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ORIGINAL ARTICLE

Synthesis of novel 2,5-disubstituted-1,3,4-selenadiazoles from fatty acid hydrazides

Himani Varshney, Aiman Ahmad, Abdul Rauf *

Department of Chemistry, Aligarh Muslim University, Aligarh 202002, India

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Abstract A series of novel unsaturated hydroxy and non-hydroxy fatty acid residue substituted 1,3,4-selenadiazoles were described here. These derivatives were synthesized from the reaction of fatty acid hydrazide **1(a–d)** with acetyl chloride in the presence of anhydrous sodium carbonate in tetrahydrofuran and water at 0 °C, to form N′-acetyl undec-10-enoic hydrazide **2a**, N′-acetyl-(9Z)-octadec-9-enoic hydrazide **2b**, N′-acetyl-(9Z, 12R)-12-hydroxy-9-enoic hydrazide **2c**, and N′-acetyl-(9R, 12Z)-9-hydroxy-12-enoic hydrazide **2d**. Then these hydrazines (dicarbonyl compound) on reaction with Woollin's reagent (WR) in toluene led to the corresponding 2-(dec-9′-enyl)-5-methyl-1,3,4-selenadiazole **3a**, 2-[(8′Z)-heptadec-8′-enyl]-5-methyl-1,3,4-selenadiazole **3b**, 2-[(8′Z, 11′R)-11′-hydroxy-octadec-8′-enyl)]-5-methyl-1,3,4-selenadiazole **3c**, and 2-[(8′R, 11′Z)-8′-hydroxy-octadec-11′-enyl)]-5-methyl-1,3,4-selenadiazole **3d**, respectively. These synthesized compounds were characterized on the basis of IR, ^{1}H NMR, ^{13}C NMR, mass spectra and elemental analysis results.
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1. Introduction

The first organo selenium compound diethyl selenide was synthesized in 1836 (Löwig, 1836). The selenoheterocyclic compounds are closely related to the sulfur compounds but their properties are quite different from the sulfur compounds. A number of hetero organo selenium compounds (Mlochowski et al., 2007), such as isoselenazole, selenosulfide, selenadiazoles, and selenatriazoles, have been known from the literature.

Organo selenium compounds found its application in various fields such as organic synthesis (Patai and Rappoport, 1986; Back, 1994), ligand chemistry (Hope and Levason, 1993), material synthesis (Bochman, 1996), biochemistry (Burk, 1994), photography (Yamashita et al., 1994) and biologically relevant processes. In the organic synthesis, the organo selenium compounds can be used as an electrophile or as nucleophile for functional group manipulation in a variety of substrates under mild condition (Paulmier, 1986) and also utilized in modern asymmetric synthesis, which have generated a new trend in organo selenium chemistry (Wirth, 1999). In biochemistry field, the selenium atom is incorporated in the selenocystine residues in various enzymes such as tetraiodo thyronine-5′-deiodinase, formate dehydrogenase, glycine reductase, glutathione peroxidase, plasma protein P (Böck,

* Corresponding author. Address: Department of Chemistry, University Road, Aligarh Muslim University, Aligarh 202002, India. Mobile: +91 9412545345.
E-mail address: abduloafchem@gmail.com (A. Rauf).
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1994) and hydrogenase, where it has been found to act as more reactive nucleophile than their sulfur counterparts. Sometimes organo selenium compounds are also used as selenoenzyme [mimics of glutathione peroxidase (GPx)], that protects the cell membrane from oxidative damage and helps in the reduction of various hydroperoxides (Mugesh and Singh, 2000).

