1,3-Dipolar Cycloaddition in the Synthesis of Novel Isoxazoline/Pyrazole Derivatives Bearing 1,2,3-Triazoles Moiety

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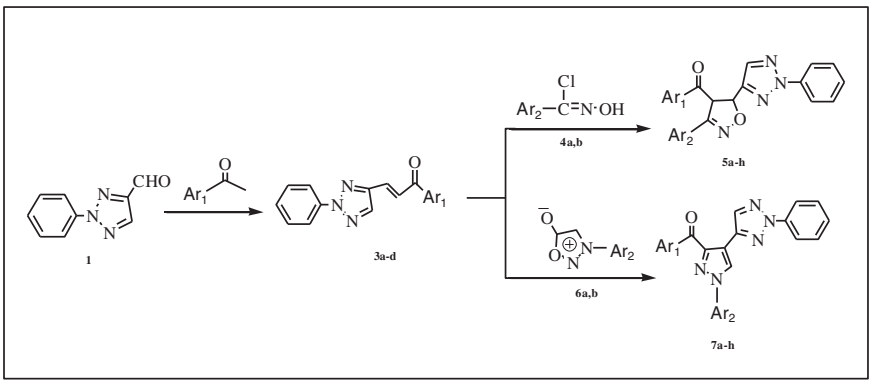
Received April 21, 2011
DOI 10.1002/jhet.1527
Published online 00 Month 2013 in Wiley Online Library (wileyonlinelibrary.com).



1,3-Dipolar cycloaddition of α,β-unsaturated ketones bearing 1,2,3-triazole moiety with nitrile oxides and sydnones obtained a series of novel 3,4,5-trisubstituted isoxazolines (**5a–h**) and 1,3,4-trisubstituted pyrazoles (**7a–h**) with different active pharmacophores in a single molecular scaffold. The structure of the target compounds was confirmed on the basis of IR, ^{1}H NMR, mass spectral, elemental analysis, and X-ray crystallographic analysis.

J. Heterocyclic Chem., **00**, 00 (2013).

INTRODUCTION

1,3-Dipolar cycloaddition has attracted much attention because it is a versatile synthetic strategy for the construction of five-membered ring heterocycles [1–3]. The nitrile oxide cycloaddition to alkenes results in the formation of isoxazolines, which are versatile intermediates for the synthesis of bifunctional and naturally occurring compounds [4–8] and also display important biological activities such as antibacterial [9], antitubercular, phosphodiesterase inhibitory [10], antiinflammatory [11], and immunostimulatory [12].

