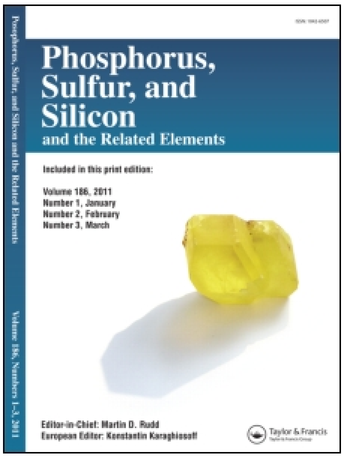

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Mono-, Bis- and Tris (Thio) Substituted Nitrobutadienes from 2-Nitrodiene with 7-Mercapto-4-Methyl Coumarin and N,S-Substituted Dienes from Mono(Thio)-Substituted Dienes with Amines

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*Thiosubstituted nitrodien compounds **3a** and **4a** were prepared by mixing compound **1** with thiol **2a**. **1** gave **5a** by the reaction with coumarin derivative **2a** in EtOH containing sodium hydroxide. Mono(thio)substituted diene compound **3** reacted with **10** and **12** and yielded **11** and **13** in CH_2Cl_2. **7a–h** and **9a-d** were obtained by the reactions of **6a–h** and **8a–d** with compound **3a**.*

Keywords 2-Nitrodiene; 7-mercapto-4-methyl coumarin; dithiol; N,S-substituted nitrodiene; thiol; thiosubstituted halodienes

INTRODUCTION

It is known that mono-, di-, tris(thio)substituted compounds and N,S-substituted diene compounds were obtained from the reactions of nitrodienes with thiols, dithiols and some amines.[1–16]

Our aim in this study was to synthesize new mono(thio)-, bis(thio)-, and tris(thio)substituted compounds from the reaction of 7-mercapto-4-methyl coumarin with 2-nitropentachlorobutadiene and to synthesize and characterize new N,S-substituted nitrodiene compounds obtained from the reaction of mono(thio)substituted diene **3a** with amines.

Mono(thio)- and bis (thio) substituted compounds **3a** and **4a** with interesting structure were obtained when compound **1** was stirred with thiol **2a** in EtOH for a long time (Scheme 1).

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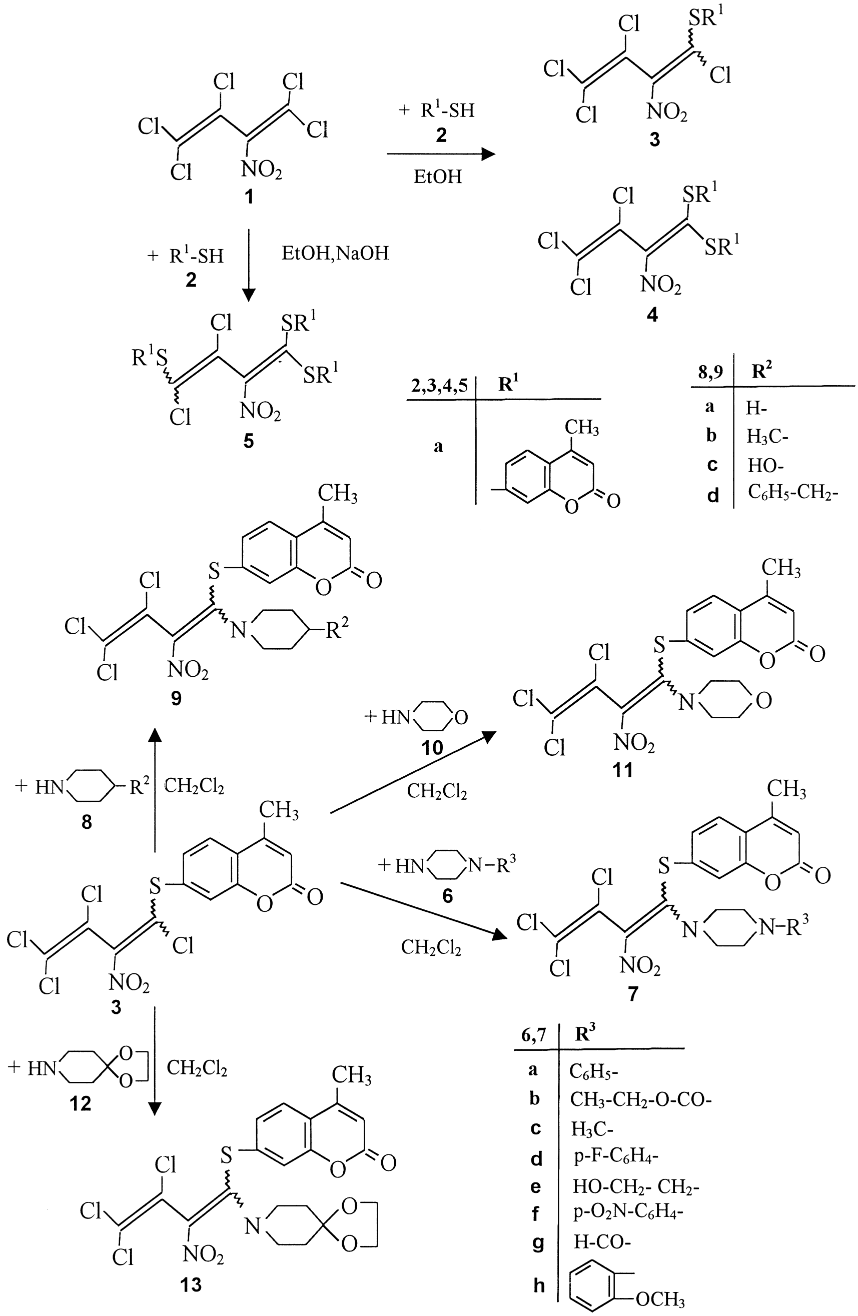