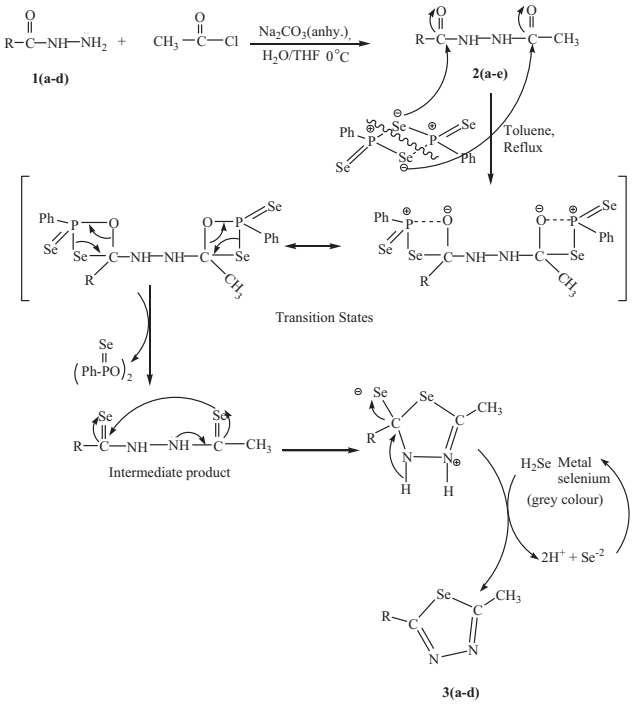
In addition to these chemical properties, substituted organo selenium compounds also show a number of biological properties (Prabakaran et al., 2011), good electro optical properties (Velusamy et al., 2005), electroluminescent (Yang et al., 2005), and non linear optic potential candidates for two photon absorption and sensor application (Ostrowski et al., 2003). Substituted selenadiazole derivatives have been reported to possess cytotoxic (Jalilian et al., 2003), and antiproliferative activities as well. These compounds are found to be active against various types of cancer cells such as colon (HT-29), breast (MCF-7), lung (HTB-54) and leukemia (CCRF-CEM) (Plano et al., 2010) and also active against HIV-I replication in MT_4-cells (Zhan et al., 2009). Apart from the above mentioned biological properties selenadiazoles, have also been found to possess anticonvulsant, antitumor, antiinflammatory, analgesic, antibacterial, fungicidal (Shealy and Clayton, 1967; Padmavathi et al., 2009; Parveen et al., 2009; El Sadek et al., 2013) and pesticidal activities.

1,2,4-Aryl selenadiazoles can be obtained by the reaction of selenocarboxamides in the presence of iodine (Becker and Meyer, 1904; Cohen, 1978; Dotsenko et al., 2013) and substituted 1,3,4-selenadiazoles can be synthesized from the reaction of N,N′-diaryloxalodihydrazonoyldichlorides with potassium selenocyanate (Farag et al., 1994), but the selenocarboxamide gives better yield and less reaction time in the presence of palladium catalyst (Al-Rubaie et al., 2002). Substituted and Multi-arm/Multiple 1,2,3-selenadiazole rings have been prepared by the reaction of selenium dioxide with α-ketomethylene semicarbazones or hydrazones in the presence of acetic acid (Saravanan et al., 2007; Al-Smadi and Ratrout, 2005; Al-Smadi and Al-Momani, 2008). The synthesis of 1,2,3-selenadiazoles under ultrasonic and microwave irradiation has also been reported in the literature (Shinde et al., 2010). 3,5-Diaryl-1,2,4-selenadiazoles have been synthesized from selenoamides (Rong and Sen, 2002), these selenoamides are not only useful for the synthesis of selenium-nitrogen heterocycles but also for the reaction with various organic and inorganic reagents because of the high reactivity of their carbon selenium double bond. The selenadiazoles are utilized in the synthesis of cadmium selenide (Khanna et al., 2004), which is an important semi conductor that can act as optoelectronic material. Here, we are generally focusing on the synthesis of 2,5-disubstituted-1,3,4-selenadiazoles. A number of methods have been reported for their syntheses, all these methods are limited due to some consequences. But 2,4-diphenyl-1,3-diselenadiphosphetane-2,4-diselenide (Hua et al., 2009) [PhP(Se)(μ-Se)]$_2$, is found to be the more appropriate reagent in every aspect for the synthesis of 2,5-disubstituted-1,3,4-selenadiazoles, although WR is very useful in the synthesis of a wide variety of cyclic and acyclic selenium containing compounds (Hua et al., 2013).

