Synthesis of Some Novel 3,6-Bis(1,2,3-triazolyl)-*s*-triazolo[3,4-b]-1,3,4-thiadiazole Derivatives

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The cyclization of 1-amino-2-mercapto-5-[1-(4-ethoxyphenyl)-5-methyl-1,2,3-triazol-4-yl]-1,3,4-triazole which was synthesized from *p*-ethoxyaniline with various triazole acid in absolute phosphorus oxychloride yields 3,6-bis(1,2,3-triazolyl)-*s*-triazolo[3,4-b]-1,3,4-thiadiazole derivatives **9a~j**, and their structures are established by MS, IR, CHN and ^{1}H NMR spectral data.

Keywords: Synthesis; *s*-Triazolo[3,4-b]-1,3,4-thiadiazole; 1,2,3-Triazole; 1,3,4-Triazole; 3,6-Bis(1,2,3-triazolyl)-*s*-triazolo[3,4-b]-1,3,4-thiadiazole.

INTRODUCTION

In recent years in various publications, fused heterocycles have been found to possess many unique properties in synthesis and pharmacology. Especially, *s*-triazolo[3,4-b]-1,3,4-thiadiazole derivatives have been attracting chemists and pharmacologists. Certain compounds having a 1,3,4-triazole nucleus have been reported as fungicidals,[1] insecticidals,[2] antimicrobials[3] and bactericidals.[4] Compounds with a 1,2,3-triazole nucleus have been reported as antibacterials,[5] antifungals,[6] antivirals,[7] anti-inflammatories and analgesics.[8] Recently, some new 1,3,4-triazole derivatives have been synthesized as possible anticonvulsants[9] and plant growth regulators;[10] and 1,2,3-triazole derivatives have been synthesized to inhibit tumor proliferation, invasion, metastasis,[11] and have shown anti-HIV properties.[12,13] Likewise, the 1,3,4-thiadiazole nucleus which incorporates an N-C-S linkage exhibits a large number of biological activities.[14] The fused *s*-triazolo[3,4-b]-1,3,4-thiadiazole derivatives show various biological effects, such as antifungal,[15] antibacterial, hypotensive, and CNS depressant activities.[16] Phenacetin[N-(4-Ethoxyphenyl)acetamide] is an antipyretic analgesic which is included in our target compounds. For this reason, the heterocyclic derivatives containing two 1,2,3-triazoles, 1,3,4-triazole, and 1,3,4-thiadiazole nucleus are very interesting, and we also demonstrated that new the title compounds of *s*-triazolo[3,4-b]-1,3,4-triazoles containing more heterocycles can be studies, but their properties have not been published in the literature up to now. There are six rings in the complex structure of the compounds. Three rings are triazole rings and one is a thiadiazole ring. The route of syntheses is in Scheme I.

EXPERIMENTAL SECTION

All melting points were uncorrected and determined on an XT_4-100x microscopic melting point apparatus. IR spectra were obtained in KBr discs on a Shimadzu IR-435 spectrometer. MS were performed on an HP-5988A spectrometer (EI at 70 eV). ^{1}H NMR spectroscopy ($CDCl_3$) were recorded on an Avance Mercury plus-300 instrument with TMS as an internal standard. Elemental analyses were carried out on a Yanaco CHN Corder MT-3 analyzer.

