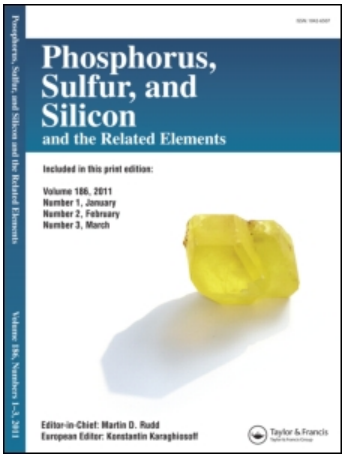


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

ORGANIC SELENIUM COMPOUNDS. PART I: SYNTHESIS AND APPLICATION OF SOME NEW DIARYL-SELENIDES AND SELENONES CONTAINING AMINO ACID MOIETIES

M. A. Abbady[a]; Sh. H. Abdel-Hafez[a]
[a] Chemistry Department, Faculty of Science, Assiut University, Assiut, Egypt

To cite this Article Abbady, M. A. and Abdel-Hafez, Sh. H.(2000) 'ORGANIC SELENIUM COMPOUNDS. PART I: SYNTHESIS AND APPLICATION OF SOME NEW DIARYL-SELENIDES AND SELENONES CONTAINING AMINO ACID MOIETIES', Phosphorus, Sulfur, and Silicon and the Related Elements, 160: 1, 121 — 139
To link to this Article: DOI: 10.1080/10426500008043676
URL: http://dx.doi.org/10.1080/10426500008043676

Phosphorus, Sulfur and Silicon, 2000, Vol. 160, pp. 121-139
Reprints available directly from the publisher
Photocopying permitted by license only

ORGANIC SELENIUM COMPOUNDS. PART I: SYNTHESIS AND APPLICATION OF SOME NEW DIARYL-SELENIDES AND SELENONES CONTAINING AMINO ACID MOIETIES

M.A. ABBADY* and SH.H. ABDEL-HAFEZ

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

(Received July 28, 1999; In final form November 19, 1999)

4′-Nitro-4-aminodiphenylselenide (**1**) reacts with chloroacetyl chloride giving 4′-nitro-4-chloroacetylaminodiphenylselenide (**2**) which undergo facile reaction with certain amines and hydrazine yielding 4-glycylamino and hydrazinoacetylamino-4′-nitrodiphenylselenides (**3**) and (**5**). Two moles of (**2**) react with one mole of piperazine and/or hydrazine to give 1,4-bis [p-N-(p′-nitro-diphenylselenido)aminocarbonylmethylene] piperazine (**4**) and 1,2-bis[p-N-(p′-nitro-diphenylselenido)aminocarbonyl-methylene]hydrazine (**6**). Condensation of (**5**) with aromatic aldehydes in the presence of glacial acetic acid yielded new Schiff bases (**7**). N-phthaloylglycyl chloride reacts with (**1**) in dioxane in the presence of triethylamine to give N-(N′-phthaloylaminoacyl)-4-aminodiphenylselenide (**8**), hydrazinolyses of which affords N-(aminoacyl)-4-amino-4′-nitrodiphenylselenide (**9**). Compound (**9**) undergoes facile condensation with aromatic aldehydes in the presence of piperidine to give Schiff bases (**10**). Compound (**2**) interacts with malononitrile in the presence of K_2CO_3 giving 2-amino-(p′-nitrodiphenylselenido)-5-oxo-Δ^2-pyrrolin-3-carbonitrile (**11**). Oxidation of (**3,7**) and (**10**) using H_2O_2/gl. acetic acid mixtures furnished the corresponding diarylselenones (**12, 13** and **14**).

Keywords: Selenium compounds; diaryl selenides; diaryl selenones; Schiff bases

INTRODUCTION

Since the last two decades, considerable work has been published by M.A. Abbady *et al.*[1–9,20] dealing with the chemistry of diaryl sulphides and diarylsulphones containing different heterocyclic and other organic

* To whom all correspondance should be addressed.

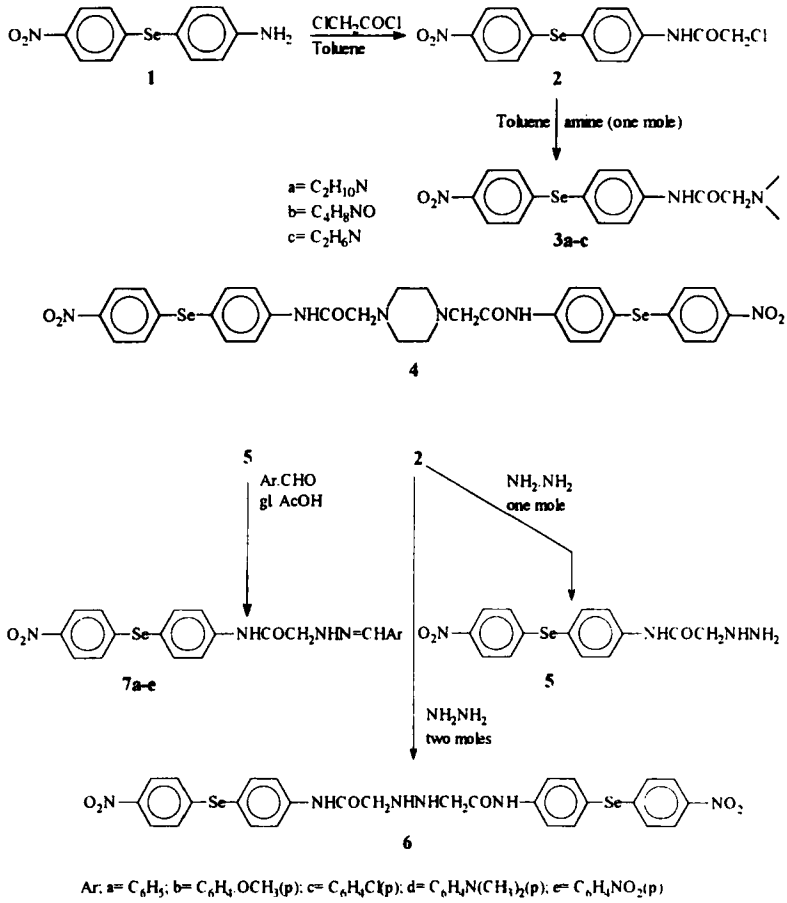
moieties with the aim to evaluate the exchangable intra and interrelationships between the basic molecules, i.e. diphenylsulphides and sulphones from one side and certain bonded organic moieties on the other side, and their effects on the reactions and biological activities of the resulting combined molecules. The valuable scientific and application results[1–9] obtained attracted our attention to apply that idea on their organic selenium analogues. Recently considerable work[10–12] has been directed toward the synthesis and investigations of organic selenium compounds in chemical, biological and industrial aspects.