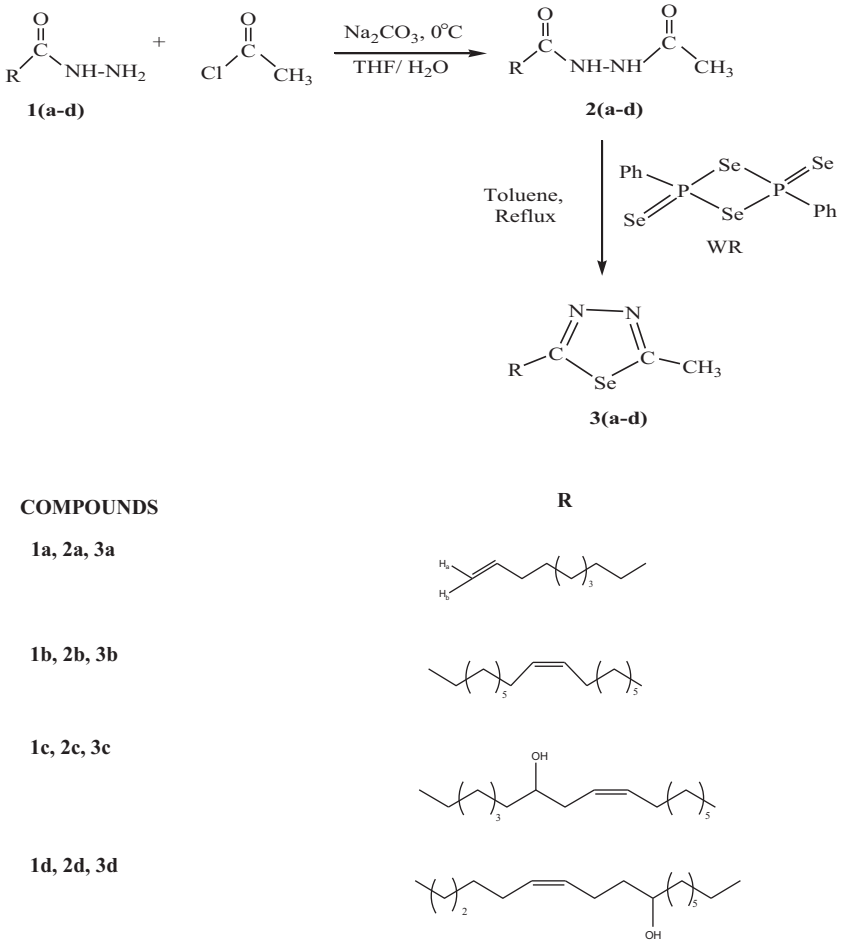
The fatty acid organo selenium compounds were synthesized earlier (Agarwal et al., 1990; Saeed et al., 1991) from our laboratory. In this paper, we report the synthesis of fatty acid residue substituted 1,3,4-selenadiazoles with Woollin's reagent (WR) through the corresponding 1,2-dicabonyl compound selenation.

2. Results and discussion

We report the synthesis of 2-alkenyl/hydroxy alkenyl-5-alkyl-substituted-1,3,4-selenadiazole **3(a–d)**, from the corresponding intermediate N′-acetyl fatty acid hydrazide **2(a–d)**, on reaction with Woollin's reagent in dry toluene. These substituted hydrazides **2(a–d)**, were synthesized by the reaction of fatty acid hydrazide **1(a–d)**, with acetyl chloride in THF/H_2O solvent in the presence of anhydrous Na_2CO_3 at 0 °C. The synthetic pathway for the synthesis of substituted fatty acid hydrazides **2(a–d)** and 2,5-disubstituted 1,3,4-selenadiazoles **3(a–d)**, is presented in Scheme 1 and proposed mechanism of the reaction was also described. All the synthesized compounds were purified by column chromatography and characterized by IR, ^{1}H NMR, ^{13}C NMR elemental analyses and mass spectra. The detailed spectral description of compound **2(a)** is given below.



The IR spectrum of the compound showed characteristic peaks at 3314, 3219 cm^{-1} (N═H stretching), 1628 cm^{-1} (C═O stretch) and at 1265 cm^{-1} (N─N stretch). The ^{1}H NMR spectra of the compound showed some diagnostic peaks. Two singlets were observed at δ 9.07, 8.82 for two N─H stretching. The methine proton of C_{10} showed a signal at δ 5.79. The methylene protons designated as H_b and H_a, displayed two distinct δ values when coupled with adjacent C_{10} methine protons. Thus, spectra showed two doublets at δ 4.98, 4.92 and a sharp singlet at δ 2.17 for methyl protons. The ^{13}C NMR spectra showed peaks at δ 174.2, 172.1 for carbonyl carbon and at 18.5 for methyl carbon adjacent to



Scheme 1 Synthesis of novel 2,5-disubstituted 1,3,4-selenadiazoles.

carbonyl carbon. Elemental analysis result and molecular formula were also consistent with the mass spectra. The characterization data of compound **3(a)** are discussed below.