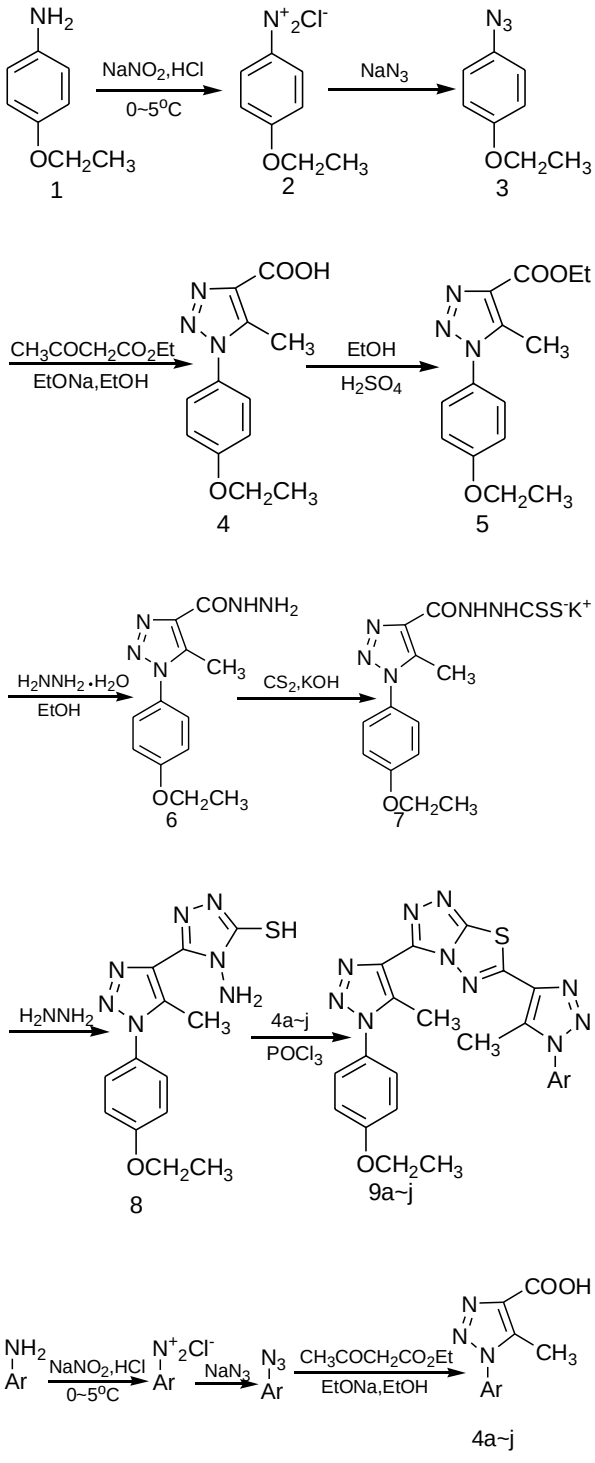
Phosphorus oxychloride was redistilled (b.p. 105).

2.1 5-Methyl-1-subsituted-1,2,3-triazol-4-caroxylic acid (**4a-j**) were prepared following methods in the literature.[17,18]

2.2 Preparation of ethyl 1-(4-ethoxyphenyl)-5-methyl-1,2,3-triazol-4-carboxyate (**5**)

In a 150 mL round bottomed flask was placed a mixture of **4** (24.7 g, 0.10 mole), absolute ethanol (46 g, 59 mL, 1.0 mole) and concentrated sulfuric acid (6 mL), and the mixture was refluxed gently for 12 hours, cooled to room temperature, and then refrigerated for 5 hours. A white solid was obtained and filtered and the solid was washed with absolute ethanol and recrystallized from absolute ethanol. The yield of **5** (a white crystalline solid, m.p. 113-114 °C) was 23.4 g (85.0%). ^{1}H NMR: 7.304-7.349 (d, 2H, J = 9.0 Hz, Ar_1-3,5), 7.000-7.045 (d, 2H, J = 9.0 Hz, Ar_1-2,6), 4.399-4.505 (q, 2H,

Scheme I



J = 7.0 Hz, $TRZ_1CO_2CH_2$-), 4.042-4.146 (q, 2H, J = 6.8 Hz, Ar_1OCH_2-), 2.540 (s, 3H, TRZ_1-CH_3), 1.417-1.487 (t, 3H, J = 7.0 Hz, $TRZ_1CO_2CH_2C\underline{H}_3$), 1.402-1.472 (t, 3H, J = 6.8 Hz, Ar1$OCH_2C\underline{H}_3$). MS: 275 (M^+, 45), 247 (M-28-N_2 or CH_2=CH_2, 1), 230 (M-45-CH_3CH_2O, 10), 218 (M-57-N_2-CH_3CH_2, -17), 202 (M-CH_3CH_2OCO, 10), 190 (27), 174 (58), 146 (100), 121 (10), 83 (86), 65 (68). IR: 3411, 3091, 2983, 2935, 2884, 1717, 1593, 1563, 1516, 1435, 1375, 1349, 1248, 1222, 1120, 1103, 1049, 1023, 983, 837, 786 cm^{-1}.