RESULTS AND DISCUSSION

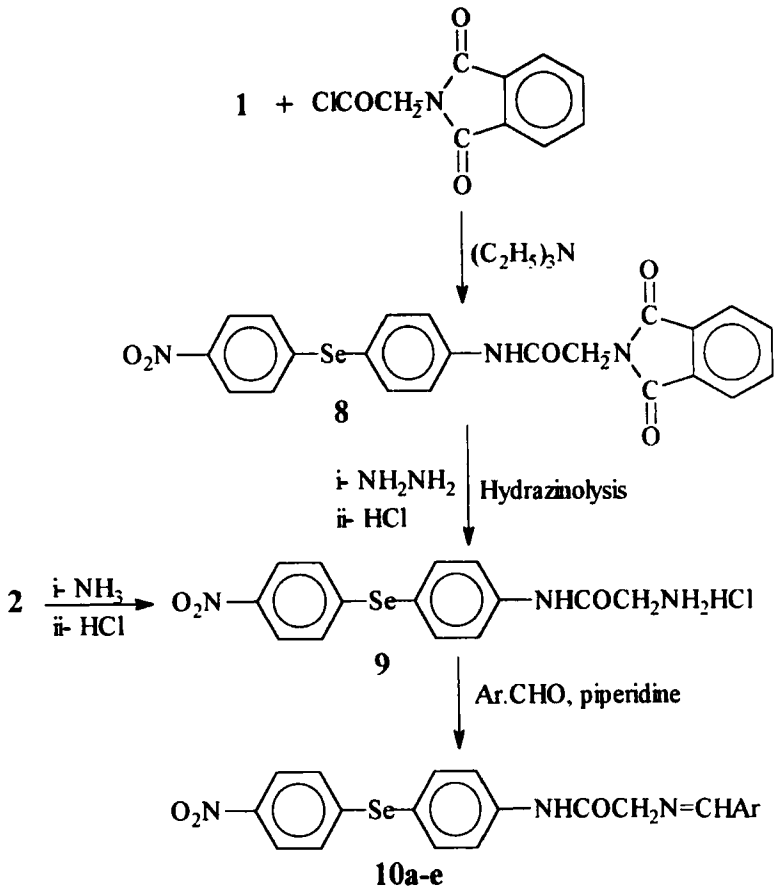
In the present investigation efforts were made to prepare different types of the *hitherto* unreported diarylselenides and diarylselenone derivatives containing amino acid moieties. Thus the starting substance for the forthcoming syntheses and studies is 4-amino-4′-nitro-diphenylselenide (**1**) which was prepared by partial reduction of 4,4′-dinitrodiphenylselenide using phenylhydrazine in the presence of decaline as a solvent rather than p-chlorobenzene as described in the literature[13]. When (**1**) was treated with chloroacetyl chloride in dry toluene gave 4-chloroacetylamino-4′-nitro-diphenylselenide (**2**). The importance of piperazine and its analogues as local anesthetics[14–16] encouraged us to prepare 4-N-glycylamino-4′-nitrodiphenylselenides containing these amines. Thus (**2**) reacted readily with piperidine, morpholine and dimethylamine in dry toluene giving (**3a-c**). Interaction of two moles of (**2**) with one mole of piperazine yielded 1,4-bis(p-N-(p′-nitrodiphenylselenido)(aminocarbonylmethylene) piperazine (**4**).

Condensation of one mole of (**2**) with one mole of hydrazine hydrate afforded 4-substituted hydrazino acetylamino diphenylselenides (**5**) while condensation of two moles of (**2**) with one mole of hydrazine hydrate furnished 1,2-bis(N-(p′-nitrodiphenylselenido)(aminocarbonylmethylene) hydrazine (**6**). Condensation of (**5**) with aromatic aldehydes in glacial acetic acid furnished new Schiff bases (**7**) in good yields.

Reaction of (**1**) with phthaloylglycyl chloride in dioxane using triethylamine as basic catalyst gave α-phthalimido-N-[(p′-nitrophenyl)selenolophenyl]acetamide[11] (**8**). The phthaloyl group could be removed from (**8**)



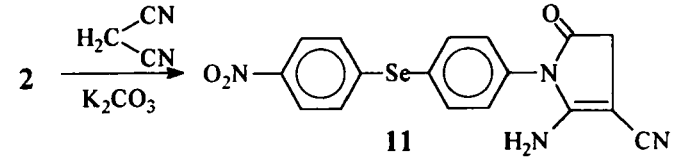
by hydrazinolysis to give N-glycyl-4-amino-4′-nitrodiphenylselenide hydrochloride (**9**). Compound (**9**) could also be prepared by an alternative route by which (**2**) was treated with ammonia gas to give the corresponding 4-glycylamino-4′-nitrodiphenylselenide *in situ* which on treatment with hydrogen chloride readily afforded (**9**). The obtainable two N-glycyl-4-amino-4′-nitrodiphenylselenide hydrochlorides (**9**) using these two different routes are identical (m.p., mmp., physical and spectral data). Condensation of (**9**) with aromatic aldehydes in abs. ethanol using dry piperidine as basic catalyst furnished the Schiff bases (**10**).