The IR spectrum of compound **3(a)**, showed characteristic peaks at 1461 cm^{-1} (C═N stretch), 1268 cm^{-1} (N—N stretch), and 1082 cm^{-1} (C—N stretch). The ^{1}H NMR spectra of the compound showed some diagnostic peaks. The methine proton C_9 showed a signal at δ 5.80, the methylene protons H_b and H_a showed two separate doublets at δ 4.99, 4.93 respectively and a sharp singlet at δ 2.10 for methyl protons. The ^{13}C NMR spectra showed diagnostic peaks at δ 168.8, 158.7 for ring carbons. Elemental analysis showed the significant results. A mass spectrum of the compound was also consistent with assigned molecular formula.

3. Experimental

3.1. Physical measurements

Undec-9-enoic acid (98%) and (9Z)-octadec-10-enoic acid (97%) were purchased from the Fluka Chemicals, Switzerland. (9Z, 12R)-12-Hydroxy-octadec-9-enoic (Ricinolic) and (9R, 12Z)-9-hydroxy-octadec-12-enoic (Isoricinolic) acids were isolated from the naturally occurring *Wrightia tinctoria* seeds by standard extraction procedure (Gunstone, 1954). The solvents used for the extraction procedure, were purified by the normal distillation process. Woollin's reagent was commercially available and purchased from Sigma Aldrich, USA.

The fatty chain substituted 1,3,4-selenadiazole derivatives were synthesized by adopting the reported procedure (Hua et al., 2009). The purity of the newly synthesized compounds was tested on glass plates coated with silica gel G (for thin layer chromatography) and purification of the synthesized compounds was carried out by column chromatography with silica gel (mesh 60–120 for column chromatography), purchased from Merck, Mumbai. The melting points were determined on an electro thermal digital melting point apparatus on glass cover slips and are uncorrected. Infrared spectra (IR) were recorded as KBr-pellets on a FT-IR spectrometer in cm^{-1}. The ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker Avance II-400 spectrometer in $CDCl_3$ using Me_4Si (TMS, Tetramethylsilane) as standard. Chemical shifts were recorded in δ (delta) units. Mass spectra were recorded on a Jeol SX-102/DA-600 (FAB) spectrometer.

*3.2. General procedure for the synthesis of fatty acid hydrazides **1(a–d)***

Fatty acid hydrazides were synthesized from the literature reported method (Rauf et al., 2007), previously synthesized in our laboratory.

3.3. General procedure for the synthesis of dialkyl hydrazines/substituted fatty acid hydrazides **2(a–d)**

A suspension of fatty acid hydrazides (0.01 mol) and anhydrous sodium carbonate (0.01 mol) was prepared in 60 mL of tetrahydrofuran (THF) and 60 mL of water. This suspension was gradually added to a continuously stirred solution of acetyl chloride (0.11 mol) in 30 mL of THF at 0 °C. The reaction was stirred at 0 °C for 4–5 h and then at room temperature for 8 h. A precipitate was obtained, which was then separated out by filtration and wash the precipitate 2–3 times with cold THF, then with the diethyl ether and finally dried in vacuum. Spectral description of the newly synthesized compounds was given below.

