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FACILE PREPARATION OF 1,3-SELENAZINE DERIVATIVES BY REACTION OF PRIMARY SELENOAMIDES WITH α,β-UNSATURATED ALDEHYDES OF IN THE PRESENCE OF BF_3•Et_2O

Mamoru Koketsu,* Yuichi Takenaka, Sohma Hiramatsu, and Hideharu Ishihara*

Department of Chemistry, Faculty of Engineering, Gifu University,
Gifu 501-1193, Japan

Abstract ——— Various 1,3-selenazine derivatives were synthesized by the reaction of primary selenoamides with α,β-unsaturated aldehydes in the presence of BF_3•Et_2O.

Many syntheses of selenium-containing heterocyclic compounds have been reported because of their interesting reactivities[1] and potential pharmaceutical purposes.[2] Primary selenoamides are often used as the precursors for the syntheses of selenium-nitrogen heterocyclic compounds.[3] Recently, 1,3-selenazine derivatives prepared from primary selenoamide[3g] have been reported to possess the anti-bacterial activity and anti-tumor effects.[4] From the results of the investigation of structure-biological activity relationships, selenazine skeleton bearing specific substituent groups has been indicated to influence strongly the activity.[4] Therefore, the preparation of many kinds of 1,3-selenazines has been desired for the development of potential agents. In this Note, we report the syntheses of novel 1,3-selenazine derivatives through the reaction of primary selenoamide with α,β-unsaturated aldehyde in the presence of BF_3•Et_2O.

Various reactions were investigated to establish the optimal conditions for the synthesis of 4*H*-5,6-dihydro-1,3-selenazine (**3**) (Table 1). Each reaction was carried out for 2 h. The reactions using CCl_4,

Table 1. Investigation of the optimal conditions for the synthesis of 1,3-selenazine.

Entry	Solvent	Temp.	Yield (%) **3a**
1	$CHCl_3$	reflux	80
2	$CHCl_3$	rt	59
3	$CHCl_3$	0°C	46
4	CH_2Cl_2	reflux	65
5	CCl_4	reflux	14
6	1,4-Dioxane	reflux	35
7	Ether	reflux	16
8	THF	reflux	no reaction

dioxane, ether and THF gave **3a** in low yields and recovered the primary selenoamide (Entries 5-8). The use of chloroform was better than that of dichloromethane (Entries 1 and 4). Finally, the reaction at reflux in chloroform was found to give the highest yield of **3a** rather than those of lower temperature conditions (Entries 1-3). By using the optimal reaction conditions, various kinds of **3** were prepared from the reaction of selenoamide (**1**) with many α,β-unsaturated aldehydes (**2**) (Scheme 1). The structure of **3** was confirmed by studies of IR, MS, ^{1}H, ^{13}C, ^{77}Se NMR spectra and elemental analysis. The ^1J (^{77}Se-^{13}C) values (in the case of **3a**, J = 26.5 Hz) at the C6 carbon of **3a** were observed on the proton-decoupled ^{13}C NMR spectra. Though the 6-hydroxy-4-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine is a possible product, the possibility of its formation was ruled out by the observation of ^1J (^{77}Se-^{13}C) values at the C6 carbon of **3a**. Formation of **3** could be explained by the

Scheme 1

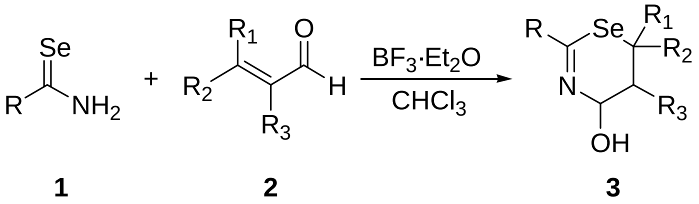
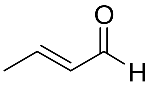
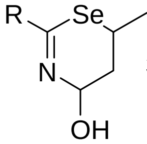
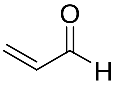
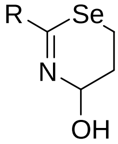
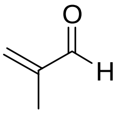
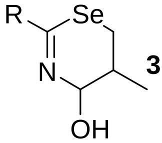
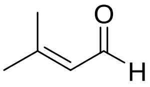
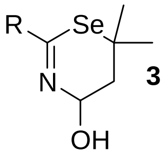
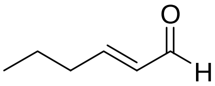
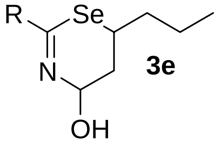
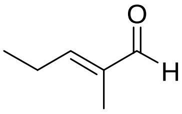
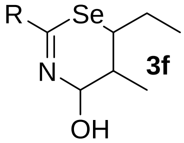
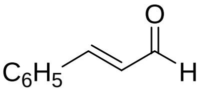
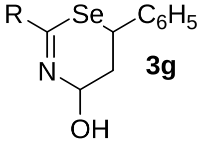