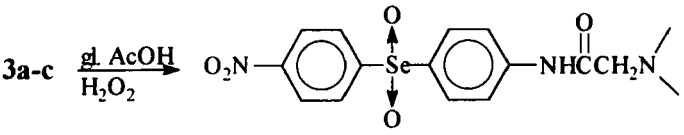
Ar; a= C_6H_5, b; $C_6H_4OCH_3$(p); c= C_6H_4Cl(p);
d= $C_6H_4N(CH_3)_2$(p); e= $C_6H_4NO_2$(p)

Interaction of malononitrile[17] with (**2**) in the presence of potassium carbonate yielded 1(4′-nitrodiphenylselenide)-5-oxo-Δ^2-pyrrolin-3-carbonitrile (**11**). This compound could be a valuable precursor for our future synthetic studies on the chemistry of diarylselenides and selenones containing heterocyclic moieties. Oxidation of (**3,7**) and (**10**) with H_2O_2/gl. acetic acid mixtures at least for 6 days led to the formation of the corre-

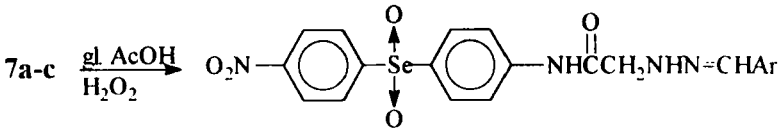
sponding diarylselenones (**12,13**) and (**14**) (c.f. Table III) in fairly moderate yields.



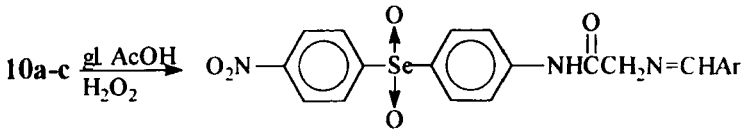
11



12a-c



13a-c



14a-c

It has been observed that the positive bridge effect[9] of p-$NO_2C_6H_4Se$-groups has no large effect on the yields of the prepared compounds by comparison with the yields of their sulphur analogues[13].

Antimicrobial activities

Biological screening of prepared compounds **3–10** and **12–14** was carried out to evaluate their antibacterial properties. Preliminary screening of the tested compounds **3–10** & **12–14** against different strains of both Gram positive and Gram negative bacteria were determined using the filter paper

disc method[18]. The results obtained prompted the authors to determine the minimum inhibitory concentration of each compound against *Staphylococcus aureus, Bacillus subtilis* and *Escherichia coli*using the agar-cup-diffusion method[21], using penicillin (100 units) as a reference. The results are listed in Table I.

TABLE I Minimum inhibitory concentrations (m.i.c.) of compounds (--) against different organisms

Compound No.	*m.i.c. ($\mu g\ ml^{-1}$)*		
	Staphylococcus aureus	*Bacullus subtilis*	*Escherichia coli*
3a	218	215	248
3b	219	218	245
3c	220	214	237
4	221	218	240
5	225	230	242
6	240	237	240
7a	235	234	244
7b	224	215	250
7c	240	219	246
7d	218	230	250
7e	231	217	241
8	236	232	240
9	226	218	245
10a	243	238	253
10b	220	235	247
10c	230	219	239
10d	220	235	247
10e	230	219	239
12a	220	228	249
12b	225	218	247
12c	219	217	239

Compound No.	m.i.c. (μg ml^{-1})		
	Staphylococcus aureus	*Bacullus subtilis*	*Escherichia coli*
13a	225	217	256
13b	251	236	249
13c	219	232	251
13d	232	219	243
13e	238	234	248
14a	230	220	249
14b	238	235	241
14c	259	238	251
14d	219	235	246
14e	228	225	241
Penicillin as ref.	10	10	–

Experimental procedure

The time-period required for the completion of the reaction and the purity of the prepared compounds were monitored by TLC. Melting points were determined on a Fisher-Johns melting point apparatus and are uncorrected. Elemental analyses were performed on a Perkin-Elmer 240 elemental analyser. IR spectra[19]were recorded on a Bye-Unicam SP 3–100 spectrophotometer using KBr wafer technique. ^{1}HNMR spectra were recorded on a varian EM-39090 MHz NMR spectrometer in suitable deuterated solvent using TMS as internal standard (chemical shifts in δ ppm).

4′-Nitro-4-aminodiphenylselenide (1)

This was prepared according to the method given in literature[13] with some modification in which the selective reduction of 4,4′-dinitrodiphenyl-selenide is accomplished using decaline as a solvent. Orange crystals were obtained by successive crystallizations (methanol, n-butanol and benzene); m.p. 124°C. yield 55%.

IR: at 1545, 1345 cm^{-1} (NO_2) and 3360, 3380 cm^{-1} (NH_2). ^{1}HNMR in $CDCl_3$: at δ 3.7 (s, 2H, NH_2) and at δ 6.5–8.0 (m, 8H for Ar-H).

Anal. Calc. for $C_{12}H_{10}N_2O_2Se$:	C, 49.15; H. 3.41; N, 9.55
Found:	C, 49.01; H, 3.43; N, 9.48

4′-Nitro-4-chloroacetylaminodiphenylselenide (2)

Chloroacetyl chloride (0.01 mole) was added slowly to a solution of (**1**) (0.015 mole) in dioxane (150 ml) and the reaction mixture was refluxed for 3 hr, poured into cold water. The precipitate was collected and crystallized from a mixture of H_2O/C_2H_5OH (1:1); m.p. 170°C. yield 71%.