3.3.1. N′-Acetyl undec-10-enoic hydrazide **2(a)**

White powder; Yield: 74%; m.p. 98–99 °C; IR (KBr, cm^{-1}): 3314, 3219 (N—H stretch), 2913 (C—H asymm.), 2850 (C—H symm.), 1628, 1588 (C=O), 1265 (N—N stretch), 1183 (C—C aliphatic), 1082 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 9.07, 8.82 (s, 1H, N*H*—N*H*), 5.79 (tdd, 1H, $J_{H-^9CH_2}$ = 5.7 Hz, J_{H-H_a} = 9.0 Hz, J_{H-H_b} = 15.7 Hz, CH_2=C*H*), 4.98 (dd, 1H, J_{Ha-H} = 9.0 Hz, $J_{H_a-H_b}$ = 1.0 Hz, H_aC=CH), 4.92 (dd, 1H, J_{H_b-H} = 15.7 Hz, $J_{H_b-H_a}$ = 1.0 Hz, H_bC=CH), 2.25 (t, 2H, J = 7.5 Hz, CH_2CO), 2.17 (s, 3H, COCH_3), 2.03 (m, 2H, =CHCH_2), 1.63 (m, 2H, =CH_2CH$_2$CO), 1.34 (br.s, 10H, $CH_2(CH_2)_5$); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 174.2, 172.1, 128.9, 128.1, 37.1, 36.9–20.9, 18.5; MS (ESI): m/z = 263.1 $[M+Na]^+$, Calculated = 263.2. Analysis found: C, 64.77; H, 9.99; N, 11.43%. $C_{13}H_{24}N_2O_2$ requires C, 64.97; H, 10.04; N, 11.65%.

3.3.2. N′-Acetyl-(9Z)-octadec-9-enoic hydrazide **2(b)**

White powder; Yield: 76%, m.p. 123 °C; IR (KBr, cm^{-1}): 3322, 3228 (N—H stretch), 2924 (C—H asymm.), 2852 (C—H symm.), 1633, 1598 (C=O), 1282 (N—N stretch), 1176 (C—C aliphatic), 1094 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 9.20, 8.53 (s, 1H, N*H*—N*H*), 5.26 (m, 2H, C*H*=C*H*), 2.67 (t, 2H, J = 7.6 Hz, CH_2CO), 2.10 (s, 3H, COCH_3), 2.02 (m, 4H, CH_2CH=CHCH_2), 1.93 (m, 2H, CH_2=CH$_2$CO), 1.62 (m, 2H, CH_2CH$_3$), 1.26 (br.s, 18H, $(CH_2)_9$), 0.80 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 175.1, 173.5, 131.2, 129.5, 36.9, 35.4–21.5, 18.1, 14.6; MS (ESI): m/z = 361.5 $[M+Na]^+$, Calculated = 361.4. Analysis found: C, 70.67; H, 11.09; N, 8. 17%. $C_{20}H_{38}N_2O_2$ requires C, 70.97; H, 11.29; N, 8.27%.

3.3.3. N′-Acetyl-(9Z, 12R)-12-hydroxy-octadec-9-enoic hydrazide **2(c)**

White powder; Yield: 65–70%; m.p. 119 °C; IR (KBr, cm^{-1}): 3320, 3236 (N—H stretch), 2920 (C—H asymm.), 2852 (C—H symm.), 1631, 1598 (C=O), 1272 (N—N stretch), 1166 (C—C aliphatic), 1041 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 9.15, 8.67 (s, 1H, N*H*—N*H*), 5.40 (m, 2H, C*H*=C*H*), 3.78 (m, 1H, C*H*OH), 2.36 (t, 2H, J = 7.6 Hz, CH_2CO), 2.12 (s, 3H, COCH_3), 2.05 (m, 4H, CH_2CH=CHCH_2), 1.98 (m, 1H, CHO*H*), 1.64 (m, 2H, CH_2CH$_2$CO), 1.60 (m, 2H, CH_2-CHOH), 1.30 (br.s, 16H, $(CH_2)_8$), 0.89 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 176.0, 175.2, 130.8, 130.1, 71.5, 36.2, 35.1–20.9, 18.9, 13.8; MS (ESI): m/z = 377.4 $[M+Na]^+$, Calculated = 377.4. Analysis found: C, 67.67; H, 10.69; N, 7. 89%. $C_{20}H_{38}O_3N_2$ requires C, 67.77; H, 10.78; N, 7.90%.