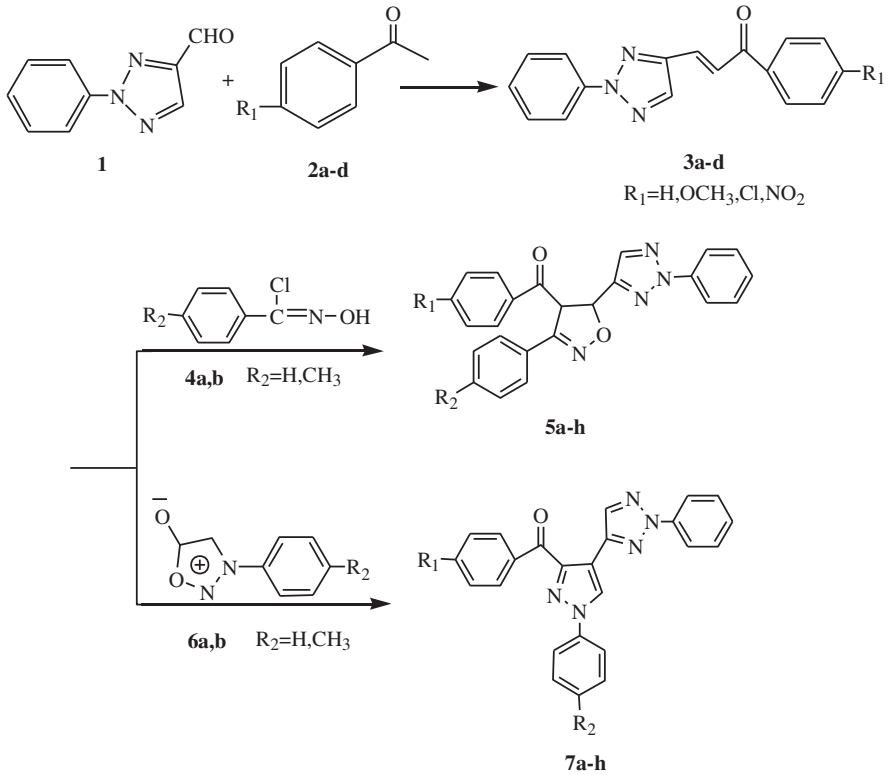
The synthesis of pyrazoles has received considerable attention because of their applications in pharmaceutical industries because of their antimicrobial [13], antiviral [14], antitumor [15], antiinflammatory [16], cyclooxygenase-2 (COX-2), and non-nucleoside HIV-1 reverse transcriptase inhibitory properties [17,18]. Some well-known drugs such as sildenafil (Viagra), rimonabant (Acomplia), and celecoxib (Celebrex) are pyrazole derivatives. A number of methods are available for the synthesis of pyrazoles [19–24]; the most efficient and commonly used method involves the condensation of hydrazine with 1,3-dicarbonyl compounds. Regioselective synthesis of the pyrazole ring remains a significant challenge for organic chemists. Meanwhile, sydnones are easily accessible aromatic compounds and versatile synthetic intermediates with a masked azomethine imine or hydrazine unit [25,26]. The 1,3-dipolar cycloaddition reaction with various simple dipolarophiles such as alkynes and alkenes offers a convenient synthetic route for the preparation of pyrazole derivatives [27], However, less attention has been paid on the 1,3-dipolar cycloaddition of sydnones with more complex dipolarophiles. Recently, literature reported a convenient access to 1,3,4-trisubstituted pyrazoles by the reaction of sydnones with unsymmetrical acetylenic ketones (dipolarophiles) [28,29], but now, we found that replacing acetylenic ketones with unsymmetrical propenones (α,β-unsaturated ketones) can also afford 1,3,4-trisubstituted pyrazoles. In addition, the biological activities of 1,2,3-triazole derivatives [30–32] make them important targets for synthetic chemists.

Encouraged by all these facts and our continued interest in the synthesis of novel heterocycles employing 1,3-dipolar cycloaddition, we report herein the complete study of the reaction of α,β-unsaturated ketones bearing 1,2,3-triazole moiety with nitrile oxides and sydnones, leading to new 3,4,5-trisubstituted isoxazolines and 1,3,4-trisubstituted pyrazoles with different active pharmacophores in a single molecular scaffold, which may have potential biological and medical applications.

RESULTS AND DISCUSSION

The target compounds **5a–h** and **7a–h** were prepared as depicted in Scheme 1. In the initial step, the α,β-

Scheme 1



5,7: a, R_1=H, R_2=H **b**. R_1=OCH_3, R_2=H **c.** R_1=Cl, R_2=H **d**. R_1=NO_2, R_2=H
e, R_1=H, R_2=CH_3 **f**. R_1=OCH_3, R_2=CH_3 **g**. R_1=Cl, R_2=CH_3 **h**. R_1=NO_2, R_2=CH_3

unsaturated carbonyl compounds **3a–d** were obtained by Claisen–Schmidt condensation by reacting substituted acetophenones **2a–d** and 2-phenyl-4-formyl-1,2,3-triazole **1**. Then, the reaction of chalcones **3** with arylnitrile oxides, which is prepared *in situ* from arylhydroximinoyl chlorides **4a,b** with triethylamine, stirring at room temperature in dichloromethane yielded cycloadducts **5a–h**. The progress of each reaction was monitored by thin layer chromatography. The IR spectrum of **5a** exhibit C=O stretching at 1633 cm^{-1} and C=N stretching at 1496 cm^{-1} bands. In addition, The ^{1}HNMR spectrum of compound **5a** is in agreement with the proposed structure. Two characteristic doublets of the isoxazoline are recorded at 6.03 ppm for Hα and 5.93 ppm for Hβ with 5.6 Hz as coupling constant, which reveals that the Hα and Hβ are trans. The mass spectrum of compound **5a** revealed the existence of the molecular ion peaks M^+ at 316 *m/z* and significant fragmentation peaks, which is strong evidence for the structure.