IR: at 1550, 1340 cm^{-1} (NO_2), at 1662 cm^{-1} (C=O) and 3290, 3380 cm^{-1} (NH). ^{1}HNMR in $CDCl_3$: at δ 4.2 (s, 2H, CH_2), at δ 7.2–8.1 (m, 8H for Ar-H) and at δ 10.2 (s, 1H, NH).

Anal. Calc. for $C_{14}H_{11}N_2O_3SeCl$:	C, 45.47; H, 2.97; N, 7.57; Cl. 9.60
Found:	C, 45.52; H, 2.81; N, 7.51; Cl, 9.52

4-Glycylaminodiarylselenides (3)

A mixture of (**2**) (0.01) mole and the appropriate secondary amine in 20 ml dry toluene was refluxed for 5–6 hr. The amine hydrochloride is filtered and the organic layer extracted with 1 N HCl (3x30 ml). The acidic extract was neutralized with sodium carbonate solution and the precipitated solid was filtered, washed, with sodium carbonate solution and crystallized from the proper solvent to give **3** (Table II).

1,4-bis(p-N-Nitro-diphenylselenido)aminocarbonylmethylene) piperazine (4)

A mixture of (**2**) (0.02 mole) and piperazine (0.01 mole) in dioxane was refluxed for 4 h and the reaction mixture worked-up as described above. The obtained product was crystallized from ethanol to give (**4**) in 60–65% yield; m.p. 205°C.

TABLE II Physical and spectral data of compounds **3, 7, 10**

Ar or -N	*m.p.°C (solvent of cryst)*	*yield %*	*Molecular formula*	*Elemental analysis Calcd./Found %*				*Spectral data*
				C	*H*	*N*	*Cl*	
$_5H_{10}N$	110 pet. ether (80–100°C)	65	$C_{19}H_{21}N_3O_3Se$	54.55 54.41	5.02 5.85	10.04 10.15	–	IR: 1550, 1340 cm^{-1} (NO_2), 2840 cm^{-} (CH_2), 1670 cm^{-1} (C=O). ^{1}HNMR (CD 1.5 (m, 6H, $3CH_2$ of piperidine), δ 2.5 ($N(CH_2)_2$ in piperidine, δ 7.4–8 (m, 8H, δ 9.3 (s, 1H, NH) and δ 3.2 (s, 2H, CH_2
$_8H_8NO$	105 ethanol	68	$C_{18}H_{19}N_3O_4Se$	51.43 51.25	4.52 4.38	10.00 10.20	–	IR: 1550, 1340 cm^{-1} (NO_2), 2840 cm^{-} of CH_2), 1720 cm^{-1} (C=O), 1120 cm^{-1} ^{1}HNMR ($CDCl_3$); δ 3.2 (s, 2H of CH_2) (t, 4H, CH_2OCH_2), δ 2.7 (t, 4H, -N(CH 7.2–8 (m, 8H, Ar-H) and δ 9.3 (s, 1 H,
$_2H_6N$	120 pet. ether (80–100°C)	60	$C_{16}H_{17}N_3O_3Se$	50.79 50.30	4.49 4.45	11.11 11.05	–	IR: 1550, 1340 cm^{-1} (NO_2), 2900 cm^{-} of CH_2), 1670 cm^{-1} (C=O), 1380 (N-C ^{1}HNMR (DMSO); δ 3.8 (s, 2H, CH_2), 8.2 (m, 8H, Ar-H), δ 9.3 (s, 1H, NH) a (s, 6H, $N(CH_3)_2$)
$_5H_5$	131 benzene	70	$C_{21}H_{18}N_4O_3Se$	55.63 55.51	3.97 3.81	12.36 12.29		IR: 1625 cm^{-1} (C=N), 1715 cm^{-1} (C=(1550 1345 cm^{-1} (NO_2). ^{1} HNMR (DM 3.6 (d, 2H, CH_2), δ 8.4 (s, 1H, N=CH). 8.3 (m, 13H, Ar-H), δ 10.1 (s, 1H, NH and δ 8.7 (b, 1H, NH)

Ar or -N	m.p.°C (solvent of cryst)	yield %	Molecular formula	Elemental analysis Calcd./Found %				Spectral data
				C	H	N	Cl	
C_6H_4-OCH_3(p)	124 pet. ether (100–120°C)	72	$C_{22}H_{20}N_4O_4Se$	54.6 54.51	4.1 4.05	11.5 11.51	–	IR: 1620 cm^{-1} (C=N), 1715 cm^{-1} (C= 1550n 1345 cm^{-1} (NO_2), 1460 cm^{-1} (^{1}HNMR (DMSO), δ 3.2 (d, 2H, CH_2), (s, 3H, CH3), δ 7.4–8.3 (m, 12H, Ar-H (s, 1H, N=CH), δ 10.1 (s, 1H, NHCO) 8.8 (B, 1H, NH)
C_6H_4-Cl(p)	133 benzene	69	$C_{21}H_{17}N_4O_3SeCl$	51.69 51.71	3.48 3.50	11.48 11.40	7.28 7.08	IR: 1625 cm^{-1} (C=N), 1710 cm^{-1} (C= 1550, 1345 cm^{-1} (NO_2). ^{1}HNMR (DM 3.2 (d, 2H, CH_2), δ 7.4–8.3 (m, 12H, A 8.4 (s, 1H, N=CH) and δ 10,1 (s, 1H, N
C_6H_4-$N(CH_3)_2$(p)	121 n-butanol	65	$C_{23}H_{23}N_5O_3Se$	55.64 55.52	4.63 4.51	14.11 14.02	–	IR: 1640 cm^{-1} (C=N), 1730 cm^{-1} (C= 1220 cm^{-} (sp3 C-N).] HNMR (DMSO) (d, 2H, CH_2), δ 3.5 (s, 3H, CH_3), δ 7.2- (m, 12H, Ar-H), δ 10.1 (s, 1H, NHCO) (s, 1H, N=CH) and δ 8.8 (b, 1H, NH)
C_6H_4-NO_2(p)	120 pet. ether (80–100°)	64	$C_{21}H_{17}N_5O_5Se$	50.60 50.41	3.41 3.31	14.05 14.10	–	IR: 1635 cm^{-1} (C=N), 1720 cm^{-1} (C= 1550, 1340 cm^{-1} (NO_2). ^{1}HNMR (DM 3.2 (d, 2H, CH_2), δ 8.8 (b, 1H, NH), δ 7 (m, 12H, Ar-H), δ 10.1 (s, 1H, NHCO) 8.6 (s, 1H, N=CH)
C_6H_5	105 ethanol	68	$C_{21}H_{17}N_3O_3Se$	57.53 57.41	3.88 3.75	9.58 9.40	–	IR: 1615 cm^{-1} (C=N), 1710 cm^{-1} (C= 1650, 1345 cm^{-1} (NO_2). ^{1}HNMR (DM 3.6 (s, 2H, CH_2), δ 8.3 (s, 1H, N=CH), 8.2 (m, 13H, Ar-H) and δ 10.1 (s, 1H, N

