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Novel *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides: synthesis and characterization

Aamer SAEED*, Majid HUSSAIN, Muhammad QASIM
Department of Chemistry, Quaid-I-Azam University, Islamabad, Pakistan

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Abstract: A number of novel *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides (**4a**–**j**) of biological interest were efficiently synthesized by treating 2-(5-phenyl-2*H*-tetrazole-2-yl)acetohydrazide (**3**) with a variety of aroyl/heterocyclyl or alkanoyl chlorides. FTIR, ^{1}H NMR, ^{13}C NMR, GC-MS, and elemental analyses data confirmed the structures assigned to the newly synthesized compounds.

Key words: Tetrazoles, hydrazides, acylation

1. Introduction

Heterocyclic compounds display a broad spectrum of biological activities. 5-Substituted 1,2,3,4-tetrazoles are 5-member aromatic heterocyclic compounds containing 4 nitrogen atoms. The literature on this nucleus is rapidly expanding. This heterocycle has gained significance not only in coordination chemistry as a ligand[1] but also in medicinal chemistry as a metabolically stable surrogate for a carboxylic acid group.[2] 5-Substituted 1,2,3,4-tetrazoles are reported to possess several biological activities including antibacterial,[3] antifungal,[4] antinoceceptive,[5] analgesic,[6] anti-inflammatory,[7] anticonvulsant,[8] hypoglycemic,[9] and antihypertensive activities.[10]

In conjunction with tetrazoles, hydrazide is another important functionality and a key precursor for the synthesis of several bioactive scaffolds such as oxadiazoles, thiadiazoles, Schiff bases, pyrazoles, and triazoles. The conversion of tetrazoles bearing hydrazide moiety into Schiff bases[11] and triazoles[12] has been reported.

In the light of these studies, concerning the individual importance of tetrazoles and hydrazides, the aim of this work was to synthesize some new *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides. Diversity can be introduced by using a variety of aryl/heterocyclyl substituents leading to compounds with enhanced biological activities. The tetrazole scaffold is especially a bioisostere for the carboxylate group and a novel ligand for applications in coordination chemistry. Figure 1 illustrates the medicinally important tetrazole derivatives like anticonvulsant[8] (a), analgesic[6] (b), antinoceceptive,[5] (c), hypoglycemic,[9] (d) antibacterial[3] (e), and antifungal[4] (f) reported in the literature.