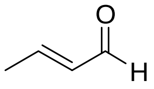
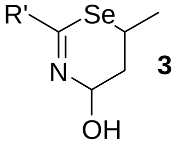
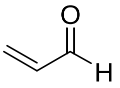
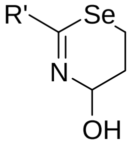
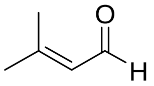
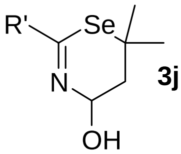
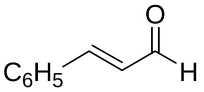
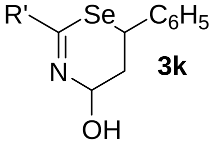
Table 2. Synthesis of various 1,3-selenazines (**3**) using 4-methylselenobenzamide (**1a**).

Entry	Aldehyde (**2**)	Product (**3**)	Yield, % **3** (*cis/trans*)[a]
1	 **2a**	 **3a**	80 (73/27)
2	 **2b**	 **3b**	29
3	 **2c**	 **3c**	57 (55/45)
4	 **2d**	 **3d**	39
5	 **2e**	 **3e**	76 (76/24)
6	 **2f**	 **3f**	66
7	 **2g**	 **3g**	54 (81/19)

R = 4-CH_3-C_6H_4, [a] Calculated by ^{1}H NMR spectra.

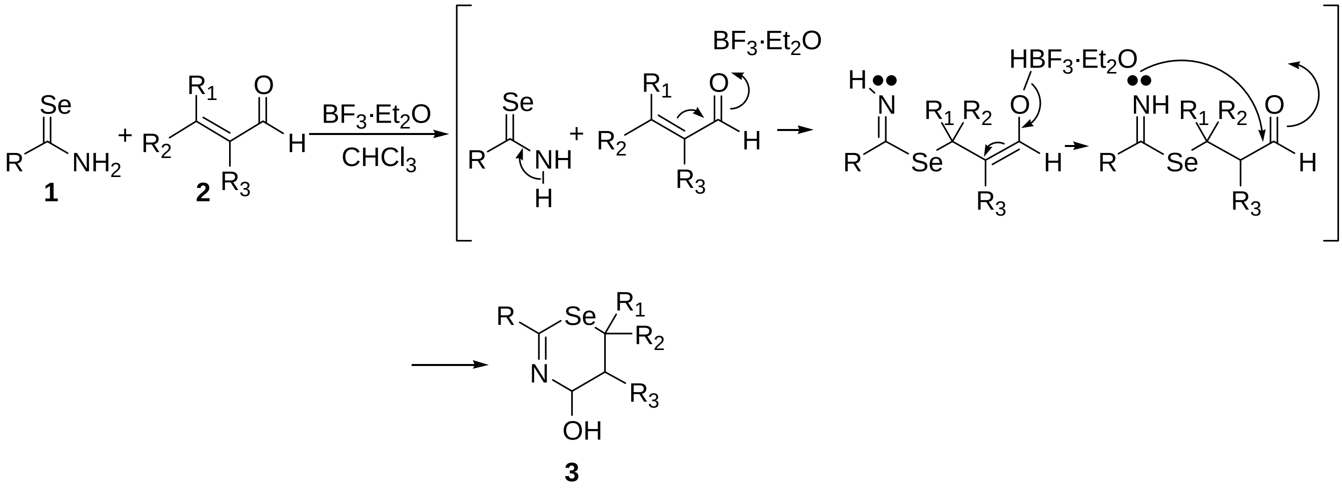
possible mechanism presented in Scheme 2, in which the reaction of primary selenoamides (**1**) with α,β-unsaturated aldehyde (**2**) is initiated on the nucleophilic addition of selenium of selenoamide to β position of carbonyl carbon of **2**, affording the 4*H*-5,6-dihydro-1,3-selenazine (**3**). Obtained selenazines except **3b**, **3d**, **3i** and **3j** consist of diastereomers containing two or three asymmetric centers at the C4, C6 and/or C5 positions of selenazine ring. NOESY spectra of **3** containing diastereomers gave NOE correlationpeak between H4 and H6. The major diastereomer was confirmed to be a *cis* relationship between the OH group at C4 and the substituent at C6. The results of reaction of 4-methylselenobenzamide (**1a**) with various α,β-unsaturated aldehydes (**2**) are summarized in Table 2. The results hexaneselenoamide (**1b**) are shown in Table 3. The reactions