8,9	R^2
a	H-
b	H_3C-
c	HO-
d	C_6H_5-CH_2-

6,7	R^3
a	C_6H_5-
b	CH_3-CH_2-O-CO-
c	H_3C-
d	p-F-C_6H_4-
e	HO-CH_2- CH_2-
f	p-O_2N-C_6H_4-
g	H-CO-
h	-OCH_3

SCHEME 1

The new yellow compounds **3a** and **4a** are stable. 1 Mole of nitrodiene compound **1** gave tris (thio)substituted compound **5a** by the reaction with 4 moles of 7-mercapto-4-methyl coumarin in EtOH containing sodium hydroxide.

Mono(thio)substituted diene **3a** and 2-nitrodiene **1** were very reactive compounds. N- and S-nucleophiles easily replace the chlorine of the nitrovinyl group in 2-nitropentachlorobutadiene. Substitution reaction proceeds by the addition-elimination reactions.

The piperazin compounds are important for therapeutical use and also some piperazine compounds were used in gen transfer agents. It is known that some coumarin derivatives were used as anticancer agents[17–20]

The reaction of **8a–d** with **3a** gave **9a–d**. Mono(thio)substituted diene **3a** reacted with piperazine **6a–g** and gave **7a–g**. These new compounds are stable. The structure of the products were determined by microanalysis and spectroscopic data. IR-spectra of the >C=O band in the coumarin rings showed a characteristic band at 1730–1740 cm^{-1} regions. **7b** and **7g** showed a characteristic >C=O band arising from the R^3-group, as well. IR spectrum of compound **7e** showed a characteristic HO-band in the 3450 cm^{-1} region.

Mono(thio)substituted diene **3a** reacted with **10** and **12** and yielded new N,S-substituted diene compounds **11** and **13** in CH_2Cl_2.

EXPERIMENTAL SECTION

Melting Points are uncorrected: Büchi SMP 20 capillary apparatus.

- IR-spectra: Shimadzu FTIR-8101.
- ^{1}H-NMR-Spectra: Varian Unity Inova 500 MHz (used $CDCl_3$ as a solvent)
- Elemental Analyzer 1110 Carlo-Erba.
- Thin-layer chromatography: TLC plates silica: 60 F254 (Merck, Darmstadt), detection with ultraviolet light (254 nm).
- Column chromatography: Silica 60 (Merck), particle size 0.063–0.20 mm.

Preparation of S-Substituted Polyhalonitrodienes Standart Work Up Procedure I

Equimolar amounts of 2-nitro-1,3,4,4-pentachloro-1,3-butadiene **1** and thiols were stirred for 36 h at room temperature until completion of the reaction. Chloroform was added to the reaction mixture. The organic layer was separated and washed with water (4 × 30 ml) and dried with $CaCl_2$ or $MgSO_4$. The solvent was evaporated and the residue was purified by column chromatography on silica gel (Table I).