3.3.4. N′-Acetyl-(9R, 12Z)-9-hydroxy-octadec-12-enoic hydrazide **2(d)**

Light yellow powder; Yield: 72%; m.p. 122 °C; IR (KBr, cm^{-1}): 3326, 3238 (N—H stretch), 2925 (C—H asymm.), 2848 (C—H symm.), 1627, 1578 (C=O), 1299 (N—N stretch), 1170 (C—C aliphatic), 1054 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 9.23, 8.63 (s, 1H, N*H*—N*H*), 5.42 (m, 2H, C*H*=C*H*), 3.75 (m, 1H, C*H*OH), 2.35 (t, 2H, J = 7.5 Hz, CH_2CO), 2.16 (s, 3H, COCH_3), 2.07 (m, 4H, CH_2-CH=CHCH_2), 1.90 (m, 1H, CHO*H*), 1.59 (m, 2H, CH_2CH$_2$-CO), 1.48 (m, 2H, CH_2CHOH), 1.31 (br.s, 16H, $(CH_2)_8$), 0.88 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 177.2, 176.8, 132.3, 131.4, 72.4, 38.7, 32.5–25.4, 17.8, 14.0; MS (ESI): m/z = 377.5 $[M+Na]^+$, Calculated = 377.4. Analysis found: C, 67.64; H, 10.59; N, 7.79%. $C_{20}H_{38}O_3N_2$ requires C, 67.77; H, 10.78; N, 7.90%.

3.4. General procedure for the synthesis of 2,5-disubstituted-1,3,4-selenadiazoles **3(a–d)**

An equimolar mixture of hydrazine derivatives (**2**) (0.01 mol) and Woollin's reagent (WR) (0.01 mol) in dry toluene, was refluxed for 12 h. The red suspension was obtained, which was disappeared on refluxing. Finally a brown suspension was obtained along with the gray metal selenium. Progress of the reaction was monitored by TLC. After completion of the reaction, the reaction mixture was cooled to room temperature and removed the excess of toluene by drying the suspension in vacuum. After that, the residue was dissolved in dichloromethane and purified by column chromatography (with appropriate eluent), to give the target product as oily liquid. For the calculation of molecular weight, the most abundant isotope of selenium [^{80}Se, Mol. wt: 79.997] is taken. Spectral description of the newly synthesized compounds was given below.

3.4.1. 2-(Dec-9′-enyl)-5-methyl-1,3,4-selenadiazoles **3(a)**

Oily liquid; Yield: 64%; IR (KBr, cm^{-1}): 2919 (C—H asymm.), 2852 (C—H symm.), 1461 (C=N), 1163–808 (C—C aliphatic), 1268 (N—N stretch), 1082 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 5.80 (tdd, 1H, $J_{H-^9CH_2}$ = 5.9 Hz, J_{H-H_a} = 9.2 Hz, J_{H-H_b} = 16.0 Hz, CH_2=C*H*), 4.99 (dd, 1H, J_{H_a-H} = 9.2 Hz, $J_{H_a-H_b}$ = 1.2 Hz, H_aC=CH), 4.93 (dd, 1H, J_{H_b-H} = 16.0 Hz, $J_{H_b-H_a}$ = 1.2 Hz, H_bC=CH), 2.77 (t, 2H, J = 7.6 Hz, CH_2C=N), 2.10 (s, 3H, =CCH_3), 1.94 (m, 2H, =CHCH_2), 1.75 (m, 2H, CH_2CH$_2$C=N), 1.27 (br.s, 10H, $CH_2(CH_2)_5$); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 168.8, 158.7, 129.9, 128.8, 36.3, 35.5–22.4, 17.5; MS (ESI): m/z = 309.2 $[M+Na]^+$, Calculated = 309.1. Analysis found: C, 54.45; H, 7.69; N, 9. 69%. $C_{13}H_{22}N_2Se$ requires C, 54.55; H, 7.73; N, 9.78%.

3.4.2. 2-[(8′Z)-Heptadec-8′-enyl]-5-methyl-1,3,4-selenadiazoles **3(b)**

Oily liquid; Yield: 66%; IR (KBr, cm^{-1}): 2927 (C—H asymm.), 2855 (C—H symm.), 1457 (C=N), 1171–790 (C—C aliphatic), 1278 (N—N stretch), 1084 (C—N stretch); ^{1}H NMR (400 MHz,

$CDCl_3$, δ, ppm): 5.15 (m, 2H, C*H*═C*H*), 2.27 (t, 2H, J = 7.4 Hz, CH_2C═N), 2.10 (s, 3H, ═CCH_3), 2.01 (m, 4H, CH_2CH═CHCH_2), 1.46 (m, 2H, C$H_2$$CH_2$C═N), 1.18 (br.s, 20H, ($CH_2$)$_{10}$), 0.82 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 167.1, 159.2, 134.2, 133.3, 37.0, 36.8–20.5, 18.0, 14.2; MS (ESI): m/z = 407.3 $[M+Na]^+$, Calculated = 407.4. Analysis found: C, 62.45; H, 9.36; N, 7. 13%. $C_{20}H_{36}N_2Se$ requires C, 62.49; H, 9.42; N, 7.28%.