2.3 1-(4-Ethoxyphenyl)-5-methyl-1,2,3-triazol-4-carbonylhydrazine (**6**) was prepared from (**5**) following a procedure in a method in the literature.[19]

A mixture of 0.1 mol compound **5** and 0.15 mole (85% hydrazine hydrate) was refluxed in 200 mL of ethanol for 4 hours. A white solid was obtained and filtered. The solid was recrystallized from dimethyl sulfoxide to gave 24.3 g (93.0% yield) of product, m.p. 222-223 °C. ^{1}H NMR: 7.477-7.521 (d, 2H, J = 8.8 Hz, Ar_1-3,5), 7.095-7.139 (d, 2H, J = 8.8 Hz, Ar_1-2,6), 4.450-4.720 (broad peak, 3H, -$NHNH_2$), 4.054-4.157 (q, 2H, J = 7.0 Hz, Ar_1OCH_2-), 2.474 (s, 3H, TRZ_1-CH_3), 1.315-1.385 (t, 3H, J = 7.0 Hz, $Ar_1OCH_2CH_3$). MS: 261 (M^+, 72), 217 (5), 204 (42), 202 (25), 174 (49), 162 (20), 146 (86), 134 (15), 121 (16), 119 (21), 83 (31), 77 (25), 69 (50), 65 (66), 57 (77), 43 (100). IR: 3307, 3264, 3213 (N-H), 2979, 2931, 1669 (C=O), 1639, 1608, 1587, 1516, 1476, 1447, 1269, 1249 (Ar-O-R), 1119, 1045, 959 (1,2,3-triazole ring), 845, 658 cm^{-1}.

2.4 1-Amino-5-[1-(4-ethoxyphenyl)-2-mercapto-5-methyl-1,2,3-triazol-4-yl]-1,3,4-triazole (**8**) was prepared from **6** via **7** following the method reported in the literature.[20]

Carbon disulfide (0.14 mol) was added dropwise to an ice-cold solution of potassium hydroxide (0.15 mole) and compound **6** (0.09 mole) in 150 mL absolute ethanol. The mixture was stirred at room temperature for 15 hours. The solid was filtered and washed with absolute diethyl ether (3 × 50 mL). The product **7** was obtained in nearly quantitative yield and employed in the next reaction without further purification.

A suspension of **7** (about 0.08 mol) and hydrazine hydrate 85% (0.16 mole) was refluxed while stirring for 4 hours. The color of the reaction mixture changed to dark green, hydrogen sulfide was evolved, and a homogeneous solution resulted. On dilution with 500 mL of cold water and acidification with concentrated hydrochloric acid, a white solid was precipitated. The product was filtered, washed with water, and recrystallized from ethanol to give white flakes of **8**, 17.8 g (70% yield), m.p. 204-205 °C. ^{1}H NMR: 7.371-7.400 (d, 2H, J = 8.7 Hz, Ar_1-3,5), 7.047-7.076 (d, 2H, J = 8.7 Hz, Ar_1-2,6), 4.080-4.150 (q, 2H, J = 7.0 Hz, Ar_1-OCH_2-), 2.525 (s, 3H, TRZ_1-CH_3), 2.521 (s, 1H, -SH), 1.620-1.840

Table 1. Structures and melting points of the compounds **4a-j**

Compound No.	Ar.	Mp (°C)	Compound No.	Ar	Mp (°C)
4a	4-$CH_3C_6H_4$	183-184	**4f**	2,5-$Cl_2C_6H_3$	154-156
4b	3-ClC_6H_4	186-188	**4g**	4-$CH_3OC_6H_4$	185-186
4c	4-ClC_6H_4	177-179	**4h**	4-$C_2H_5OC_6H_4$	166-167
4d	4-BrC_6H_4	204-205	**4i**	α-$C_{10}H_7$	184-186
4e	3-BrC_6H_4	181-182	**4j**	β-$C_{10}H_7$	184-185