Preparation of S,S-Substituted Polyhalonitrodienes Standart Work Up Procedure II

To a mixture of thiols and **1** or monosubstituted dienes in 30 ml of ethanol, 2 g of NaOH (in 10 ml of water) was added at room temperature. The mixture was stirred for 1 h until completion of the reaction. Chloroform was added to the reaction mixture. The organic layer was separated and washed with water (4 × 30 ml) and dried with $CaCl_2$ or $MgSO_4$. The solvent was evaporated and the residue was purified by column chromatography on silica gel (Table I).

Preparation of N,S-Substituted Polyhalonitrodienes Standart Work Up Procedure III

Equimolar amounts of S-substituted polyhalonitrodienes and amine derivative were stirred in dichloromethane until completion of the reaction. Chloroform was added to the reaction mixture. The organic layer was separated and washed with water (4 × 30 ml) and dried with $CaCl_2$ or $MgSO_4$. The solvent was evaporated and the residue was purified by column chromatography on silica gel (Table I).

2-Nitro-1,3,4,4-tetrachloro-1-(7-thio-4-methylcoumarino)-1,3-butadiene (3a)

Prepared according to the procedure I. Yield: 0.761 g (48%). -m.p: 181–182°C. $R_f = 0.680$ (CH_2Cl_2).

2-Nitro-3,4,4-trichloro-1,1-bis(7-thio-4-methylcoumarino)-1,3-butadiene (4a)

Prepared according to the procedure I. Yield: 0.558 g (26%). −m.p: 216–218°C. $R_f = 0.160$ (CH_2Cl_2).

2-Nitro-1,1,4-tris(7-thio-4-methylcoumarino)-3,4-dichloro-1,3-butadiene (5a)

Prepared according to the procedure II. Yield: 0.153 g (28%). −m.p: 192–193°C. $R_f = 0.60$ (EtAc).

TABLE I Spectral Data of the New Compounds

Product No	Mole. form. (mol. wt.)	Calculated/found (%)			IR (cm^{-1})	^{1}H-NMR δ (ppm)
		C	H	N		
3a	$C_{14}H_7SNCl_4O_4$ (427.09)	39.37 40.27	1.65 2.24	3.28 3.09	3050, 3075 (C—H), 1600 (C=C), 1300, 1530 (C—NO_2), 1735 (C=O)	1.7–1.8 (m, 3H, CH_3), 6.3–6.5 (m, 1H, CO—CH—), 7.1–7.8 (m, 3H, H_{arom})
4a	$C_{24}H_{14}S_2NCl_3O_6$ (582.87)	49.46 50.28	2.42 3.21	2.40 2.19	2980, 3020, 3050 (C—H), 1600 (C=C), 1290, 1300, 1520 (C—NO_2), 1740 (C=O)	1.7–1.8 (m, 6H, 2CH_3), 6.1–6.3 (m, 2H, 2CO—CH—), 7.0–7.6 (m, 6H, H_{arom})
5a	$C_{34}H_{21}S_3NCl_2O_8$ (738.65)	55.29 55.15	2.87 3.43	1.90 1.76	2900, 3000, 3050 (C—H), 1600 (C=C), 1245, 1560 (C—NO_2), 1735 (C=O)	1.9–2.6 (m, 9H, 3CH_3), 6.0–6.5 (m, 3H, 3CO—CH—), 6.8–7.95 (m, 9H, H_{arom})
7a	$C_{24}H_{20}SN_3Cl_3O_4$ (522.86)	52.14 52.69	3.64 3.46	7.60 7.01	2800, 2900, 3075 (C—H), 1610 (C=C), 1265, 1540 (C—NO_2), 1725 (C=O)	1.5–1.7 (m, 3H, CH_3), 2.8–4.0 (m, 8H, $H_{piper.}$), 6.1–6.3 (m, 1H, CO—CH—), 6.7–7.8 (m, 8H, H_{arom})
7b	$C_{21}H_{20}SN_3Cl_3O_6$ (548.83)	45.95 45.42	3.67 3.36	7.65 7.21	2850, 3000, 3100 (C—H), 1600 (C=C), 1280, 1525 (C—NO_2), 1710, 1735 (C=O)	1.1–1.3 (m, 3H, —OCH_2CH_3), 1.4–1.6 (m, 3H, CH_3), 2.2–3.7 (m, 8H, $H_{piper.}$), 4.0–4.2 (m, 2H, —OCH_2CH_3), 6.1–6.4 (m, 1H, CO—CH—), 7.1–7.7 (m, 3H, H_{arom})
7c	$C_{19}H_{18}SN_3Cl_3O_4$ (490.79)	46.49 46.52	3.69 3.19	8.56 7.90	2800, 2950, 3050 (C—H), 1600 (C=C), 1275, 1285, 1520 (C—NO_2), 1740 (C=O)	0.7–1.4 (m, 3H, CH_3), 2.0–2.3 (m, 3H, N—CH_3), 2.3–3.8 (m, 8H, $H_{piper.}$), 6.1–6.4 (m, 1H, CO—CH—), 6.5–7.8 (m, 3H, H_{arom})