*Correspondence: aamersaeed@yahoo.com

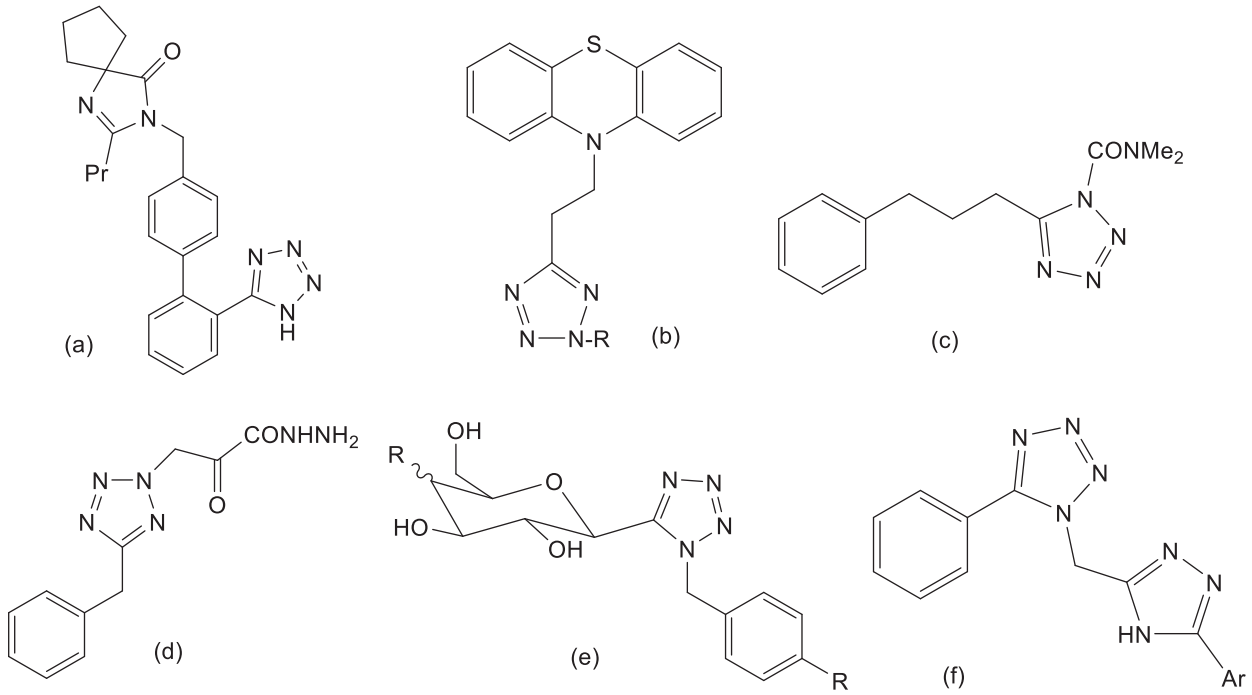

Figure 1. Some pharmacologically important tetrazole derivatives reported in the literature.

2. Experimental

Melting points were recorded using a digital Gallenkamp (SANYO, Loughborough, UK) model MPD BM 3.5 apparatus and are uncorrected. ^{1}H and ^{13}C NMR spectra were determined in $CDCl_3$ at 300 and 75 MHz, respectively, using a Bruker AM-300 spectrophotometer (Billerica, Middlesex, MA, USA). FT-IR spectra were recorded using a Rad Excalibur FTS 3000 MX spectrophotometer (Madison, WI, USA). Mass spectra (EI, 70 eV) were recorded on a GC-MS instrument (Agilent Technologies 1200 series, Santa Clara, CA, USA), and elemental analyses were carried out with a LECO-183 CHNS analyzer (LECO Corporation, St Joseph, MI, USA). The R_f values are reported in n − hexane:ethyl acetate (1:1) as mobile phase.

Synthesis of 5-phenyl-2*H*-tetrazole (1)

5-Phenyl tetrazole was prepared according to the literature procedure.[2] A mixture of sodium azide (3 mmol), benzonitrile (0.20 g, 2 mmol), and zinc(II) chloride (0.40 g, 3 mmol) was suspended in H_2O (16 mL) and the reaction mixture was refluxed for 15 h. On completion (TLC control), the mixture was cooled to room temperature and the solid obtained was filtered and then was washed with water. In continuation of the workup, the solid residue was treated with 3 N HCl (4 mL) to afford the product as a white solid (2.1 g, yield 78%). mp 216 °C (lit.[2] 217 °C). ^{1}H NMR (300 MHz, DMSO) δ (ppm): 7.59–7.62 (m, 3H, Ar–H), 8.02–8.06 (m, 2H, Ar–H), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 124.55 (1'C), 127.24 (2'C), 129.89 (3'C) 131.73 (4'C), 155.79 (tetrazole ring carbon).

Synthesis of methyl 2-(5-phenyl-2*H*-tetrazole-2-yl)acetate (2)

A mixture of 5-phenyltetrazole (0.438 g, 3 mmol), triethylamine (1.674 mL, 12 mmol), and acetonitrile (25 mL) was added dropwise to a stirred solution of methyl chloroacetate (0.523 mL, 6 mmol) in 15 mL of acetonitrile. The reaction mixture was heated on an oil bath for 2 h, keeping the temperature at 82 °C. The

progress of the reaction was monitored by TLC. Acetonitrile was removed under reduced pressure and the product was recrystallized in *n*-hexane to get pure methyl 2-(5-phenyl-2*H*-tetrazole-2-yl)acetate as a white crystalline solid, (1.85 g, yield 73%). mp 98–100 °C. IR (Neat) cm^{-1}: 1281 (N=N–N), 1547 (Ar–C=C), 1606 (C=N), 1756 (C=O), 2854 (CH_3), 3067 (Ar–C–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 3.75 (s, 2H, CH_3), 5.93 (s, 2H, CH_2), 7.56–7.59 (m, 3H, Ar–H), δ 8.06–8.10 (m, 2H, Ar–H). ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.43, 53.83 ($\underline{CH}_2$C=O, OCH_3), 126.82 (1'C), 126.99 (2'C), 129.84 (3'C) 131.28 (4'C), 164.85 (tetrazole ring carbon), 167.11 (C=O).