Table 3. Synthesis of various 1,3-selenazines (**3**) using hexaneselenoamide (**1b**).

Entry	Aldehyde (**2**)		Product (**3**)		Yield, % **3** (*cis/trans*)[a]
1		**2a**		**3h**	87 (73/27)
2		**2b**		**3i**	29
3		**2d**		**3j**	41
4		**2g**		**3k**	68 (80/20)

R’ = n-C_5H_{11}, [a] Calculated by ^1H NMR spectra.

Scheme 2



indicated in Table 2 were carried out under the reflux conditions as confirmed in Table 1. In contrast, in the case of the reaction with hexaneselenoamide (**1b**), the reaction at room temperature gave better yield than that at reflux because of lability of aliphatic selenoamide itself.[5] From the results of Tables 2 and 3, yields of both **3b** and **3i** to be substituent-free at C5 and C6 were low. This might be attributable to lability of Michael adduct to be their intermediate.

EXPERIMENTAL

General

Primary selenoamides were synthesized according to a previously described procedure.[6] The ^{77}Se NMR (76 MHz) spectra were obtained from a JEOL α-400 spectrometer, and ^{77}Se chemical shifts are expressed in ppm deshielded with respect to near Me_2Se in $CDCl_3$. ^{1}J (^{77}Se-^{13}C) values are the ^{77}Se satellites of the proton-decoupled ^{13}C NMR spectra.

General procedure for synthesis of 4*H*-5,6-dihydro-1,3-selenazine (3) Crotonaldehyde (**2a**) (0.07 g, 1.0mmol) was added dropwise to stirred solution of 4-methylselenobenzamide (**1a**) (0.20 g, 1.0 mmol) in dry chloroform (10 mL) under an argon atmosphere. The reaction mixture was refluxed for 10 min. Then BF_3•Et_2O (1 equiv.) was dropwise added to the mixture. The reaction mixture was refluxed for 2 h. The mixture was extracted with dichloromethane and washed with saturated sodium carbonate solution. The organic layer was dried over sodium sulfate and evaporated to dryness. The residue was purified by flash chromatography on silica gel with dichloromethane to give **3a** in 80% yield as a mixture of *cis/trans* (73/27). ***cis*-4-Hydroxy-6-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3a)** Yellow solid; mp 66.6-68.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.29 (m, 1H), 1.48 (d, *J* = 6.8 Hz, 3H), 2.19 (m, 1H), 2.33 (s, 3H), 3.70 (m, 1H), 4.15 (br s, 1H), 4.87 (dd, *J* = 2.0, 8.0 Hz, 1H), 7.16 (d, *J* = 7.8 Hz, 2H), 7.66 (d, *J* = 7.8 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.3, 23.0, 31.9 (t), 37.5 86.9, 126.6, 129.0, 136.7, 141.0, 159.3; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 389.5; IR (Neat) 3356, 1607 cm^{-1}; MS (CI) m/z 270 (M^++1). ***trans*-4-Hydroxy-6-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3a)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.29 (m, 1H), 1.55 (d, *J* = 7.2 Hz, 3H), 1.83 (m, 1H), 2.33 (s, 3H), 3.70 (m, 1H), 4.15 (br s, 1H), 4.97 (dd, *J* = 2.0, 4.8 Hz, 1H), 7.16 (d, *J* = 7.8 Hz, 2H), 7.66 (d, *J* = 7.8 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.3, 24.0, 29.5 (t), 35.4 82.5, 126.7, 129.0, 137.0, 141.0, 160.7; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 384.0.