(Continued on next page)

TABLE I Spectral Data of the New Compounds *(Continued)*

Product No.	Mole. form. (mol. wt.)	Calculated/found (%)			IR (cm^{-1})	^{1}H-NMR δ (ppm)
		C	H	N		
7d	$C_{24}H_{19}SN_3Cl_3O_4F$ (570.85)	50.49 50.22	3.35 3.20	7.36 7.21	2800, 3075 (C—H), 1600 (C=C), 1275, 1510, 1545 (C—NO_2), 1735 (C=O)	1.4–1.6 (m, 3H, CH_3), 2.3–3.9 (m, 8H, $H_{piper.}$), 6.1–6.4 (m, 1H, CO—CH—), 6.6–7.7 (m, 7H, H_{arom})
7e	$C_{20}H_{20}SN_3Cl_3O_5$ (520.82)	46.12 46.64	3.87 4.35	8.07 7.74	2750, 2850, 2900, 3100 (C—H), 1600 (C=C), 1230, 1275, 1520 (C—NO_2), 1730 (C=O), 3450 (OH)	0.7–1.4 (m, 3H, CH_3), 1.6–2.0 (m, 1H, OH), 2.2–3.8 (m, 12H, $6CH_2$), 6.1–6.4 (m, 1H, CO—CH—), 7.1–7.7 (m, 3H, H_{arom})
7f	$C_{24}H_{19}SN_4Cl_3O_6$ (597.87)	48.22 48.63	3.20 3.23	9.37 8.95	2800, 2920 (C—H), 1590 (C=C), 1220, 1260, 1530 (C—NO_2), 1735 (C=O)	0.7–1.2 (m, 3H, CH_3), 1.2–3.8 (m, 8H, $H_{piper.}$), 6.1–6.4 (m, 1H, CO—CH—), 6.5–8.2 (m, 7H, H_{arom})
7g	$C_{19}H_{16}SN_3Cl_3O_5$ (504.78)	45.21 45.39	3.19 4.07	8.32 7.97	2800, 3050 (C—H), 1600 (C=C), 1230, 1270, 1535 (C—NO_2), 1730 (C=O)	0.8–1.4 (m, 3H, CH_3), 2.0–3.8) m, 8H, $H_{piper.}$), 6.1–6.4 (m, 1H, CO—CH—), 7.0–7.8 (m, 3H, H_{arom})
7h	$C_{25}H_{22}SN_3Cl_3O_5$ (582.89)	51.52 51.70	3.80 3.30	7.21 6.78	2750, 2800, 2950, 3100 (C—H), 1610 (C=C), 1250, 1280, 1530 (C—NO_2), 1735 (C=O)	0.8–1.7 (m, 3H, CH_3), 2.2–3.8 (m, 8H, $H_{piper.}$), 3.85–4.0 (m, 3H, OCH_3), 6.2–6.4 (m, 1H, CO—CH—), 6.7–7.7(m, 7H, H_{arom})
9a	$C_{19}H_{17}SN_2Cl_3O_4$ (475.78)	47.96 48.09	3.60 3.54	5.88 5.46	2850, 2960, 3100 (C—H), 1600 (C=C), 1275, 1540 (C—NO_2), 1730 (C=O)	0.7–1.4 (m, 3H, CH_3), 1.4–3.8 (m, 10H, $H_{piper.}$), 6.1–6.3 (m, 1H, CO—CH—), 7.2–7.7 (m, 3H, H_{arom})