Similarly, the chalcones *n* were subsequently treated with sydnone **6a,b** in the presence of triethylamine in dichloromethane to afford **7a–h**. The intense broad band at 1656 cm^{-1} in the IR spectra of **7b** was ascribed to the stretching vibration of C=O. The C=N band was represented by two intense broads centered at about 1583 and 1522 cm^{-1}. Two different sets of signals at 8.35 and 8.27 ppm in the ^{1}H NMR spectrum of **7c** can be distinguished from the signals of C=C-H proton and N=C-H proton, respectively. The protons belonging to the aromatic ring were seen at δ 8.01–7.25 as multiplet signals. A singlet at δ 3.84 ppm is attributed to the OCH_3 protons. Its mass spectrum revealed a peak corresponding to its molecular ion at *m/z* 421(M^+).

To elucidate the structure of these compounds, we examined the structure of **5e** and **7f** by X-ray crystallography. The crystal data and structure refinement are shown in Table 1. Selected bond lengths and angles are listed in Table 2 and the hydrogen bond geometry in Table 3. The C-H···π stacking interactions in the crystal are given in Table 4. The crystal structure of the compound **5e and 7f** is shown in Figures 1 and 2, respectively, and a perspective view of the crystal packing in the unit cell is tabulated in Figures 3 and 4, respectively.

X-ray diffraction study of the compound **5e** has shown that the title compound $C_{25}H_{20}N_4O_2$ crystallizes in the orthorhombic system with space grouping P2(1)2(1)2(1). The isoxazole ring in this compound (**5e**) adopts an envelope conformation, only with maximum deviation of 0.0555 Å for atom C10 for the plane defined by N4/O2/C11/C12. In addition, the dihedral angle between the isoxazole ring and the C2–C7 phenyl ring is 9.21°, confirming

Table 1

Crystal data and structure refinement.

	7f	**5e**
Formula	C26 H21 N5 O2	C25 H20 N4 O2
CCDC	821936	821937
Formula weight	435.48	408.45
Temperature	293(2) K	293(2) K
Crystal Size, mm	0.43 × 0.27 × 0.11	0.56 × 0.42 × 0.23
Crystal system	Triclinic	Orthorhombic
Space group	P-1	P2(1)2(1)2(1)
a, Å	7.8621(11)	7.7924(2)
b, Å	12.2253(18)	21.7321(4)
c, Å	12.1903(16)	12.3162(2)
α, deg	103.472(3)	90
β, deg	104.323(3)	90
γ, deg	90.992(3)	90
V, Å^3	1100.5(3)	2085.69(7)
Z	2	4
Dc, mg/m^3	1.314	1.301
θ range, deg	3.07–27.48	3.09–27.48
μ, mm^{-1}	0.086	0.085
Reflections collected	9793	20445
Data/restraints/ parameters	4553/0/299	4765/0/281
Final R indices	R1 = 0.1039,	R1 = 0.0334,
[I > 2σ(I)]	wR2 = 0.1945	wR2 = 0.0912
R indices (all data)	R1 = 0.0575,	R1 = 0.0475,
	wR2 = 0.1620	wR2 = 0.1156

Table 2

Selected bond lengths (Å) and bond angles (°).