4-Hydroxy-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3b) Yellow solid; mp 76.2-78.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.52 (m, 1H), 2.25 (m, 1H), 2.28 (s, 3H), 3.09 (m, 1H), 3.24 (m, 1H), 4.83 (dd, *J* = 2.8, 4.8 Hz, 1H), 7.18 (d, *J* = 8.1 Hz, 2H), 7.67 (d, *J* = 8.1 Hz, 2H), 8.94 (br s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 18.7 (t), 21.3, 27.0, 85.3, 126.6, 129.1, 137.0, 141.1, 158.4; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 271.5; IR (Neat) 3254, 1602 cm^{-1}; MS (CI) m/z 256 (M^++1); Anal. Calcd for $C_{11}H_{13}NOSe$: C, 51.98; H, 5.15; N, 5.51. Found: C, 51.84; H, 5.02; N, 5.78.

***cis*-4-Hydroxy-5-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3c)** Yellow solid; mp 70.8-72.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.17 (d, *J* = 6.4 Hz, 3H), 1.64 (m, 1H), 2.32 (s, 3H), 2.84 (m, 1H), 3.87 (br s, 1H), 4.54 (d, *J* = 8.4 Hz, 1H), 7.14 (d, *J* = 6.4 Hz, 2H), 7.64 (d, *J* = 6.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 11.4, 21.2, 25.1 (t), 31.3, 88.3, 126.5, 128.9, 136.7, 140.9, 157.7; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 293.2; IR (Neat) 3259, 1604 cm^{-1}; MS (CI) m/z 270 (M^++1); Anal. Calcd for $C_{12}H_{15}NOSe$: C, 53.74; H, 5.64; N, 5.22. Found: C, 53.72; H, 5.61; N, 5.28. ***trans*-4-Hydroxy-5-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3c)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.94 (d, *J* = 6.4 Hz, 3H), 2.11 (m, 1H), 2.32 (s, 3H), 2.96 (m, 1H), 3.87 (br s, 1H), 4.84 (d, *J* = 3.2 Hz, 1H), 7.14 (d, *J* = 6.4 Hz, 2H), 7.64 (d, *J* = 6.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 17.3, 21.2, 26.9 (t), 28.1, 86.0, 126.3, 128.9, 136.8, 140.9, 159.3; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 237.1.

4-Hydroxy-6,6-dimethyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3d) Orange liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.49 (dd, *J* = 10.8, 13.6 Hz, 1H), 1.60 (s, 3H), 1.64 (s, 3H), 1.92 (dd, *J* = 2.4, 13.6 Hz, 1H), 2.36 (s, 3H), 4.99 (dd, *J* = 2.4, 13.6 Hz, 1H), 3.77 (br s, 1H), 7.17 (d, *J* = 8.4 Hz, 2H), 7.66 (d, *J* = 8.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.3, 32.8, 33.8, 44.2 (t), 85.3, 126.8, 129.1, 136.9, 141.1, 160.4; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 480.9; IR (Neat) 3354, 1614 cm^{-1}; MS (CI) m/z 284 (M^++1); Anal. Calcd for $C_{13}H_{17}NOSe$: C, 55.32; H, 6.04; N, 4.96. Found: C, 55.30; H, 5.98; N, 4.99.

***cis*-4-Hydroxy-2-(4-methylphenyl)-6-propyl-4*H*-5,6-dihydro-1,3-selenazine (3e)** Yellow solid; mp 74.6-76.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.92 (t, *J* = 7.2 Hz, 3H), 1.30 (m, 2H), 1.42 (m, 2H), 1.66 (m, 2H), 1.80 (m, 2H), 2.20 (m, 1H), 2.34 (s, 3H), 3.69 (m, 1H), 4.55 (br s, 1H), 4.84 (dd, *J* = 2.8, 10.4 Hz, 1H), 7.16 (d, *J* = 8.0 Hz, 2H), 7.66 (d, *J* = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.7, 20.5, 21.2, 35.8, 38.1 (t), 39.7, 86.8, 126.6, 128.9, 136.7, 140.9, 159.2; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 370.3; IR (Neat) 3266, 1602 cm^{-1}; MS (CI) m/z 298 (M^++1); Anal. Calcd for $C_{14}H_{19}NOSe$: C, 56.76; H, 6.46; N, 4.73. Found: C, 56.61; H, 6.20; N, 4.87. ***trans*-4-Hydroxy-2-(4-methylphenyl)-6-propyl-4*H*-5,6-dihydro-1,3-selenazine (3e)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.92 (t, *J* = 7.2 Hz, 3H), 1.28 (m, 2H), 1.42 (m, 2H), 1.66 (m, 2H), 1.80 (m, 2H), 1.91 (m, 1H), 2.34 (s, 3H), 3.58 (m, 1H), 4.55 (br s, 1H), 4.97 (dd, *J* = 2.8, 8.8 Hz, 1H), 7.16 (d, *J* = 8.0 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.6, 20.8, 21.2, 34.0, 38.1, 40.1, 82.5, 126.7, 128.9, 137.0, 140.9, 130.2; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 358.6.