9b	$C_{20}H_{19}SN_2Cl_3O_4$ (489.80)	49.04 48.93	3.90 3.80	5.71 6.47	2750, 2850, 2900, 3090 (C—H), 1600 (C═C), 1220, 1280, 1550 (C—NO_2), 1740 (C═O)	0.8–1.2 (m, 6H, $2CH_3$), 1.3–3.4 (m, 9H, $H_{piper.}$), 6.1–6.3 (m, 1H, CO—CH—), 7.1–7.7 (m, 3H, H_{arom})
9c	$C_{19}H_{17}SN_2Cl_3O_5$ (491.78)	46.40 46.75	3.48 3.67	5.69 5.00	2950, 3100 (C—H), 1600 (C═C), 1260, 1540 (C—NO_2), 3450 (OH), 1725 (C═O)	0.8–1.3 (m, 3H, CH_3), 1.4–1.6 (m, 1H, OH), 1.6–2.5 (m, 9H, $H_{piper.}$), 6.3–6.4 (m, 1H, CO—CH—), 7.2–7.8 (m, 3H, H_{arom})
9d	$C_{26}H_{23}SN_2Cl_3O_4$ (565.90)	55.18 54.36	4.09 3.69	4.95 4.31	2770, 2900, 3050 (C—H), 1610 (C═C), 1220, 1280, 1535 (C—NO_2), 1740 (C═O)	0.8–1.3 (m, 3H, CH_3), 1.5–3.6 (m, 11H, $5CH_2$ and 1CH), 6.3–6.4 (m, 1H, CO—CH—), 7.0–7.7 (m, 8H, H_{arom})
11	$C_{18}H_{15}SN_2Cl_3O_5$ (477.75)	45.25 45.16	3.16 2.78	5.86 5.50	2850, 2900, 3000, 3100 (C—H), 1600 (C═C), 1270, 1280, 1540 (C—NO_2), 1735 (C═O)	1.4–1.6 (m, 3H, CH_3), 2.4–3.8 (m, 8H, $H_{morph.}$), 6.3–6.5 (m, 1H, CO—CH—), 7.1–7.8 (m, 3H, H_{arom})
13	$C_{21}H_{19}SN_2Cl_3O_6$ (533.82)	47.25 47.06	3.59 3.35	5.25 5.31	2800, 2950, 3080 (C—H), 1600 (C═C), 1250, 1280, 1535 (C—NO_2), 1740 (C═O)	0.8–1.8 (m, 3H, CH_3), 2.3–3.8 (m, 8H, $H_{piper.}$), 3.8–4.0 (m, 4H, —O—$(CH_2)_2$—O—), 6.3–6.5 (m, 1H, CO—CH—), 7.2–7.8 (m, 3H, H_{arom})

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-phenyl Piperazine (7a)

Prepared according to the procedure III. Yield: 0.168 g (65%). −m.p. 201–202°C. $R_f = 0.333$ (CH_2Cl_2).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-ethoxycarbonyl Piperazine (7b)

Prepared according to the procedure III. Yield: 0.136 g (53%). −m.p: 189–191°C. $R_f = 0.133$ (CH_2Cl_2).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-methyl Piperazine (7c)

Prepared according to the procedure III. Yield: 0.128 g (56%). −m.p: 172–174°C. $R_f = 0.130$ (EtAc).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-[4-fluorophenyl]-piperazine (7d)

Prepared according to the procedure III. Yield: 0.154 g (57%). −m.p: 203–204°C. $R_f = 0.6$ (CH_2Cl_2).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-[1-(2-hydroxyethyl)]-piperazine (7e)

Prepared according to the procedure III. Yield: 0.115 g (47%). −m.p: 170–172°C. $R_f = 0.718$ (CH_3OH).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-[1-(4-nitrophenyl)]-piperazine (7f)

Prepared according to the procedure III. Yield: 0.130 g (55%). −m.p: 188–189°C. $R_f = 0.3$ ($CHCl_3$).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-[formyl]-piperazine (7g)

Prepared according to the procedure III. Yield: 0.138 g (58%). −m.p: 194–195°C. $R_f = 0.375$ (CH_3OH).