Table 2. Structures, yields and melting points of compounds **9a-j**

Compound	R	Yield (%)	M.P (°C)	Compound	R	Yield (%)	M.P (°C)
9a	4-$CH_3C_6H_4$	65	242-243	**9f**	2,5-$Cl_2C_6H_3$	70	252-253
9b	3-ClC_6H_4	76	228-229	**9g**	4-$CH_3OC_6H_4$	70	236-237
9c	4-ClC_6H_4	72	289-290	**9h**	4-$C_2H_5OC_6H_4$	72	226-227
9d	4-BrC_6H_4	66	290-291	**9i**	α-$C_{10}H_7$	45	267-268
9e	3-BrC_6H_4	74	227-228	**9j**	β-$C_{10}H_7$	48	286-287

[a] Satisfactory microanalyses were obtained for all the compounds.

Table 3. IR spectral data of compounds **9a-j**

No.	IR (cm^{-1}) (KBr disc)
9a	3081, 2976, 2893, 1610, 1517, 1471, 1251, 1175, 1118, 1045, 966, 946, 840, 823, 781, 717
9b	3069, 2980, 2935, 2883, 1611, 1589, 1518, 1490, 1466, 1302, 1254, 1172, 1114, 1044, 969, 948, 846, 790, 721, 686
9c	3076, 2974, 2930, 2893, 1608, 1515, 1470, 1410, 1249, 1174, 1115, 1092, 1042, 966, 944, 837, 782, 715, 671
9d	3093, 2976, 2893, 1608, 1516, 1495, 1473, 1400, 1272, 1249, 1176, 1113, 1075, 1044, 966, 946, 840, 783, 714, 671
9e	3078, 2979, 2933, 2882, 1610, 1587, 1518, 1488, 1466, 1302, 1255, 1171, 1114, 1044, 970, 948, 845, 787, 757, 720, 686
9f	3091, 2980, 2930, 1614, 1587, 1519, 1472, 1254, 1174, 1095, 1048, 967, 947, 838, 808, 781, 721
9g	3082, 2977, 2837, 1610, 1517, 1471, 1252, 1175, 1117, 1042, 966, 945, 838, 780, 718
9h	3067, 2981, 2920, 1608, 1584, 1516, 1462, 1303, 1255, 1172, 1115, 1045, 967, 947, 843, 782, 721
9i	3056, 2977, 2935, 2895, 1610, 1518, 1469, 1303, 1252, 1174, 1118, 1049, 969, 948, 845, 804, 775, 720
9j	3056, 2976, 2882, 1608, 1517, 1472, 1416, 1248, 1174, 1114, 1050, 970, 947, 828, 780, 750, 719

(broad peak, 2H, -NH_2), 1.449-1.497 (t, 3H, J = 7.0 Hz, Ar_1-OCH_2CH_3). MS: 317 (M^+, 16), 302 (1), 285 (1), 273 (3), 260 (5), 201 (3), 194 (17), 179 (8), 173 (3), 171 (11), 151 (11), 137 (13), 121 (100), 111 (7), 105 (23), 95 (10), 83 (10), 77 (17), 69 (16), 57 (16), 55 (20), 43 (19). IR: 3449, 3281 (N-H), 3186, 3111, 2974, 2942, 2838, 2783 (S-H), 1632, 1610 (C=N), 1519, 1499, 1467, 1291, 1254 (Ar-O-R), 1174, 1019, 949 (1,2,3-triazole ring), 840, 669.

2.5 General procedure of preparation of 6-(1-aryl-5-methyl-1,2,3-triazol-4-yl)-3-[1-(4-ethoxyphenyl)-5-methyl-1,2,3-triazol-4-yl]-*s*-triazolo[3,4-b]-1,3,4-thiadiazole derivatives **9a-j**.