6-Ethyl-4-hydroxy-5-methyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3f) Yellow liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.83 (d, *J* = 6.8 Hz, 3H), 1.02 (t, *J* = 7.6 Hz, 3H), 1.69 (m, 1H), 1.93 (m, 1H), 2.07 (m, 1H), 2.39 (s, 3H), 4.24 (br s, 1H), 3.88 (m, 1H), 4.86 (d, *J* = 2.8 Hz, 1H), 7.18 (d, *J* = 8.0 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 12.3, 21.3, 26.8, 33.6, 46.5 (t), 89.5, 126.4, 129.0, 136.7, 141.0, 159.8; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 318.7; IR (Neat) 3355, 1609 cm^{-1}; MS (CI) m/z 298 (M^++1); Anal. Calcd for $C_{14}H_{19}NOSe$: C, 56.76; H, 6.46; N, 4.73. Found: C, 56.69; H, 6.27; N, 4.81.

***cis*-4-Hydroxy-6-phenyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3g)** Orange solid; mp 117.0-118.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.90 (m, 1H), 2.35 (s, 3H), 2.40 (m, 1H), 3.51 (br s, 1H), 4.86 (m, 1H), 5.07 (m, 1H), 7.15-7.76 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.4, 35.6, 40.7 (t), 87.1, 126.6, 127.5, 127.9, 128.9 129.2, 136.5, 140.9, 141.3, 159.8; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 422.5; IR (Neat) 3252, 1601 cm^{-1}; MS (CI) m/z 332 (M^++1); Anal. Calcd for $C_{17}H_{17}NOSe$: C, 72.05; H, 6.05; N, 4.94. Found: C, 71.85; H, 5.88; N, 4.99. ***trans*-4-Hydroxy-6-phenyl-2-(4-methylphenyl)-4*H*-5,6-dihydro-1,3-selenazine (3g)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.08 (m, 1H), 2.23 (m, 1H), 2.36 (s, 3H), 3.51 (br s, 1H), 4.86 (m, 1H), 5.37 (dd, *J* = 2.4, 6.8 Hz, 1H), 7.15-7.76 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.4, 33.9, 37.1, 82.0, 126.7, 127.5, 128.0, 128.9 129.2, 136.5, 140.9, 141.3, 159.8; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 396.4.

***cis*-4-Hydroxy-6-methyl-2-pentyl-4*H*-5,6-dihydro-1,3-selenazine (3h)** Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, *J* = 6.8 Hz, 3H), 1.21 (m, 1H), 1.28-1.36 (m, 4H), 1.46 (d, *J* = 6.8 Hz, 3H), 1.63 (quint, *J* = 6.8 Hz, 2H), 2.16 (ddd, *J* = 2.4, 4.4, 13.2 Hz, 1H), 2.45 (t, *J* = 6.8 Hz, 2H), 3.64 (m, 1H), 4.52

(br s, 1H), 4.72 (d, J = 10.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.9, 22.4, 23.0, 27.5, 31.1, 31.3, 37.8, 43.0 (t), 86.2, 163.8; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 396.6; IR (Neat) 3242, 1626 cm^{-1}; MS (CI) m/z 250 (M$^+$+1); Anal. Calcd for $C_{10}H_{19}NOSe$: C, 48.39; H, 7.72; N, 5.64. Found: C, 48.30; H, 7.48; N, 5.55. ***trans*-4-Hydroxy-6-methyl-2-pentyl-4*H*-5,6-dihydro-1,3-selenazine (3h)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, J = 6.8 Hz, 3H), 1.21 (m, 1H), 1.28-1.36 (m, 4H), 1.54 (d, J = 6.8 Hz, 3H), 1.63 (quint, J = 6.8 Hz, 2H), 1.79 (ddd, J = 2.4, 4.4, 13.2 Hz, 1H), 2.45 (t, J = 6.8 Hz, 2H), 3.64 (m, 1H), 4.52 (br s, 1H), 4.81 (d, J = 10.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.9, 24.1, 27.6, 28.9, 31.1, 31.3, 35.2, 43.4 (t), 81.2, 164.9; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 388.5.