Synthesis of 2-(5-phenyl-2*H*-tetrazole-2-yl)acetohydrazide (3)

To a solution of tetrazole-ester (**2**) (0.218 g, 1.0 mmol) in 10 mL of dry distilled methanol was added hydrazine hydrate (2 mmol).[13] The reaction mixture was stirred at room temperature. The reaction was monitored by TLC. The precipitates obtained were filtered and then washed with methanol to obtain tetrazole-hydrazide (**3**). White crystalline solid, (0.35 g, yield 95%). mp 212 °C. (lit.[2] 205 °C). IR (Neat) cm^{-1}: 1280 (N=N–N), 1549 (Ar–C=C), 1608 (C=N), 1659 (C=O), 3057 (Ar–C–H), 3132 (N–H), 3307 (NH_2); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 4.46 (s, 2H, NH_2), 5.45 (s, 2H, CH_2), 7.55–7.61 (m, 3H, Ar–H), 8.05–8.08 (m, 2H, Ar–H), 9.65 (s, 1H, NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 54.14 ($\underline{CH}_2$C=O), 124.89 (1'C), 126.24 (2'C), 130.09 (3'C) 131.93 (4'C), 163.99 (tetrazole ring carbon), 164.62 (C=O).

General procedure for the synthesis of *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides (4a–j)

Different acyl/aroyl chlorides were synthesized by refluxing a variety of acids in thionyl chlorides for 25–30 min. The acid chlorides (0.1 mmol) were added slowly to a stirred solution of 2-(5-phenyl-2*H*-tetrazole-2-yl)acetohydrazide (**3**) (0.1 mmol) in dry DMF at room temperature. The reaction mixture was stirred for a further 30 min and the progress of the reaction was followed by TLC. On completion, the reaction mixture was poured into an excess of cold water and the solid precipitated out, which was filtered and washed with methanol. The solid was further recrystallized in ethanol/methanol to afford the pure products.

4-Nitro-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4a)

Light green solid (0.82 g, yield 95%). mp 245–247 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1549 (Ar–C=C), 1564 (–NO_2), 1608 (C=N), 1654, 1659 (C=O), 3057 (Ar–C–H), 3132, 3170 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.75 (s, 2H, CH_2), 7.57 (t, J = 3.6 Hz, 4', 3', 3H), 8.07 (d, J = 8.7 Hz, 2", 2H), 8.33 (m, 2', 2", 4H), 10.88, 11.03 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.64 (CH_2), 124.24 (1'C), 126.82 (2'C), 129.58 (3', 2"C), 149.92 (nitro-C), 164.19 (tetrazole ring carbon), 164.30, 164.74 (C=O). Analysis of $C_{16}H_{13}N_7O_4$ (367.10). (% calcd./found): C: 52.32/52.02, H: 3.57/3.80, N: 26.69/26.08. MS, m/z(%): 367 $[M]^{\cdot+}$ (67), 202 (100), 165 (25), 159 (45), 208 (37).

2-Chloro-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4b)

Yellowish solid (0.75 g, yield 82%). mp 230 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1553 (Ar–C=C), 780 (–C–Cl), 1608 (C=N), 1654, 1659 (C=O), 3060 (Ar–C–H), 3130, 3172 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.71 (s, 2H, CH_2), 7.41–8.11 (m, 9H, Ar–H), 10.74, 10.93 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.80 (CH_2), 126.82 (1'C), 127.01 (2'C), 128.84 (3'C) 133.28 (4'C), 138.80 (2"C), 163.59 (tetrazole ring carbon), 164.72, 166.40 (C=O). Analysis of $C_{16}H_{13}ClN_6O_2$ (356.08). (% calcd./found): C: 53.86/53.02, H: 3.67/3.80, N: 23.56/24.08. MS, m/z(%): 256 $[M]^{\cdot+}$ (70), 258 (25), 202 (100), 154 (45), 159 (55), 197 (37).