A mixture of 1-amino-5-[1-(4-ethoxyphenyl)-5-methyl-1,2,3-triazol-4-yl]-2-mercapto-1,3,4-triazole **8** (1 mmol), 5-methyl-1-substituted-1,2,3-triazol-4-carboxylic acid (1 mmol), and $POCl_3$ (5 mL) was heated under refluxing for 6 hours with stirring. The cooled reaction mixture was poured into crushed ice and made alkaline by adding potassium hydroxide, and then the resulting solid was filtered and dried. The solid was purified by chromatography on a column of silica gel and eluted successively with 2:1 ethyl acetate-petroleum ether. The desired product was obtained and its re-

Table 4. ^{1}H NMR spectral data of compounds **9a-j**

No.	^{1}H NMR ($CDCl_3$-d) δ (ppm), *J* (Hz)
9a	7.436-7.465 (d, 2H, *J* = 8.7 Hz, Ar_2-3,5), 7.431-7.461 (d, 2H, *J* = 9.0 Hz, Ar_1-3,5), 7.062-7.091 (d, 2H, *J* = 8.7 Hz, Ar_2-2,6), 7.058-7.088 (d, 2H, *J* = 9.0 Hz, Ar_1-2,6), 4.115-4.143 (q, 2H, *J* = 7.2 Hz, Ar_1OCH_2), 2.787 (s, 3H, TRZ_2-CH_3), 2.740 (s, 3H, TRZ_1-CH_3), 1.457-1.505 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9b	7.441-7.598 (m, 3H, Ar_2-4,5,6), 7.433-7.463 (d, 2H, *J* = 9.0 Hz, Ar_1-3,5), 7.266 (s, 1H, Ar_2-2), 7.060-7.090 (d, 2H, *J* = 9.0 Hz, Ar_1-2,6), 4.091-4.163 (q, 2H, *J* = 7.2Hz, Ar_1OCH_2-), 2.834 (s, 3H, TRZ_2-CH_3), 2.742 (s, 3H, TRZ_1-CH_3), 1.457-1.505 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9c	7.590-7.619 (d, 2H, *J* = 8.7 Hz, Ar_2-3,5), 7.462-7.492 (d, 2H, *J* = 9.0 Hz, Ar_1-3,5), 7.463-7.492 (d, 2H, *J* = 8.7 Hz, Ar_2-2,6), 7.044-7.074 (d, 2H, *J* = 9.0 Hz, Ar_1-2,6), 4.076-4.147 (q, 2H, *J* = 7.2 Hz, Ar_1OCH_2-), 2.818 (s, 3H, TRZ_2-CH_3), 2.740 (s, 3H, TRZ_1-CH_3), 1.443-1.491 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9d	7.760-7.787 (d, 2H, *J* = 8.1 Hz, Ar_2-3,5), 7.429-7.461 (d, 2H, *J* = 9.6 Hz, Ar_1-3,5), 7.409-7.436 (d, 2H, *J* = 8.1 Hz, Ar_2-2,6), 7.058-7.090 (d, 2H, *J* = 9.6 Hz, Ar_1-2,6), 4.091-4.163 (q, 2H, *J* = 7.2 Hz, Ar_1-OCH_2-), 2.816 (s, 3H, TRZ_2-CH_3), 2.742 (s, 3H, TRZ_1-CH_3), 1.457-1.505 (t, 3H, *J* = 7.2 Hz, Ar_1-CH_2CH_3)