Compd. No.	*Ar or -N*	*m.p.°C (solvent of cryst)*	*yield %*	*Molecular formula*	*Elemental analysis Calcd./Found %*				*Spectral data*
					C	*H*	*N*	*Cl*	
10b	C_6H_4-OCH_3(p)	140 ethanol	66	$C_{22}H_{19}N_3O_4Se$	56.41 56.38	4.06 4.01	8.97 8.89	–	IR 1620 cm^{-1} (C=N), 1715 cm^{-1} (C=O), 1550, 1345 (NO_2), 1460 cm^{-1}(OCH_3). ^{1}HNMR (DMSO), δ 3.3 (s, 2H, CH_2), δ 3.7 (s, 3H, CH_3), δ 7.4–8.2 (m, 12H, Ar-H), δ 8.4 (s, 1H, N=CH) and δ 10.1 (s, 1H, NHCO)
10c	C_6H_4-Cl(p)	145 dioxan + water	71	$C_{21}H_{16}N_3O_3SeCl$	53.33 53.29	3.38 3.30	8.88 8.92	7.51 7.42	IR: 1630 cm^{-1} (C=N), 1720 cm^{-1} (C=O), 1550, 1340 cm^{-1} (NO_2). ^{1}HNMR (DMSO). δ 3.3 (s, 2H, CH_2), δ 7.4–8.2 (m, 12H, Ar-H), δ 8.4 (s, 1H, N=CH) and δ 10.1 (s, 1H, NHCO)
10d	$C_6H_4N(CH_3)_2$(p)	115 pet. ether (100–120°C)	75	$C_{23}H_{22}N_4O_3Se$	57.38 57.21	4.57 4.38	11.64 11.51	–	IR: 1635 cm^{-1} (C=N), 1725 cm^{-1} (C=O), 1220 cm^{-1} (Sp3 C-N).^{1}HNMR (DMSO), δ 3.8 (s, 2H, CH_2), δ 2.9 (s, 6H, $N(CH_3)_2$), δ 7.3–8.2 (m, 12H, Ar-H), δ 10.2 (s, 1H, NHCO) and δ 8.5 (s, 1H, N=CH)
10e	$C_6H_4NO_2$(p)	130 benzene	72	$C_{21}H_{16}N_4O_5Se$	52.17 52.01	3.31 3.28	11.59 11.62	–	IR: 1550, 1340 cm^{-1} (NO_2), 1720 cm^{-1} (C=O), 1230 cm^{-} (C=N).^{1} HNMR (DMSO), δ 3.4 (s, 2H, CH_2), δ 7.5–5.8 (m, 12H, Ar-H), δ 10.1 (s, 1H, NHCO) and δ 8.6 (s, 1H, N=CH)

TABLE III Physical and spectral data of compounds **12, 13, 14**

Ar or -N	*m.p.°C (solvent of cryst)*	*yield %*	*Molecular formula*	*Elemental analysis Calcd./Found %*				*Spectral data*
				C	*H*	*N*	*Cl*	
$_5H_{10}N$	118 pet. ether (100–180°C)	52	$C_{19}H_{21}N_3O_3Se$	50.67 50.50	4.66 4.59	9.33 9.35	–	IR: 1550, 1340 cm^{-1} (NO_2), 2840 cm^{-1} (CH_2), 1670 cm^{-1} (C=O), 1320, 1120 cm^{-1} (SeO_2). ^{1}HNMR ($CDCl_3$); δ 1.5 (m, 6H, of piperidine), δ 2.5 (d, 4H, $N(Cl\ l_2)_2$ in p ine, δ 3.2 (s, 2H, CH_2), δ 7.4–8.1 (m, 8H, and δ 9.6 (s, 1H, NH)
$_4H_8NO$	122 ethanol	53	$C_{18}H_{19}N_3O_6Se$	47.79 47.72	4.20 4.11	9.29 9.18	–	IR: 1550, 1340 cm^{-1} (NO_2), 2840 cm^{-1} (CH_2), 1720 cm^{-1} (C=O), 1320, 1120 cm^{-1} (SeO_2). ^{1}HNMR ($CDCl_3$); δ 3.2 (s, 2H of C 3.8 (t, 4H, $CH_2O\ CH_2$), δ 2.7 (t, 411, – N(δ 7.3–8.1 (m, 8H, Ar-H) and δ 9.6 (s, 1H,
$_2H_6N$	134 pet. ether (100–120°C)	54	$C_{16}H_{17}N_3O_5Se$	46.83 46.70	4.14 4.01	10.24 10.31	–	IR: 1550, 1340 cm^{-1} (NO_2), 2900 cm^{-1} (CH_2), 1670 cm^{-1} (C=O), 1380 (N-CH_3), 1120 cm^{-1} (SeO_2). ^{1}HNMR (DMSO); δ 3 2H, CH_2), δ 7.4–8.3 (m, 8H, Ar-H), δ 9.6 NH) and δ 3.0 (s, 6H, $N(CH_3)_2$)
$_6H_5$	139 benzene	50	$C_{21}H_{18}N_1O_5Se$	51.95 51.81	3.71 3.60	11.54 11.45	–	IR: 1625 cm^{-1} (C=N), 1715 cm^{-1} (C=O), 1345 cm^{-1} (NO_2), 1320, 1120 cm^{-1} (SeO ^{1}HNMR (DMSO), δ 3.6 (d, 2H. CH_2), δ 8 1H, N=CH), δ 7.5–8.4 (m, 13H. Ar-H), δ 1 1H, NHCO) and δ 8.8 (b, 1H, NH)