2-Bromo-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4c)

Light brown solid (0.73 g, yield 90%). mp 257–260 °C. IR (Neat) cm^{-1}: 1285 (N=N–N), 1540 (Ar–C=C), 695 (–C–Br), 1608 (C=N), 1654, 1660 (C=O), 3057 (Ar–C–H), 3132, 3170 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.73 (s, 2H, CH_2), 7.42–7.47 (m, 7H, Ar–H), 8.22 (2'H), 10.62, 10.93 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.78 (CH_2), 118.8 (2"C) 126.82 (dd, J = 7.5, 1.8 Hz, 1'C), 126.99 (2'C), 129.84 (3'C) 131.28 (4'C), 163.59 (tetrazole ring carbon), 164.72, 166.40 (C=O). Analysis of $C_{16}H_{13}BrN_6O_2$ (400.03). (% calcd./found): C: 47.90/40.98, H: 3.27/3.80, N: 20.95/20.80. MS, m/z(%): 400 $[M]^{\cdot+}$ (70), 402 (55), 240 (48), 202 (100), 197 (50) 159 (55).

2-Chloro-6-nitro-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4d)

Light yellowish solid (0.86 g, yield 80%). mp 275 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1549 (Ar–C=C), 782 (–C–Cl), 1560 ($–NO_2$), 1608 (C=N), 1650, 1655 (C=O), 3057 (Ar–C–H), 3132, 3170 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.60 (s, 2H, CH_2), 7.41–7.61 (m, 3', 4'H, 3H) 7.71–8.31 (m, 5H, Ar–H), 10.88, 11.03 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.84 (CH_2), 122.24 (1'C), 127.24 (2'C), 129.89 (3'C), 133.3 (chloro-C) 147.50 (nitro-C), 163.19 (tetrazole ring carbon), 164.30, 165.74 (C=O). Analysis of $C_{16}H_{12}ClN_7O_4$ (401.06). (% calcd./found): C: 47.83/47.50, H: 3.01/3.70, N: 24.40/24.80. MS, m/z(%): 401 $[M]^{\cdot+}$ (75), 403 (45), 242 (60), 202 (100), 199 (55), 159 (55).

3,5-Dimethoxy-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4e)

White solid (0.58 g, yield 76%). mp 265 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1552 (Ar–C=C), 1220 (–C–O), 1608 (C=N), 1652, 1656 (C=O), 3055 (Ar–C–H), 3132, 3170 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 3.84 (s, 6H, –OMe), 5.51 (s, 2H, CH_2), 6.69–7.63 (m, 9H, Ar-H), 9.98, 10.03 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.36 (CH_2), 57.69 (–OMe), 126.97 (1'C), 127.24 (2'C), 129.89 (3'C), 131.73 (4'C), 161.70 (3", 5"Cs), 164.57 (tetrazole ring carbon), 167.30, 168.75 (C=O). Analysis of $C_{18}H_{18}N_6O_4$ (382.14). (% calcd./found): C: 56.54/56.10, H: 4.74/5.04, N: 21.98/22.02. MS, m/z(%): 382 $[M]^{\cdot+}$ (70), 223 (69), 202 (100), 180 (63), 159 (55).

4-Bromo-3,5-dimethoxy-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)benzohydrazide (4f)

Brown solid (0.85 g, yield 78%). mp 282 °C. IR (Neat) cm^{-1}: 790 (–C–Br), 1280 (N=N–N), 1549 (Ar–C=C), 1608 (C=N), 1654, 1659 (C=O), 3057 (Ar–C–H), 3132, 3170 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 3.94 (s, 6H, –OMe), 5.50 (s, 2H, CH_2), 6.69–7.63 (m, 9H, Ar–H), 9.88, 10.03 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.36 (CH_2), 56.69 (–OMe), 126.97 (1'C), 127.24 (2'C), 129.89 (3'C), 131.73 (4'C), 158.70 (3", 5"Cs), 164.57 (tetrazole ring carbon), 166.30, 168.25 (C=O). Analysis of $C_{18}H_{17}BrN_6O_4$ (460.05). (% calcd./found): C: 46.87/46.90, H: 3.71/3.62, N: 18.22/18.85. MS, m/z(%): 460 $[M]^{\cdot+}$ (80), 462 (45), 301(65), 258 (40), 243 (63), 202 (100), 217 (57), 159 (55).