Compound **5e**			
O(2)–N(4)	1.4088(19)	N(1)–N(2)–N(3)	114.94(14)
O(2)–C(9)	1.4532(19)	N(1)–N(2)–C(25)	122.27(13)
O(1)–C(13)	1.2144(19)	N(3)–N(2)–C(25)	122.79(14)
N(1)–C(9)	1.326(2)	N(1)–C(9)–C(8)	108.35(15)
N(1)–N(2)	1.3303(18)	N(1)–C(9)–C(10)	120.64(14)
N(2)–N(3)	1.3347(19)	C(8)–C(9)–C(10)	131.01(16)
N(2)–C(25)	1.425(2)	C(12)–C(11)–C(13)	111.67(12)
N(3)–C(8)	1.327(2)	C(12)–C(11)–C(10)	100.41(12)
N(4)–C(12)	1.277(2)	C(13)–C(11)–C(10)	111.38(12)
C(11)–C(12)	1.547(2)	N(4)–C(12)–C(5)	121.63(14)
C(10)–C(9)	1.482(2)	N(4)–C(12)–C(10)	114.01(14)
C(9)–C(8)	1.396(2)	C(5)–C(12)–C(10)	124.33(13)
Compound **7f**			
N(1)–C(12)	1.341(3)	N(3)–N(4)–C(20)	123.41(18)
N(1)–N(2)	1.357(2)	N(3)–N(4)–N(5)	115.10(18)
N(1)–C(5)	1.423(3)	N(5)–N(4)–C(20)	121.48(19)
N(2)–C(10)	1.332(3)	C(12)–C(11)–C(13)	126.0(2)
N(3)–N(4)	1.328(2)	C(12)–C(11)–C(10)	103.91(19)
N(3)–C(9)	1.335(3)	C(10)–C(11)–C(13)	129.8(2)
N(4)–N(5)	1.334(3)	N(2)–C(10)–C(9)	117.6(2)
N(4)–C(20)	1.423(3)	N(2)–C(10)–C(11)	111.4(2)
N(5)–C(8)	1.314(3)	C(11)–C(10)–C(9)	130.9(2)
O(2)–C(13)	1.216(3)	C(8)–C(9)–C(10)	132.3(2)
C(11)–C(13)	1.470(3)	N(3)–C(9)–C(10)	120.1(2)
C(10)–C(9)	1.468(3)	N(3)–C(9)–C(8)	107.6(2)
C(1)–C(2)	1.505(3)	C(12)–N(1)–N(2)	111.85(18)
C(9)–C(8)	1.384(3)	C(12)–N(1)–C(5)	128.54(19)
C(12)–C(11)	1.376(3)	N(2)–N(1)–C(5)	119.59(17)

that these two planes are almost coplanar. The isoxazole ring forms dihedral angles of 64.05° and 57.98° with the 1,2,3-triazole ring and the plane of phenyl ring C12–C19, respectively. The 1,2,3-triazole ring is almost parallel to the plane of phenyl C20–C25 because of an existing dihedral angle of 0.74°. Within the molecule, the bond distances of C13–O1 (1.2144 Å) are significantly shorter than a normal single C-O bond (1.367(3) Å) but longer than a typical C═O bond (1.119 Å). At the same time, the sum of C10–C11–C13, C10–C11–C12, and C13–C11–C12 bond angles is 359.98º, and that of C11–C12–N4, C5–C12–C11, and C5–C12–N4 is 360.05º, showing that atoms C11 and C12 are of sp^2 hybridization. X-ray crystal structure determination indicates that there are two independent molecules in the unit. The packing in compound **5e** is only held by a C-H. . .Cg (π-Ring) (Table 3). Atoms C4, C14, and C23 act as a hydrogen bond donor respectively, via H. . .Cg bond to generate the super molecular structures.

The compound **7f** has shown that the title compound $C_{26}H_{21}N_5O_2$ crystallizes in the triclinic system with space grouping P-1. The pyrazole ring as the center is planar, which forms dihedral angles of 47.95° and 23.61° with the two planes of phenyl rings C14–C19 and C2–C7, respectively. The 1,2,3-triazole ring is twisted to the pyrazole ring and the phenyl ring(C20–C25), forming a dihedral angle of 15.22° and 7.01°, respectively. The C13–O2 bond distance of 1.216(3) Å indicates clearly the double bond nature of the O2═C13 bond. It is worth to illuminate that there exist kinds of hydrogen-bonding interactions in the crystal structure. The C12–H12. . .O1 is intramolecular hydrogen-bonding interactions and weak intermolecular hydrogen bond of the C–H. . .O as C8–H8. . .O2 (Table 4), with symmetry code −x,1 − y,1 − z. Furthermore, the C··π stacking interactions between the neighboring molecules are also observed. (Fig. 2 and Table 3) The C10 atoms are involved in O2···π interactions with the phenyl ring (centroid Cg3, C2–C7, symmetry code: −1 − X,−Y,1 − Z), which increase ulteriorly the stability of the 3D supramolecular architecture of the polymer.

CCDC-**821936** for **5e** and **821937** for **7f** contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from the Cambridge Crystallographic Data Centre (CCDC) via e-mail: deposit@ccdc.cam.ac.uk.

In conclusion, we have obtained two series of compounds bearing 1,2,3-triazole via 1,3-dipolar cycloaddition reaction. Meanwhile, the X-ray crystallography further confirmed the molecular conformation of the titled compounds.