3.4.3. 2-[(8′Z, 11′R)-11′-Hydroxy-octadec-8′-enyl)]-5-methyl-1,3,4-selenadiazoles ***3****(****c****)*

Yellow oily liquid; Yield: 65%; IR (KBr, cm^{-1}): 2924 (C—H asymm.), 2852 (C—H symm.), 1458 (C═N), 1169–798 (C—C aliphatic), 1254 (N—N stretch), 1094 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 5.29 (m, 2H, C*H*═C*H*), 3.76 (m, 1H, C*H*OH), 2.34 (t, 2H, J = 7.4 Hz, CH_2C═N), 2.17 (s, 3H, ═CCH_3), 2.02 (m, 4H, CH_2CH═CHCH_2), 1.95 (m, 1H, CHO*H*), 1.45 (m, 2H, C$H_2$$CH_2$C═N), 1.43 (m, 2H, C$H_2$-CHOH), 1.29 (br.s, 16H, (CH_2)$_8$), 0.92 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 165.2, 158.8, 133.7, 133.4, 72.3, 36.9, 35.3–21.0, 17.9, 14.3; MS (ESI): m/z = 423.5 $[M+Na]^+$, Calculated = 423.3. Analysis found: C, 59.98; H, 9.01; N, 6.89%. $C_{20}H_{36}N_2OSe$ requires C, 60.00; H, 9.04; N, 6.99%.

3.4.4. 2-[(8′R, 11′Z)-8′-Hydroxy-octadec-11′-enyl)]-5-methyl-1,3,4-selenadiazoles ***3****(****d****)*

Yellow oily liquid; Yield: 62%; IR (KBr, cm^{-1}): 2929 (C—H asymm.), 2857 (C—H symm.), 1453 (C═N), 1159–818 (C—C aliphatic), 1262 (N—N stretch), 1075 (C—N stretch); ^{1}H NMR (400 MHz, $CDCl_3$, δ, ppm): 5.37 (m, 2H, C*H*═C*H*), 3.77 (m, 1H, C*H*OH), 2.33 (t, 2H, J = 7.6 Hz, CH_2C═N), 2.14 (s, 3H, ═CCH_3), 2.03 (m, 4H, CH_2CH═CHCH_2), 1.93 (m, 1H, CHO*H*), 1.47 (m, 2H, C$H_2$$CH_2$C═N) 1.45 (m, 2H, C$H_2$CHOH), 1.28 (br.s, 16H, (CH_2)$_8$), 0.91 (dis.t, 3H, CH_2CH_3); ^{13}C NMR (100 MHz, $CDCl_3$, δ, ppm): 166.9, 159.8, 132.7, 132.3, 73.4, 36.4, 34.9–21.2, 18.8, 14.4; MS (ESI): m/z = 423.4 $[M+Na]^+$, Calculated = 423.3. Analysis found: C, 59.97; H, 8.99; N, 6.94%. $C_{20}H_{36}N_2OSe$ requires C, 60.00; H, 9.04; N, 6.99%.

4. Conclusion

Different 2,5-disubstituted-1,3,4-selenadiazoles have been synthesized from the substituted fatty acid hydrazides (1,2-dicarbonyl compound) by the reaction with acetyl chloride and Woollin's reagent, through an intermediate product. This method is very simple, efficient and fast. The hetero cyclic selenium fatty acid derivatives have been synthesized for the first time in appreciable yield. In, recent year, attention has increasing been given to the fatty acid organo selenium compounds. The synthesis of fatty chain substituted 1,3,4-delenadiazoles, provides a systematic and general route to the synthesis of other heterocyclic compounds (containing selenium metal atom as hetero atom), for future development in the field of heterocyclic chemistry and lipid chemistry.

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