9e	7.480-7.740 (m, 3H, Ar_2-4,5,6), 7.428-7.460 (d, 2H, *J* = 9.6 Hz, Ar_1-3,5), 7.259 (s, 1H, Ar_2-2), 7.054-7.086 (d, 2H, *J* = 9.6 Hz, Ar_1-2,6), 4.111-4.139 (q, 2H, *J* = 7.2 Hz, Ar_1OCH_2-), 2.827 (s, 3H, TRZ_2-CH_3), 2.724 (s, 3H, TRZ_1-CH_3), 1.453-1.501 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9f	7.549-7.611 (d, 2H, *J* = 7 Hz, Ar_2-3,4), 7.432-7.463 (d, 2H, *J* = 9.3 Hz, Ar_1-3,5), 7.271 (s, 1H, Ar_1-6), 7.059-7.090 (d, 2H, *J* = 9.3 Hz, Ar_1-2,6), 4.093-4.161 (q, 2H, *J* = 7.2 Hz, Ar_1OCH_2-), 2.782 (s, 3H, TRZ_2-CH_3), 2.742 (s, 3H, TRZ_1-CH_3), 1.461-1.505 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9g	7.434-7.461 (d, 2H, *J* = 8.1 Hz, Ar_2-3,5), 7.414-7.444 (d, 2H, *J* = 9.0 Hz, Ar_1-3,5), 7.092-7.119 (d, 2H, *J* = 8.1 Hz, Ar_2-2,6), 7.060-7.090 (d, 2H, *J* = 9.0 Hz, Ar_1-2,6), 4.093-4.162 (q, 2H, *J* = 7.2 Hz, Ar_1O-CH_2-), 3.914 (s, 3H, Ar_2OCH_3), 2.771 (s, 3H, TRZ_2-CH_3), 2.740 (s, 3H, TRZ_1-CH_3), 1.461-1.505 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)
9h	7.375-7.463 (2d, 4H, *J* = 8.1 Hz, Ar_1, Ar_2-2,6), 7.046-7.097 (d, 4H, *J* = 8.1 Hz, Ar_1, Ar_2-3,5), 4.082-4.152 (2q, 4H, *J* = 7.2 Hz, Ar_1, Ar_2-OCH_2-), 2.726, 2.755 (2s, 6H, Ar_1, Ar_2-CH_3), 1.448-1.495 (t, 6H, *J* = 7.2 Hz, Ar_1, Ar_2-$OCCH_3$)
9i	8.014-8.154 (dd, 2H, *J* = 8.1 Hz, Ar_2-2,4), 7.558-7.680 (m, 4H, Ar_2-5,6,7,8), 7.414-7.443 (d, 2H, *J* = 8.7 Hz, Ar_2-3,5), 7.416-7.443 (d, 1H, *J* = 8.1 Hz, Ar_2-3), 7.043-7.072 (d, 2H, *J* = 8.7 Hz, Ar_1-2,6), 4.077-4.146 (q, 2H, *J* = 6.9 Hz, Ar_1OCH_2-), 2.739 (S, 3H, TRZ_1-CH_3), 2.612 (S, 3H, TRZ_2-CH_3), 1.445-1.491 (t, 3H, *J* = 6.9 Hz, $Ar_1OCH_2CH_3$)
9j	8.016-8.106 (m, 4H, Ar_2), 7.534-7.674 (m, 3H, Ar_2), 7.414-7.437 (d, 2H, *J* = 7.2 Hz, Ar_1 = 3.5), 7.058-7.082 (d, 2H, *J* = 7.2 Hz, Ar_1-2.6), 4.081-4.157 (q, 2H, *J* = 7.2 Hz, Ar_1OCH_2-), 2.865 (S, 3H, TRZ_2-CH_3), 2.741 (S, 3H, TRZ_1-CH_3), 1.449-1.501 (t, 3H, *J* = 7.2 Hz, $Ar_1OCH_2CH_3$)

sults are given in Table 2.