EXPERIMENTAL

All of the reactions were monitored by TLC. Melting points were determined via a mettler FP-5 melting point apparatus (Ningbo Biocotek Scientific Instrument Co., China) and were uncorrected. Elemental analyses were analyzed on a Perkin-Elmer 2400 elemental analyzer (USA). The IR spectra were recorded on potassium bromide pellet on a Bruker Equinox 55 FTIR spectrophotometer

Table 3

C–H. . .π hydrogen bonds for the title compound (Å, °).

D-H. . .A	d(H. . .A)	d(D. . .A)	<(DHA)	Symmetry code
5e				
C(4)–H(4B)–Cg(4)	2.88	3.671(2)	144	−1/2 + X,3/2 − Y,−Z
C(14)–H(14A)–Cg(5)	2.88	3.509(2)	126	1 − X,1/2 + Y,−1/2 − Z
(23)–H(23A)–Cg(4)	2.92	3.668(2)	136	−X,−1/2 + Y,−1/2 − Z
7f				
C(10)–O(2)–Cg(3)	3.931(3)	4.215	95.02(16)	−1 − X,−Y,1 − Z

Table 4

Hydrogen bonded geometry (distances and angles are given in Å and °).

D-H. . .A	d(D-H)	d(H. . .A)	d(D. . .A)	<(DHA)	Symmetry code
C(8)–H(8A). . .O(1)	0.93	2.51	3.354(3)	152	−x,1 − y,1 − z
C(20)–H(20A). . .O(2)	0.93	2.46	3.006(3)	118	Intra

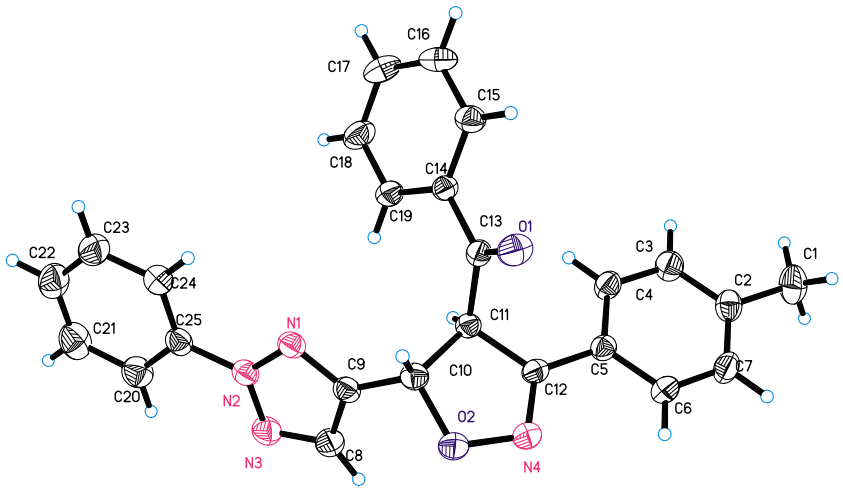


Figure 1. The crystal structure of the compound **5e**. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

(Germany). The ^{1}H NMR spectra were measured by a Varian Inova-400 spectrophotometer (USA) using TMS as an internal reference. Mass spectra were preformed on an Agilent 5975 apparatus (EI, 70eV) (USA). Compounds 1 [33], 3 [34], 4 [35], and 6 [25,26] were prepared according to the known procedure.

General procedure for the preparation of 3-(4-substituted-phenyl)-4-(4-substituted-benzoyl)-5-(2-phenyl-1,2,3-triazol-4-yl)-4,5-dihydro-isoxazolines (5a–h). A mixture of the appropriate hydroxamoyl chlorides **4** (1 mmol) and the chalcones **3** (1 mmol) was stirred in ethanol in CH_2Cl_2 (15 mL). After dissolution of the reactants, a solution of triethylamine (0.5 mL) was added dropwise. Then, the solution was stirred at room temperature for further 2 days. The solid mass separated out was filtered off, the filtrate was evaporated under reduced pressure, and the residue was chromatographed on a silica gel column by using ethylacetate: petroleum ether (1:8) as eulent to afford the corresponding oxazoline derivatives **5a–h**.