Ar or -N	m.p.°C (solvent of cryst)	yield %	Molecular formula	Elemental analysis Calcd./Found %				Spectral data
				C	H	N	Cl	
H_4-OCH_3(p)	130 n-butanol	48	$C_{22}H_{20}N_4O6Se$	51.26 51.18	3.88 3.75	10.87 10.61	–	IR: 1620 cm^{-1} (C=N), 1715 cm^{-1} (C=O), 1345 cm^{-1} (NO_2), 1460 cm^{-1} (OCH_3), 13 1120 cm^{-1} (SeO_2). ^{1}HNMR (DMSO), δ 3. 2H, CH_2), δ 3.7 (s, 3H, CH_3), δ 7.5–8.4 (m Ar-H), δ 8.5 (s, 1H, N=CH), δ 10.3 (s, 1H NHCO) and δ 8.8 (b, 1H, NH)
H_4-Cl(p)	140 n-butanol	56	$C_{21}H_{17}N_4O_5SeCl$	48.51 48.40	3.27 3.20	10.78 10.65	6.83 6.75	IR: 1625 cm^{-1} (C=N), 1710 cm^{-1} (C=O), 1345 cm^{-1} (NO_2), 1320, 1120 cm^{-1} (SeO_2 ^{1}HNMR (DMSO), δ 3.2 (d, 2H, CH_2), δ 3 3H, CH_3), δ 7.5–8.4 (m, 12H, Ar-H), δ 8.6 1H, N=CH), δ 10.3 (s, 1H, NHCO) and δ 8 1H, NH)
H_4-$N(CH_3)_2$(p)	129 pet. ether (100–120°C)	59	$C_{23}H_{23}N_5O_5Se$	52.27 52.13	4.35 4.29	13.25 13.30	–	IR: 1640 cm^{-1} (C=N), 1730 cm^{-1} (C=O), cm^{-1} (sp3 C-N), 1320, 1120 cm^{-1} (SeO_2). ^{1}HNMR (DMSO) δ 3.1 (d, 2H, CH_2), δ 3. 3H, CH_3), δ 7.5–8.4 (m, 12H, Ar-H). δ 10 1H, NHCO), δ 8.6 (s, 1 H, C=CH) and δ 8 1H, NH)
H_4-NO_2(p)	135 benzene	60	$C_{21}H_{17}N_5O_7Se$	47.55 47.40	3.20 3.30	13.20 13.18	–	IR: 1635 cm^{-1} (C=N). 1720 cm^{-1} (C=O), 1340 cm^{-1} (NO_2), 1320, 1120 cm^{-1} (SeO_2 ^{1}HNMR (DMSO) δ 3.6 (d, 2H, CH_3), δ 7. (m, 12H, Ar-H), δ 10.3 (s, 1H, NHCO), δ 1H, N=CH) and 6 8.8 (b, 1H, NH)

Ar or -N	m.p.°C (solvent of cryst)	yield %	Molecular formula	Elemental analysis Calcd./Found %				Spectral data
				C	H	N	Cl	
C_6H_5	110 ethanol	52	$C_{21}H_{17}N_3O_5Se$	53.62 53.50	3.61 3.49	8.93 9.01	–	IR: 1615 cm^{-1} (C=N), 1710 cm^{-1} (C=O), 1345 cm^{-1} (NO_2), 1325, 1120 cm^{-1} (SeO_2). ^{1}HNMR (DMSO), δ 3.6 (s, 2H, CH_2), δ 8. 1H, N=CH), 6 7.4–8.3 (m, 13H, Ar-H) and 10.3 (s, 1H, NHCO)
C_6H_4-OCH_3(p)	115 ethyl acetate	54	$C_{22}H_{19}N_3O_6Se$	52.80 52.60	3.80 3.75	8.40 8.48	–	IR: 1620 cm^{-1} (C=N), 1715 cm^{-1} (C=O), 1 1345 (NO_2), 1460 cm^{-1}(OCH_3), 1325, 112((SeO_2). ^{1}HNMR (DMSO), δ 3.3 (s, 2H, CH 3.7 (s, 3H, CH_3), δ 7.5–8.4 (m, 12H, Ar-H) (s, 1H, N=CH) and δ 10.3 (s, 1H, NHCO)
C_6H_4-Cl(p)	151 methanol	50	$C_{21}H_{16}N_3O_5SeCl$	49.95 49.81	3.17 3.21	8.32 8.15	7.03 7.11	IR: 1620 cm^{-1} (C=N), 1720 cm^{-1} (C=O), 1120 cm^{-1} (SeO_2), 1550, 1340 cm^{-1} (NO_2 ^{1}HNMR (DMSO), δ 3.3 (s, 2H, CH_2). δ 7. (m, 12H, Ar-H), δ 8.4 (s, 1H, N=CH), and (s, 1H, NHCO)