***N*'-(2-(5-Phenyl-2*H*-tetrazol-2-yl)acetyl)furan-2-carbohydrazide (4g)**

White solid (0.79 g, yield 88%). mp 198–200 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1551 (Ar–C=C), 1608 (C=N), 1654, 1659 (C=O), 3072 (Ar–C–H), 3130, 3168 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.64 (s, 2H, CH_2), 6.66–8.09 (m, 8H, Ar–H), 10.55, 10.65 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 54.02 (CH_2), 126.97 (1'C), 127.24 (2'C), 129.89 (3'C), 149.08 (1"C), 164.20 (tetrazole ring carbon), 164.30, 164.74 (C=O). Analysis of $C_{14}H_{12}N_6O_3$ (312.10). (% calcd./found): C: 53.85/53.40, H: 3.87/4.00, N: 26.91/27.05. MS, m/z(%): 256 $[M]^{\cdot+}$ (70), 257 (10), 258 (25), 202 (100), 154 (45), 159 (55), 197 (37).

2-Oxo-*N*'-(2-(5-phenyl-2H-tetrazol-2-yl)acetyl)-2*H*-chromene-3-carbohydrazide (4h)

Light yellowish solid (0.91 g, yield 90%). mp 253 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1608 (C=N), 1654, 1660 (C=O), 3132, 3170 (N–H), 3250 (H–C=C–); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 5.73 (s, 2H, CH_2), 7.43–8.10 (m, 9H, Ar–H), 8.91 (s, H–C=C–), 10.75, 11.47 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.64 (CH_2), 120.20 (1'C), 127.24 (2'C), 129.89 (3'C), 131.73 (4'C), 153.0 (olefinic-C), 159.4 (C=O), 164.19 (tetrazole ring carbon), 164.30, 165.74 (C=O). Analysis of $C_{19}H_{14}N_6O_4$ (390.11). (% calcd./found): C: 58.46/58.40, H: 3.61/3.62, N: 21.53/21.56. MS, m/z(%): 390 $[M]^{\cdot+}$ (68), 231 (25), 245 (55), 202 (100), 188 (45), 159 (55), 145 (57).

(*E*)-3-(4-Methoxyphenyl)-*N*'-(2-(5-phenyl-2*H*-tetrazol-2-yl)acetyl)acrylohydrazide (4i)

White solid (0.85 g, yield 83%). mp 162–164 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1608 (C=N), 1654, 1659 (C=O), 1675 (C=C), 3132, 3170 (N–H), 3255 (H–C=C–); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 3.8 (s, –OMe), 5.75 (s, 2H, CH_2), 6.91–8.37 (m, 9H, Ar–H), 6.53 (d, J = 15.9, 1H), 7.86 (d, J = 15.9, 1H), 10.88, 11.03 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 53.64 (CH_2), 55.8 (–OMe), 114.24, 126.97 (1'C), 127.24 (2', 2"C), 129.89 (3'C), 131.73 (4'C, 4"C), 109.62 (α-C), 152.14 (β-C), 164.19 (tetrazole ring carbon), 164.30, 164.74 (C=O). Analysis of $C_{19}H_{18}N_6O_3$ (378.18). (% calcd./found): C: 60.31/59.95, H: 4.79/5.02, N: 22.21/22.26. MS, m/z(%): 378 $[M]^{\cdot+}$ (70), 219 (65), 202 (100), 258 (58), 176 (68), 120 (45), 159 (55).

***N*'-(2-(5-Phenyl-2*H*-tetrazol-2-yl)acetyl)pivalohydrazide (4j)**

Light greenish solid (0.92 g, yield 97%). mp 135–137 °C. IR (Neat) cm^{-1}: 1280 (N=N–N), 1608 (C=N), 1654, 1659 (C=O), 3125, 3160 (N–H); ^{1}H NMR (300 MHz, DMSO) δ (ppm): 1.20 (s, 9H), 5.61 (s, 2H, CH_2), 7.56–8.08 (m, 5H, Ar–H), 9.74, 10.37 (s, 2H, –NH), ^{13}C NMR (75 MHz, DMSO) δ (ppm): 28.3 (3C), 41.4 (quaternary-C), 54.95 (CH_2), 126.97 (1'C), 128.24 (2'C), 129.89 (3'C), 163.19 (tetrazole ring carbon), 165.30, 166.74 (C=O). Analysis of $C_{14}H_{18}N_6O_2$ (302.15). (% calcd./found): C: 55.62/55.58, H: 6.00/6.02, N: 27.80/27.78. MS, m/z(%): 302 $[M]^{\cdot+}$ (74), 202 (100), 187 (44), 115 (65), 100 (48).

