_2) and 1350, 1160 cm^{-1} (SO_2).
8_b	172	77	$C_{22}H_{13}N_4O_5S_3Cl$	48.48 48.83	2.38 2.61	10.28 10.59	17.63 17.82	6.51 6.95	1710 cm^{-1}(C=O), 1610 cm^{-1}(C=N), 1535,1310 cm^{-1} (NO_2), 1350,1160 cm^{-1}(SO_2) and 750 cm^{-1} (C-Cl).
8_c	182	71	$C_{23}H_{16}N_4O_5S_3$	52.67 52.28	3.05 2.96	10.68 10.41	18.32 18.52	- -	1710 cm^{-1}(C=O), 1610 cm^{-1}(C=N), 1530,1320 cm^{-1} (NO_2) and 1355,1160 cm^{-1} (SO_2).
8_d	192	74	$C_{23}H_{16}N_4O_6S_3$	51.11 51.48	2.96 3.32	10.37 10.67	17.77 17.38	- -	1710 cm^{-1}(C=O), 1610 cm^{-1}(C=N), 1515,1340 cm^{-1} (NO_2) and 1350,1160 cm^{-1} (SO_2).
9_a	193	65	$C_{28}H_{19}N_5O_4S_3$	57.43 57.16	3.24 3.39	11.96 12.27	16.41 16.64	- -	3320 cm^{-1}(NH), 1600 cm^{-1}(C=N), 1530,1315 cm^{-1} (NO_2) and 1350,1160 cm^{-1} (SO_2).
9_b	187	69	$C_{28}H_{17}N_5O_4S_3Cl_2$	51.45 51.72	2.60 2.37	10.71 10.93	14.70 14.88	10.71 10.53	3300 cm^{-1} (NH), 1595 cm^{-1}(C=N), 1530,1320 cm^{-1} (NO_2) and 1360,1160 cm^{-1} (SO_2).
9_c	185	67	$C_{30}H_{23}N_5O_4S_3$	58.72 58.96	3.75 3.68	11.41 11.15	15.66 16.29	- -	3350 cm^{-1}(NH), 1600 cm^{-1}(C=N), 1530,1310 cm^{-1} (NO_2) and 1350, 1160 cm^{-1} (SO_2).
9_d	235	62	$C_{30}H_{23}N_5O_6S_3$	55.81 56.17	3.56 3.79	10.85 10.53	14.88 15.22	- -	3310 cm^{-1}(NH), 1600 cm^{-1}(C=N), 1530, 1310 cm^{-1} (NO_2) and 1350, 1170 cm^{-1} (SO_2).

2-(2-Thioxo-thiazolin-3-yl)-6-(p-nitrophenylthio)benzthiazol (**2**). To the solution of the above prepared dithiocarbamate (0.05 mole), a cold solution of sodium chloroacetate (0.05 mole) was added portionwise during 10 minutes under stirring. Stirring was continued at room temperature for 3 hrs. Then a hot solution (85–90°C) of concentrated HCl (15 ml HCl and 6 ml H_2O) was added. On cooling, a yellow crystalline product was separated, which was filtered off and recrystallized from ethanol to give yellow crystals in 75% yield, m.p. 205°C.

Anal. Calc. for: $C_{16}H_9N_3O_3S_4$: C, 45.82; H, 2.14; N, 10.02; S, 30.54%.
Found: C, 45.36; H, 2.43; N, 11.92; S, 30.08%. IR, at 1720 cm^{-1} (C=O), 1570 cm^{-1}, 860 cm^{-1} (C=S) and at 1600 cm^{-1} (C=N); ^1H NMR, in DMSO-d_6, at δ8.25–7.20 (m, 7H, Ar-H) and at δ4.1 (s, 2H, CH_2 of rhodanine ring).

2-(5-Arylidine-4-oxo-2-thioxo-thiazolidin-3-yl)-6-(p-nitrophenylthio)benzthiazol ($\mathbf{4_{a-e}}$). An equimolar amount of (**2**) (0.01 mole) and the appropriate aromatic aldehyde (0.01 mole) were fused together for 30 minutes. Then ethanol (30 ml) was added and the mixture was refluxed for additional 3 hrs. Then the reaction mixture was filtered while hot, evaporated to about one third of its volume and allowed to cool. The solid product was filtered off and recrystallized from ethanol to give compounds $\mathbf{4_{a-e}}$. Physical constants of compounds $\mathbf{4_{a-e}}$ are listed in Table I.