RESULTS AND DISCUSSION

The new 3-[1-(4-ethoxyphenyl)-5-methyl-1,2,3-triazol-4-yl]-6-substituted-*s*-triazolo[3,4-b]-1,3,4-thiadiazole **9a-j** have been synthesized by the condensation of 1-amino-2-mercappto-5-[1-(4-ethoxyphenyl)-5-metyl-1,2,3-trizol-4-yl]-1,3,4-triazole **8** with various 5-methyl-1-substituted-1,2,3-triazol-4-carboxylic acid **4a-j** in the presence of phosphorus oxychloride. The structure of these compounds was characterized with ^{1}H NMR, IR, and MS spectroscopy. The results are given in Tables 2, 3, 4 and 5. IR absorption peaks of **8** at 3281 cm^{-1} and 3186 cm^{-1} are assigned to its NH_2 and 2782 cm^{-1} is assigned to its SH group. When **8** converted **9**, the SH peak and NH_2 peak disappears. Like the allied system, compound **9** shows absorption peaks for N-N=C in the region of 1248-1255 cm^{-1} and for C=N in 1608-1614 cm^{-1}.[21] The typical vibration bands of N-N=N were in the region of 966-970, 944-948 cm^{-1} (The typical vibration bands of N-N=N in 1*H*-1,2,3-triazole ring are the values but 2H-triazole is not),[22] which shows two 1,2,3-triazoles rings in one molecule. The vibration bands of N-N=N are in agreement with the values reported for triazole (N-N=N absorptions in the region 950-1120 cm^{-1}) by Ykman and Hartzel.[23,24] Compounds **9a-j** show absorption peaks for C-S-C in the region of 714-721 cm^{-1}.[21] In the mass spectra of **9a-j** the molecular ion peaks are very weak (relative intensities ~1-4%) and all the members of **9a-j** exhibit some important ion peaks which are identified. The chemical shift of the triazole ring methyl group shows in the range of δ 2.724-2.865 ppm in compounds **9a-j**, whereas the chemical shift of the triazole ring methyl group shows in the range of δ 2.525 ppm in compound **8**. The chemical shift of

Table 5. MS data of compounds **9a-j**

No.	M^+	*m/z* (%)
9a	498 (M^+, 1),	470 (38), 441 (20), 243 (7), 200 (10), 171 (49), 111 (28), 97 (50), 83 (71), 71 (60), 57 (86), 43 (73)
9b	518 (M^+, 1),	490 (31), 461 (15), 433 (6), 243 (6), 204 (13), 190 (24), 171 (39), 164 (29), 111 (59), 97 (58), 83 (62), 71 (73), 57 (100), 43 (74)
9c	518 (M^+, 1),	490 (45), 461 (15), 251 (66), 221 (44), 204 (27), 189 (40), 171 (90), 165 (55), 147 (46), 135 (75), 129 (70), 111 (8), 97 (9), 83 (12), 71 (23), 57 (27), 43 (100)
9d	562 (M^+, 2),	534 (11), 505 (8), 398 (4), 236 (12), 198 (10), 171 (29), 155 (31), 111 (41), 97 (66), 83 (70), 71 (79), 57 (100), 43 (71)
9e	562 (M^+, 2),	534 (62), 505 (32), 398 (12), 234 (31), 171 (100), 155 (70), 119 (18), 102 (19), 76 (42), 65 (45), 57 (6), 51 (17), 43 (11)
9f	552 (M^+, 2),	524 (32), 495 (11), 467 (15), 238 (23), 200 (33), 171 (100), 111 (8), 97 (40), 83 (49), 71 (39), 57 (47), 43 (47)
9g	514 (M^+, 2),	486 (87), 457 (34), 416 (8), 243 (12), 200 (26), 186 (74), 171 (75), 160 (21), 148 (22), 119 (15), 97 (21), 83 (38), 77 (48), 57 (52), 43 (100)
9h	528 (M^+, 2),	500 (57), 471 (25), 200 (39), 172 (100), 146 (31), 111 (27), 97 (50), 83 (58), 77 (27), 71 (56), 57 (75), 43 (70)
9i	534 (M^+, 4),	506 (44), 477 (12), 262 (21), 206 (65), 183 (35), 171 (46), 127 (6), 119 (3), 97 (7), 83 (10), 77 (11), 69 (15), 57 (18), 43 (37)
9j	534 (M^+, 3),	506 (60), 477 (22), 262 (8), 206 (92), 183 (22), 171 (55), 127 (17), 119 (4), 97 (11), 83 (14), 77 (16), 69 (24), 57 (31), 43 (47)

the triazole ring Me-proton is in agreement with the values reported for triazole (Typical chemical shift of the triazole ring Me-proton is at about δ 2.45 ppm in the NMR spectra) by Ykman.[25] Recently, we have established the crystal structure of **9h** by X-ray diffraction. The crystal structure of **9h** conforms to the structure (Scheme I).