3. Results and discussion

The synthesis of the title compounds (**4a**–**j**) was carried out according to the synthetic route sketched in Figure 2. Accordingly the [3+2] cycloaddition of sodium azide and benzonitrile in the presence of zinc chloride in aqueous medium led to the formation of 5-phenyl-2*H*-1,2,3,4-tetrazole (**1**), which is capable of existing in solution as equilibrium mixtures of N1 and N2 tautomers.[2]

The next step was the base catalyzed abstraction of the acidic NH of the tetrazole ring followed by treatment with methyl 2-chloroacetate to afford the ester (**2**). A study of the literature shows that N-(R-aminoalkyl)tetrazoles exist in solution as equilibrium mixtures of N1 and N2 tautomers. The position of equilibrium depends significantly on the polarity of the solvent and the substituents in the tetrazole ring. Interconversion between individual tautomers is shown to proceed via tight ion-pair intermediates in which intramolecular recombination is faster than the intermolecular crossover since the latter probably requires solvent separation of ion-pair intermediates.[14] Normally, such reactions have been carried out using potassium carbonate in acetone, which leads to the formation of isomeric esters, which not only requires separation. However, the use of triethylamine and acetonitrile followed by recrystallization from n-hexane led to the formation of pure methyl 2-(5-phenyl-2*H*-tetrazol-2-yl)acetate as a single pure tautomer. In FTIR the presence of stretches at 1756 cm^{-1} corroborates the attachment of ester (**1b**) moiety. In ^{1}H NMR, the presence of 2 and 3 proton

singlets at 5.94 and 3.75 ppm indicated the methylene and ester methyl groups respectively and in the ^{13}C NMR spectrum the signal at 167.11 ppm was observed for ester carbonyl carbon.

Reaction of ester (**2**) with slight excess of hydrazine hydrate in dry methanol at 45–50 °C afforded 2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazide (**3**). In FTIR the stretching at 3132 (–NH) and 3307 (–NH_2) cm^{-1} confirmed the conversion of ester into hydrazide. In the ^{1}H NMR spectrum the singlet at 4.46 ppm was assigned to the –NH_2 and that at 9.65 ppm to the –NH proton. In the ^{13}C NMR spectrum the slight upfield shift of the carbonyl signal from 167.11 to 164.62 ppm further confirmed the conversion of ester into hydrazide.[15]

Finally a number of acid chlorides were freshly prepared by refluxing the carboxylic acids with thionyl chloride. The title *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides (**4a**–**j**) were obtained by stirring acid chlorides at room temperature with 2-(5-phenyl-1*H*-tetrazole-1-yl)acetohydrazide (**3**) in dry *N*,*N*-dimethylformamide (DMF) (Figure 2).

A typical aryl derivative (**4e**) bearing a 3,5-dimethoxyphenyl group showed absorption at 1280 (N=N–N), 1552 (Ar–C=C), 1220 (–C–O), 1608 (C=N), 1652, 1656 (C=O), 3055 (Ar–C–H), 3132, and 3170 cm^{-1} (N–H) in the FTIR spectrum. ^{1}H NMR singlets at 3.84, 5.51, 9.98, and 10.03 are assignable to CH_2, NHs, and OMe besides the aromatic protons. ^{13}C NMR showed characteristic methylene signals at 53.36, methoxy at 57.69, tetrazole ring carbon at 64.57, and carbonyl carbons at 167.30 and 168.75 ppm.