4-Hydroxy-2-pentyl-4*H*-5,6-dihydro-1,3-selenazine (3i) Yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, J = 7.6 Hz, 3H), 1.24-1.37 (m, 4H), 1.44 (m, 1H), 1.64 (quint, J = 7.6 Hz, 2H), 2.17 (m, 1H), 2.43 (t, J = 7.6 Hz, 2H), 2.98 (m, 1H), 3.15 (m, 1H), 4.14 (br s, 1H), 4.66 (d, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.9, 18.2, 22.4, 27.1, 27.5, 31.0, 43.4 (t), 84.2, 163.0; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 279.2; IR (Neat) 3355, 1622 cm^{-1}; MS (CI) m/z 236 (M$^+$+1); Anal. Calcd for $C_9H_{17}NOSe$: C, 46.16; H, 7.32; N, 5.98. Found: C, 46.01; H, 7.22; N, 6.14.

6,6-Dimethyl-4-hydroxy-2-pentyl-4*H*-5,6-dihydro-1,3-selenazine (3j) Red liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, J = 7.2 Hz, 3H), 1.28-1.38 (m, 4H), 1.43 (dd, J = 10.8, 13.6 Hz, 1H), 1.54 (s, 3H), 1.58 (s, 3H), 1.63 (quint, J = 7.2 Hz, 2H), 1.85 (dd, J = 2.8, 13.6 Hz, 1H), 2.47 (t, J = 7.6 Hz, 2H), 4.86 (d, J = 10.8 Hz, 1H), 5.21 (br s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.8, 22.3, 27.6, 31.0, 32.7, 33.6, 42.1 (t), 43.0, 44.2, 83.9, 165.1; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 488.8; IR (Neat) 3232, 1625 cm^{-1}; MS (CI) m/z 264 (M$^+$+1); Anal. Calcd for $C_{11}H_{21}NOSe$: C, 50.38; H, 8.07; N, 5.34. Found: C, 50.45; H, 8.23; N, 5.22.

***cis*-4-Hydroxy-2-pentyl-6-phenyl-4*H*-5,6-dihydro-1,3-selenazine (3k)** Red liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, J = 7.2 Hz, 3H), 1.26-1.43 (m, 4H), 1.78 (quint, J = 7.2 Hz, 2H), 2.50 (t, J = 13.6 Hz, 1H), 2.70 (d, J = 16.0 Hz, 1H), 2.91 (t, J = 7.2 Hz, 2H), 4.97 (br s, 1H), 5.22 (d, J = 13.6 Hz, 1H), 5.80 (s, 1H), 7.25-7.44 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 13.5, 21.8, 27.5, 30.6, 32.3, 38.9, 40.8, 76.2 (t), 127.9, 129.2, 129.4, 135.9, 197.3; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 489.3; IR (Neat) 3242, 1606 cm^{-1}; MS (CI) m/z 312 (M$^+$+1); Anal. Calcd for $C_{15}H_{20}NOSe$: C, 58.25; H, 6.52; N, 4.53. Found: C, 58.36; H, 6.66; N, 4.71. ***trans*-4-Hydroxy-2-pentyl-6-phenyl-4*H*-5,6-dihydro-1,3-selenazine (3k)** ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.89 (t, J = 7.2 Hz, 3H), 1.26-1.43 (m, 4H), 1.78 (quint, J = 7.2 Hz, 2H), 2.50 (t, J = 13.6 Hz, 1H), 2.70 (d, J = 16.0 Hz, 1H), 2.91 (t, J = 7.2 Hz, 2H), 4.97 (br s, 1H), 5.62 (d, J = 13.6 Hz, 1H), 5.80 (s, 1H), 7.25-7.44 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 16.8, 24.8, 25.6, 27.6 30.7, 35.8, 40.6, 42.8, 83.6, 127.9, 129.2, 129.4, 135.9, 197.3; ^{77}Se NMR (78.2 MHz, $CDCl_3$) δ 478.5.

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