Ar or -N	*m.p.°C (solvent of cryst)*	*yield %*	*Molecular formula*	*Elemental analysis Calcd./Found %*				*Spectral data*
				C	*H*	*N*	*Cl*	
$C_6H_4N(CH_3)_2$(p)	120 benzene	49	$C_{23}H_{22}N_4O_5Se$	53.80 53.75	4.28 4.20	10.91 10.70	–	IR: 1635 cm^{-1} (C=N), 1725 cm^{-1} (C=O), cm^{-1} (Sp3 C-N), 1325, 1120 cm^{-1} (SeO_2) ^{1}HNMR (DMSO), δ 3.8 (s, 2H, CH_2), δ 2 6H, $N(CH_3)_2$), δ 7.4–8.3 (m, 12H, Ar-H), (s, 1H, NHCO) and δ 8.6 (s, 1H, N=CH)
$C_6H_4NO_2$(p)	139 ethanol	59	$C_{21}H_{16}N_4O_7Se$	48.93 48.81	3.10 2.95	10.87 10.75	–	IR: 1550, 1340 cm^{-1} (NO_2), 1720 cm^{-1} (1630 cm^{-1} (C=N), 1325, 1120 cm^{-1} (SeO ^{1}HNMR (DMSO), δ 3.4 (s, 2H, CH_2), δ 7 (m, 12H, Ar-H), δ 10.3 (s, 1H, NHCO) an (s, 1hn N=CH)

IR: at 1550, 1360 cm^{-1} (NO_2) and 3295 cm^{-1} (NH). ^{1}HNMR in $CDCl_3$: at δ 2.6 (s, 8H, CH_2 piperazine), at δ 7.2–8 (m, 16H, Ar-H), at δ 3.1 (s, 4H, $2CH_2$) and at δ 10.2 (s, 2H, NH).

Anal. Calc. for $C_{32}H_{30}N_6O_6Se_2$:	C, 51.06; H, 3.98; N, 11.17
Found:	C, 51.10: H, 4.01; N, 11.05

4-N-Hydrazinoacetylaminodiarylselenide (5)

A mixture of (**2**) (0.01 mole) and hydrazine hydrate (99–100%, 0.015 mole) in 15 ml of ethanol was refluxed for 4 hr. The reaction mixture was allowed to cool. The precipitated solid was filtered and washed with water and crystallized from ethanol; m.p. 125°C. yield 66 %.

IR: at 1549, 1341 cm^{-1} (NO_2), at 1654 cm^{-1} (C=O) and 3350, 3325 cm^{-1} (NH). ^{1}HNMR in $CDCl_3$: at δ 4.0 (s, 2H, CH_2), at δ 7.2–8 (m, 8H for Ar-H), at δ 10.1 (s, 1H, NH), at δ 1.8–2 (d, 2H, NH_2) and at δ 9.8 (b, 1H, NH).

Anal. Calc. for $C_{14}H_{14}N_4O_3Se$:	C, 46.03; H, 3.83; N, 15.34
Found:	C, 46.10; H, 3.79; N, 15.21

1,2-bis(N-(p'-Nitro-diphenylselenido)aminocarbonylmethylene) hydrazine (6)

A mixture of (**2**) (0.025 mole) and hydrazine hydrate (0.01 mole) in 20 ml of ethanol was refluxed for 4 hr. The reaction mixture was cooled, diluted with water and the precipitated solid was filtered, washed with cold water and crystallized from n-butanol; m.p. 145°C. yield 60 %.

IR: at 1550, 1342 cm^{-1} (NO_2), 1655 cm^{-1} (C=O) and 3290 cm^{-1} (NH). ^{1}HNMR in $CDCl_3$: at δ 4.0 (s, 4H, $2CH_2$), at δ 7.2–8 (m, 16H of Ar-H), at δ 10.1 (s, 2H, 2NH) and at δ 9.8 (b, 2H, 2NH).

Anal. Calc. for $C_{28}H_{24}N_6O_6Se_2$:	C, 48.14; H, 3.43; N, 12.03
Found:	C, 48.09; H, 3.38; N, 12.10

Preparation of Schiff bases (7)

Solution of equimolecular quantities of (**5**) and the appropriate aldehyde in glacial acetic acid was refluxed for 3–4 hr. 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 (**7a-e**) (Table II).

α-Phthalimido-N-[(p′-nitrophenyl)selenidophenyl]acetamide (8)

To a solution of **1** (0.01 mole) in dioxane (15 ml) was added N-phthaloylglycyl chloride[20] (0.01 mole) in dioxane (15 ml) followed by triethylamine (0.01 mole). The reaction mixture was allowed to stand overnight at room temperature and was treated with 2 N HCl. The precipitate thus obtained was filtered, crystallized and recrystallized from ethyl acetate to give 50% of α-phthalimido-N-[(p′-nitrophenyl) selenidophenyl]acetamide; m.p. 245°C. yield 55 %.

IR: at 1551, 1341 cm^{-1} (NO_2), at 1658 cm^{-1} (C=O), at 3290 cm^{-1} (NH) and 1720 cm^{-1}(C=O of phthalyl residue). ^{1}HNMR in $CDCl_3$ + one drop DMSO: at δ 4.5 (d, 2H, CH_2), at δ 7.2–8.2 (m, 12H, Ar-H) and at δ 10.4 (s, 1H, NH).