Phenyl-(3-phenyl-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl)methanone (5a). This compound was obtained as white crystals in yield 38%, mp 167–168°C; IR (KBr) ν: 3137 (Ar-H), 2920 (CH), 1633 (C═O), 1595, 1496 (C═N) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.20–7.51 (m, 16H, Ar-H, and N═C-H), 6.03–6.02 (d,1H, Ha, J_{ab} = 5.60 Hz), 5.93–5.92 (d, 1H, Hb, J_{ab} = 5.60 Hz); MS: *m/z*: 384 (M^+), 291, 172, 105 (100%), 97, 77, 51; *Anal*. Calcd for $C_{24}H_{18}N_4O_2$: C, 73.08; H, 4.60; N, 14.20. Found: C, 73.05; H, 4.66; N, 14.21.

(4-Methoxyphenyl)(3-phenyl-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxa zol-4-yl) methanone (5b). This compound was obtained as white crystals in yield 43%, mp 110–111°C; IR(KBr) ν: 3139 (Ar-H), 2915 (CH), 1643 (C═O), 1585, 1492 (C═N) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.31–7.82 (m, 15H, Ar-H and N═C-H), 6.21–6.20 (d,1H, Ha, J_{ab} = 5.40 Hz), 6.02–6.01 (d, 1H, Hb, J_{ab} = 5.40 Hz), 3.85 (s, 3H, OCH_3); MS: *m/z*: 424 (M^+), 321, 172, 135 (100%), 107, 77, 51; *Anal*. Calcd for $C_{25}H_{20}N_4O_3$: C, 70.74; H, 4.75; N, 13.20. Found: C, 70.67; H, 4.82; N, 13.15.

(4-Chlorophenyl)(3-phenyl-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5c). This compound was obtained as white crystals in yield 37%, mp 139–140°C; IR (KBr) ν: 3140 (Ar-H), 2933(CH), 1638 (C═O), 1588, 1483 (C═N), 763 (C-Cl) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.12–

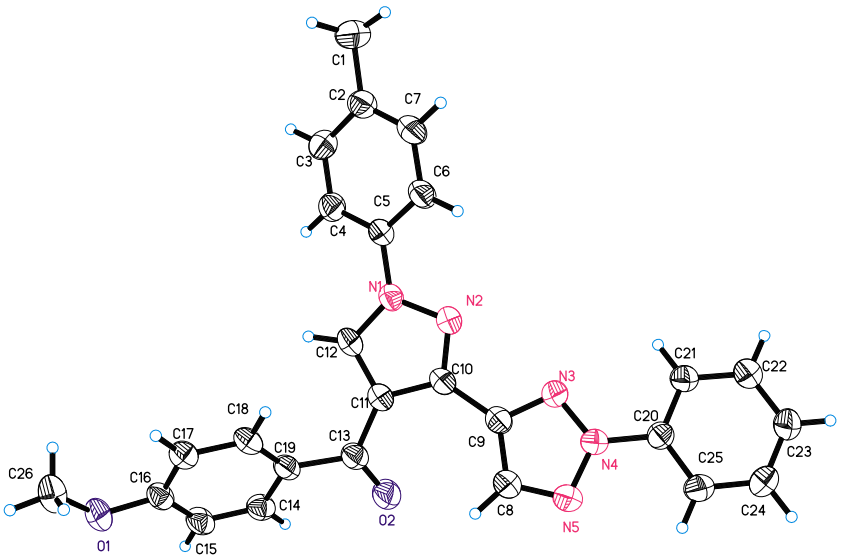


Figure 2. The crystal structure of the compound **5f**. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

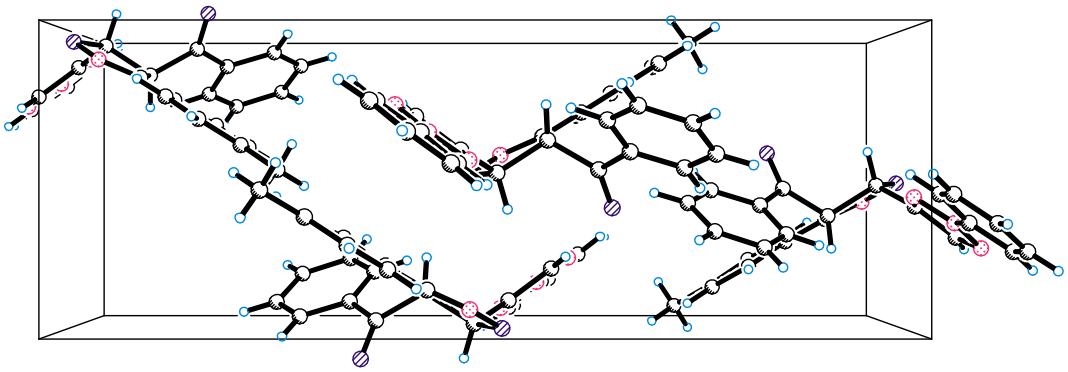


Figure 3. The molecular packing of **5e**. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