In the case of a typical heteroaryl compound (**4h**) bearing a 3-coumarinyl substituent, in the ^{1}H NMR

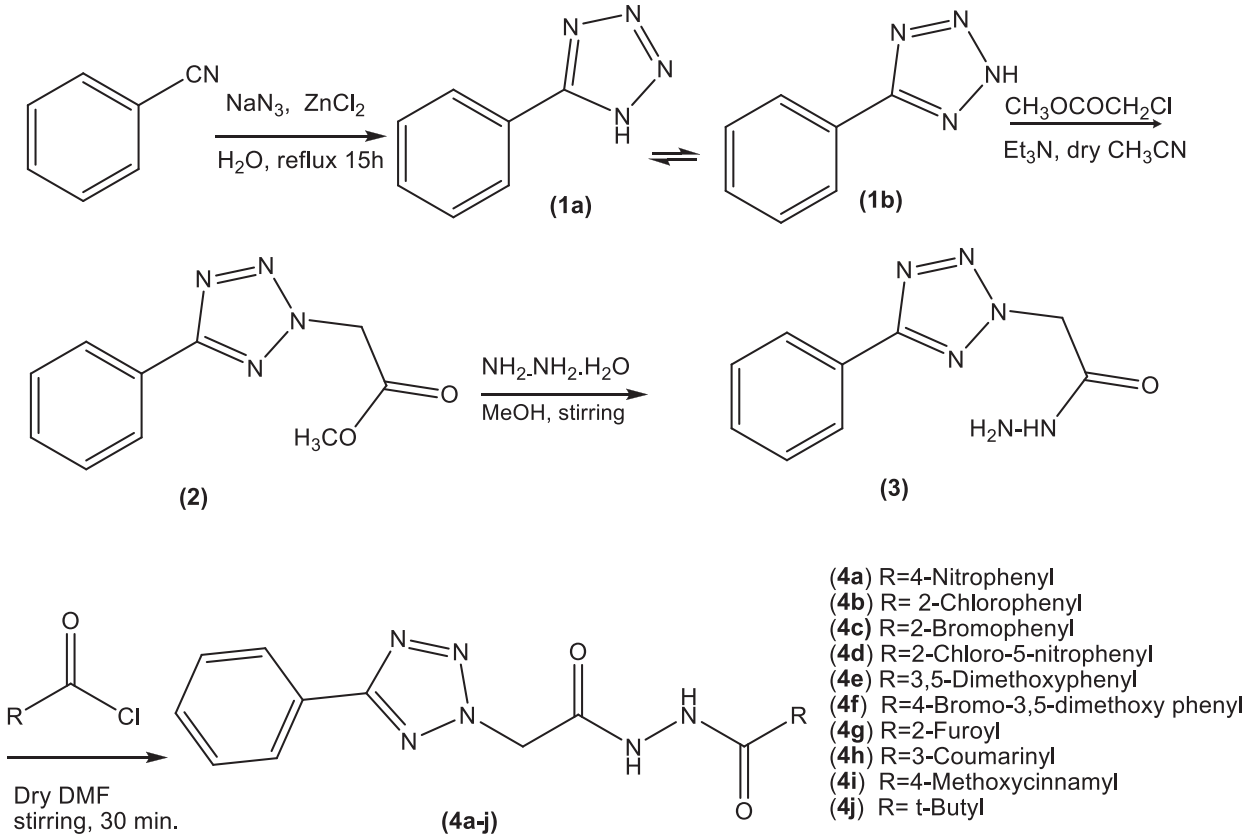

Figure 2. Synthesis of *N*-acyl/aroyl-2-(5-phenyl-2*H*-tetrazol-2-yl)acetohydrazides.

spectrum singlets appeared at 5.73 10.75, and 11.47, for CH_2 and NHs, and the doublet at 8.9 ppm indicated the olefinic proton of the coumarin ring. The ^{13}C NMR spectrum showed the corresponding signals at 53.64 (CH_2), 153.0 (olefin-C), 159.4 (lactonic C=O), 164.19 (tetrazole ring carbon), and 164.30 and 165.74 (C=O) ppm, besides aromatic carbons in the range 120.2–131.1.

4. Conclusion

In the present study, different acyl/alkenyl or aroyl groups were attached to the tetrazole hydrazide nucleus via –CONH–NH–CO– linkage to obtain new compounds with potentially improved biological activities and for use as novel ligands in coordination chemistry.

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