IR of $\mathbf{4_{a-e}}$, 1720–1690 cm^{-1} (C=O), 1640–1600 cm^{-1} (C=N) and 1530, 1320 cm^{-1} (NO_2).

^1H NMR of $\mathbf{4_b}$ in $CDCl_3$, δ7.20 (s, 1H, CH=C), δ7.2–8.2 (m, 11H, Ar-H), and for $\mathbf{4_c}$ in DMSO-d_6, δ3.76 (s, 3H, OCH_3), δ7.1 (s, 1H, CH=C), and δ7.2–8.25 (m, 11H, Ar—H).

2-(2-Arylimino-4-oxo-thiazolidin-3-yl)-6-((p-nitrophenylthio)benzthiazol ($\mathbf{5_{a-d}}$). A mixture of compound (**2**) (0.01 mole) and aromatic amine (0.01 mole) in ethanol was refluxed for 3 hrs, and then allowed to cool. The solid product was filtered off and recrystallized from chloroform-pet. ether (40–60) mixture. The physical constants of $\mathbf{5_{a-d}}$ are listed in Table I.

^1H NMR of compound $\mathbf{5_c}$ in DMSO-d_6, δ2.25 (s, 3H, CH_3), 3.75 (s, 2H, CH_2), and at δ7.15–8.1 (m, 11H, Ar—H).

2-(2,4-Diarylimino-thiazolidin-3-yl)-6-(p-nitrophenylthio)-benzthiazol ($\mathbf{6_{a-d}}$). A mixture of compound (**2**) (0.01 mole) and the appropriate aromatic amine (0.02 mole) in ethanol (50 ml) was refluxed for 4 hrs., and then allowed to cool. The solid product was filtered off and recrystallized from ethanol to give compounds ($\mathbf{6_{a-d}}$). Physical constants of compounds ($\mathbf{6_{a-d}}$) are listed in Table I.

Oxidation of diaryl sulfides (**2**), (**4**), (**5**) and (**6**) to their corresponding sulfones (**3**), (**7**), (**8**) and (**9**).

General procedure:
To diaryl sulfide (**2–6**) (0.02 mole) dissolved in acetic acid (20 ml), hydrogenperoxide (30%, 20 ml) was added, the mixture was left at room temperature for 2–7 days and the deposited diaryl sulfone was collected and recrystallized from glacial acetic acid to give compounds **3**, **7**, **8** and **9**. The physical constants of compounds are listed in Table I.

REFERENCES

1. M. K. Rout, B. Padhi and N. K. Das, *Nature*, **173,** 516 (1954).
2. T. Klosa, German Patent, 1, 093, 800 (1900), *J. Prak. Chem.*, **17,** 340 (1962).
3. R. Daklbom and A. Misorny, *Acta. Chem. Soc.*, **15,** 1367 (1961).
4. A. Larizza and G. Brancaccis, *Farm. Ed. Sci.*, **16,** 701 (1961).
5. W. O. Foye, H. B. Levine and W. L. Mckenzie, *J. Med. Chem.*, **9,** 61 (1966).
6. G. J. M. Vanderkerk, H. C. Van Os; Devries and A. K. Pesteijn, Medel Londbourhoge School En Opsoeking sstas Staat, **18,** 402 (1953).
7. M. M. Kandeel, *Phosphorus, Sulfur, and Silicon,* **48,** 149 (1990).
8. M. A. Abbady and M. M. Kandeel, *Z. Naturforsch,* **34B,** 1149 (1979).
9. M. A. Abbady, M. M. Aly and M. M. Kandeel, *Indian Journal of Chemistry,* **20B,** 53 (1981).
10. M. A. Abbady, M. M. Aly and M. M. Kandeel, *J. Chem. Techn. Biotechnol.*, **31,** 111 (1981).
11. M. A. Abbady, H. S. El-Kashef, M. A. Abd-Alla and M. M. Kandeel, *J. Chem. Techn. Biotechnol.*, **34A,** 62 (1984).
12. M. M. Kandeel, Ph.D. Thesis, Chem. Dept., Fac. of Science, Assiut University, Assiut, Egypt 134 (1985).
13. E. B. Knott, *J. Chem. Soc.*, 1644 (1956).
14. S. M. Ramsh, G. S. Antonova, A. I. Ginak and E. G. Sochilin; *Zh. Org. Khim.*, **11,** 1755 (1975).