N-[1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1,3-butadienyl)]-N^1-[1-(2-methoxyphenyl)]-piperazine (7h)

Prepared according to the procedure III. Yield: 0.119 g (49%). –m.p: 180–181°C. $R_f = 0.5$ ($CHCl_3$).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(piperidino)-1,3-butadiene (9a)

Prepared according to the procedure III. Yield: 0.123 g (55%). –m.p. 179–181°C. $R_f = 0.366$ (CH_2Cl_2).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(4-methylpiperidino)-1,3-butadiene (9b)

Prepared according to the procedure III. Yield: 0.133 g (58%). –m.p. 195–196°C. $R_f = 0.441$ ($CHCl_3$).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(4-hydroxy Piperidino)-1,3-butadiene (9c)

Prepared according to the procedure III. Yield: 0.108 g (47%). –m.p: 181–183°C. $R_f = 0.478$ ($CHCl_3$).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(4-benzyl Piperidino)-1,3-butadiene (9d)

Prepared according to the procedure III. Yield: 0.160 g (60%). –m.p: 174–175°C. $R_f = 0.848$ (EtAc).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(4-morpholino)-1,3-butadiene (11)

Prepared according to the procedure III. Yield: 0.139 g (62%). –m.p. 164–165°C. $R_f = 0.2$ (CH_2Cl_2).

1-(7-Thio-4-methylcoumarino)-2-nitro-3,4,4-trichloro-1-(1,4-dioxoazospiro)-1,3-butadiene (13)

Prepared according to the procedure III. Yield: 0.181 g (72%). –m.p. 187–188°C. $R_f = 0.666$ (EtAc).

REFERENCES

[1] A. Roedig, G. Zaby, and W. Scharf, *Chem. Ber.* **110,** 1484 (1977).
[2] A. Roedig and G. Zaby, *Liebigs Ann. Chem.* 1614 (1979).
[3] C. İbiş, *Liebigs Ann. Chem.* 1873 (1984).
[4] C. İbiş and M. Onul, *Phosphorus, Sulfur, and Silicon*, **178,** 1881 (2003).
[5] C. İbiş and G. Aydınlı, *Phosphorus, Sulfur, and Silicon*, **188,** 77 (2002).
[6] Yu. A. Ol'dekop, R. V. Kaberdin, V. I. Potkin, and I. A. Shingel, *Zh. Org. Khim.*, **15,** 46 (1979).
[7] Yu. A. Ol'dekop, R. V. Kaberdin, and V. I. Potkin, *Zh. Org. Khim.*, **14,** 1594 (1978).
[8] C. İbiş and N. Yılmaz, *Phosphorus, Sulfur, and Silicon*, **159,** 87 (2000).
[9] Yu. A. Ol'dekop, R. V. Kaberdin, and V. I. Potkin, *Zh. Org. Khim.*, **16,** 543 (1980).
[10] C. İbiş and Z. Gökmen, *Phosphorus, Sulfur, and Silicon*, **143,** 67 (1998).
[11] C. İbiş and Ç. Sayıl, *Rev. Roum. Chim.*, **46,** 211 (2001).
[12] C. İbiş and Ç. Sayıl, *Phosphorus, Sulfur, and Silicon*, **106,** 29 (1995).
[13] C. İbiş, *Bull. Soc. Chim Belg.*, **105,** 317 (1996).
[14] C. İbiş and Ç. Sayıl, *Synth. Commun.*, **24,** 2797 (1994).
[15] C. İbiş, F. S. Göuksel, and G. Aydınlı, *Phosphorus, Sulfur, and Silicon*, **178,** 777 (2003).
[16] Yu. A. Ol'dekop, R. V. Kaberdin, V. I. Potkin, and I. A. Shingel, *Zh. Org. Khim.*, **15,** 276 (1979).
[17] R. G. Harvey, C. Crartez, T. P. Ananthanorayan, and S. Schmalka, *J. Org. Chem.*, **53,** 3936 (1988).
[18] M. Nishiyoma, T. Yamamoto, and Y. Koie, *Tetrahedron Lett.*, **39,** 617 (1998).
[19] F. Kerrigon, C. Martin, and G. H. Thomas, *Tetrahedron Lett.*, **39,** 2219 (1998).
[20] I. Solodin and T. D. Heath, *Synlett*, **7,** 619 (1996).