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REFERENCES

1. Heubach, G.; Sachse, B.; Buerstell, H. *Ger Offen* 2,826,760. (Chem. Abstr. **1980**, *92*, 181200h).
2. Tanaka, G. *Japan Kokai* 74, 95, 973. (Chem. Abstr. **1975**, *82*, 156320h).
3. Griffin, D. A.; Mannion, S. K. *EP* 199474 (Chem. Abstr. **1987**, *106*, 98120u).
4. Van Reet, G.; Heeres, J.; Wals, L. *U. S. Patent* 4,160,838 (Chem. Abstr. **1979**, *91*, 175361z).
5. Zhang, Z.-Y.; Liu, Y.; Yang, S.-Y. *Pharmaceutica Sinica* **1991**, *26(11)*, 809.
6. Abdou, N. A.; Soliman, S. N.; Abou Sier, A. H. *Bull Fac Pharm*. **1990**, *28(2)*, 29.
7. Srivastava, A. J.; Swarup, S.; Saxena, V. K.; Chowdhury, B. L. *J. Indian Chem. Soc.* **1991**, *68(2)*, 103.
8. Cooper, K.; Steele, J.; Richardson, K. *EP* 329357. (Chem. Abstr. **1990**, *112*, 76957u).
9. Husain, M. I.; Mohd, A. *J. Indian Chem. Soc*. **1986**, *63*, 317.
10. Elliott, R.; Sunley, R. L.; Griffin, D. A. *GB* 2,175,301. (Chem. Abstr. **1987**, *107*, 134310n).
11. Kohn, E. C.; Liotta, L. A. *U.S.* 637145 (Chem. Abstr. **1991**, *115*, 248099w).
12. Alvarez, R.; Velazquez, S.; San-Felix, A.; Aquaro, S.; De Clercq, E.; Perno, C. F.; Karlsson, A.; Balzarini, J.; Camarasa, M. J. *J. Med. Chem.* **1994**, *37*, 4185.
13. De Clercq, E. *Medicinal Research Reviews* **2002**, *22(6)*, 531.
14. Omar, A.; Mohsen, M. E.; AboulWafa, O. M. *J. Heterocycl. Chem.* **1986**, *23*, 1339.
15. Bano, Q.; Tiwari, N.; Giyi, S.; Nizamuddin. *Indian J. Chem*. **1992**, *31B*, 714.
16. Zhang, Z.-Y.; Chen, X. *Chin. J. Chem*. **1992**, *10*, 59.
17. Khaclem, H. E. L.; Mansour, H. A. R.; Meshreki, M. H. *J. Chem. Soc(c).* **1968**, 1329.
18. Sun, X.-W.; Xu, P.-F.; Zhang, Z.-Y. *Mag. Reson. Chem.* **1998**, *36*, 459.
19. Yale, H. I.; Losee, K.; Martins, J.; Holsing, M.; Perry, F. M.;

Bernstein, J. *J. Amer. Chem. Soc*. **1953**, *75*, 1933.
20. El-Barbary, A. A.; Fahmy, M.; El-Badawi, M.; El-Brembaly, K.; El-Brollosi, N. R. *Revue Roumaine de Chimie* **1991**, *36(4-7)*, 619.
21. Zhang, Z.-Y.; Zou, N.; Zhu, Y.; Zhao, L.; Li, M. *Acta Crystal. C*. **1996**, 2787.
22. Dong, H.-S.; Quan, B. *J. Mol. Struct*. **2000**, *553*, 31
23. Ykman, P.; L'Abbé, G.; Smets, G. *Tetrahedron* **1971**, *27*, 845.
24. Hartzel, L. W.; Benson, F. R. *J. Amer. Chem. Soc.* **1954**, *76*, 667.
25. Ykman, P.; L'Abbé, G.; Smets, G. *Tetrahedron* **1971**, *27*, 5623.