Anal. Calc. for $C_{22}H_{15}N_3O_5Se$:	C, 55.00; H, 3.12; N, 8.75
Found:	C, 54.90; H, 3.10; N, 8.71

N-Glycyl-4-amino-4′-nitrodiphenylselenide hydrochloride (9)

Compound (**8**) (0.01 mole) in ethanol (25 ml) was refluxed with hydrazine hydrate (10 ml) for one hour, and the reaction mixture was evaporated to near dryness. The residue was warmed at 50°C for 10 min. with 2 N HCl (30 ml), allowed to stand at room temperature for 30 min and the precipitated phthalyl hydrazide filtered. The filtrate on evaporation in vacuo gave (**9**). yield 57 %.

IR: at 1550, 1341 cm^{-1} (NO_2), at 1657 cm^{-1} (C=O) and 3295 cm^{-1} (NH). ^{1}HNMR in DMSO: at δ 7.3–8.2 (m, 11H, 8H, Ar-H + 3H, NH_3Cl) and at δ 10.3 (s, 1H, NH).

Anal. Calc. for $C_{14}H_{14}N_3O_3SeCl$:	C, 43.47; H, 3.62; N, 10.86
Found:	C, 43.44; H, 3.58; N, 10.82

Preparation of Schiff bases (10)

The appropriate aromatic aldehyde and compound (**9**) in equimolar amounts were refluxed in dry ethanol in the presence of dry piperidine (2–3 drops) for 3 h, and the reaction mixture was concentrated and cooled. The precipitated anils were filtered, washed with cold ethanol and crystallized from it (Table II).

2-Amino-1-(p′-nitro-diphenylselenido)-5-oxo-Δ^2-pyrolin-3-carbonitrile (11)

To a solution of (0.01 mole) of (**1**) in 25 ml absolute ethanol was added malononitrile (0.015 mole) and 3 g dry K_2CO_3 and the reaction mixture was refluxed for one hour with stirring. After cooling, the reaction mixture was poured into 100 ml of water. The precipitate was collected and crystallized from ethanol or dioxane; m.p. 190°C. yield 62 %.

IR: at 1552, 1343 cm^{-1} (NO_2), at 1710 cm^{-1} (C=O) and at 2190 cm^{-1} (CN). ^{1}HNMR in DMSO: at δ 3.4 (s, 2H, CH_2), at δ 6.8 (s, 2H, NH_2), and at δ 3.4 (m, 8H, Ar-H).

Anal. Calc. for $C_{17}H_{12}N_4O_3Se$:	C, 51.13; H, 3.00; N, 14.03
Found:	C, 51.02; H, 2.95; N, 14.12

Hydrogen peroxide oxidation of diarylselendes (3,7&10) to corresponding diarylselenones (12,13&14)

A solution of diarylselenide (0.02 mole) in glacial acetic acid (50 ml), was warmed if required, cooled, filtered and 30% hydrogen peroxide (30 ml) was added to it. The mixture was kept at room temperature for 8 days and the deposited crystalline selenones were filtered and purified as usual (Table III).

References

1. M.A. Abbady, A. Askarie, M. Morgan and A.L. Ternary, J. Heterocyclic Chem., *19*, 1473 (1982).
2. M.A. Abbady and M.A. El-Maghraby, Indian J. Chem., *19 (B)*, 413–415 (1979).
3. M.A. Abbady and R. Hebbachy, Indian J. Chem. *32 (B)*, 1119–1124 (1993).
4. M.A. Abbady and M.M. Kandeel, Z. Naturforsch, *34 (B)* (1979 1149.
5. M.A. Abbady, M.A. El-Kashef, M.A. Abd-Alla and M.M. Kandeel, J. Chem. Tech. Biotech, *34 (B)* (1984) 62.

6. M.A. Abbady, M.A. Ali and M.M. Kandeel, J. Chem. Tech, Biotech., *31* (1991) 111.
7. M.A. Abbady and A.M. Osman, J. Prakt Chem., *320* (1975), 1003.
8. M.A. Abbady, D. Craig, A.L. Ternary, G.E. Martin, J. Galloy and W.H. Watson, J. Org. Chem., *46* (1980) 1008.
9. M.A. Abbady, S.R. El-Ezbawy, Sh. M. Radwan, B.E. Bayoumy and A.A. Khalaf, Egypt. J. Pharm. Sci., *27*, *No. 4*, pp. 43–66 (1986).
10. F. Werde, Biochem. Z., *83*, 96 (1917).
11. W.Z. Frank, Physiol. Chem., *339*, 202 (1964).
12. O.H. Muth, J.E. Oldfield and P.H. Weswig, Selenium in Biomedicine, Avi Publishing Co., Westport, Conn, 1967.
13. L.M. Litvinenko and R.S. Cheshko, J. General Chem., *30*, 11 (1960).
14. J. Klosa, German Patent 1,033,800 (1960): J. Prakt. Chem. *17*, 340 (1962).
15. R. Dahlbom and A. Misory, Acta Chem. Scand, *13*, 1367 (1961).
16. a) A. Jarizza and G. Brancaeeis, Farm. Ed. Sci., *16*, 701 (1961) b) W.O. Foye, H.B. Levine and W.L. Mckenzie, J. Med. Chem., *9*, 61 (1966).
17. Harry Schäfer and Kark Gewald, Monatshefte für Chemie, *120* (1989) 315–22.
18. W.B. Hugo, A.D. Russel, Pharmaceutical Microgiology Blackwell Scientific Publications, Oxford, Edinburgh, Melbourne, 1st. edn (1977).
19. L.D. Bellamy, The Infrared Spectra of Complex Molecules, Methuen, London (1956).
20. M.A. Abbady, M.M. Ali and M.M. Kandeel, Indian J. Chem., *20B*, 53–57 (1981).
21. L.P., Garrod, O.F. Grady, Antibiotic and Chemotherapy Churchill, Livingstone, Edinburgh, London, 3rd edn. (1972).