7.43 (m, 15H, Ar-H and N=C-H), 5.98-5.97 (d,1H, Ha, J_{ab} = 5.20 Hz), 5.86–5.85 (d, 1H, Hb, J_{ab} = 5.20 Hz); MS: *m/z*: 430 (M^++2), 428 (M^+), 363, 325, 172, 139 (100%), 111, 77, 51; *Anal*. Calcd for $C_{24}H_{17}ClN_4O_2$: C, 67.21; H, 4.00; N, 13.06. Found: C, 67.08; H, 4.13; N, 13.11.

(4-Nitrophenyl)(3-phenyl-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5d). This compound was obtained as white crystals in yield 33%, mp 145–146°C; IR (KBr) ν: 3141 (Ar-H), 2899 (CH), 1621 (C=O), 1589, 1488 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.15–7.49 (m, 15H, Ar-H and N=C-H), 6.00–5.99 (d,1H, Ha, J_{ab} = 4.80 Hz), 5.88–5.87 (d, 1H, Hb, J_{ab} = 4.80 Hz); MS: *m/z*:439 (M^+), 336, 172, 150(100%), 122, 77, 51; *Anal.* Calcd for $C_{24}H_{17}N_5O_4$: C, 65.60; H, 3.90; N, 15.94. Found: C, 65.58; H, 4.09; N, 14.81.

Phenyl-(3-(4-tolyl)-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5e). This compound was obtained as white crystals in yield 41%, mp 217–218°C; IR (KBr) ν: 3130 (Ar-H), 2945 (CH), 1678 (C=O), 1595, 1491 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.20–7.13 (m, 15H, Ar-H and N=C-H), 6.01–6.00 (d,1H, Ha, J_{ab} = 5.60 Hz), 5.90–5.89 (d, 1H, Hb, J_{ab} = 5.60 Hz), 2.33 (s, 3H, CH_3); MS: *m/z*:408 (M^+), 303, 158, 105 (100%), 77, 51; *Anal.* Calcd for $C_{25}H_{20}N_4O_2$: C, 73.51; H, 4.94; N, 13.72. Found: C, 73.45; H, 4.99; N, 13.75.

(4-Methoxyphenyl)(3-(4-tolyl)-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5f). This compound was obtained as white crystals in yield 45%, mp 102–103°C; IR(KBr) ν: 3133 (Ar-H), 2941 (CH), 1677 (C=O), 1595, 1494 (C=N) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.25–7.72 (m, 14H, Ar-H and N=C-H), 6.12–6.10 (d,1H, Ha, J_{ab} = 5.20 Hz), 5.99–5.98 (d, 1H, Hb, J_{ab} = 5.20 Hz), 3.87 (s, 3H, OCH_3), 2.35 (s, 3H, CH_3); MS: *m/z*:438 (M^+), 321, 172, 135 (100%), 107, 92, 77, 51; *Anal.* Calcd for $C_{26}H_{22}N_4O_3$: C, 71.22; H, 5.06; N, 12.78. Found: C, 71.15; H, 5.10; N, 12.81.

(4-Chlorophenyl)(3-(4-tolyl)-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5g). This compound was obtained as white crystals in yield 36%, mp 156–157°C; IR (KBr) ν: 3127 (Ar-H), 2955 (CH), 1678 (C=O), 1598, 1491 (C=N), 761 (C-Cl) cm^{-1}; ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 8.15–7.18(m, 14H, Ar-H and N=C-H), 5.96–5.95 (d,1H, Ha, J_{ab} = 4.80 Hz), 5.84–5.83 (d, 1H, Hb, J_{ab} = 4.80 Hz), 2.32 (s, 3H, CH_3); MS: *m/z*:444 (M^++2), 442 (M^+), 377, 339, 186, 153 (100%), 125, 77, 51; *Anal*. Calcd for $C_{25}H_{19}ClN_4O_2$: C, 67.80; H, 4.32; N, 12.65. Found: C, 67.77; H, 4.36; N, 12.60.

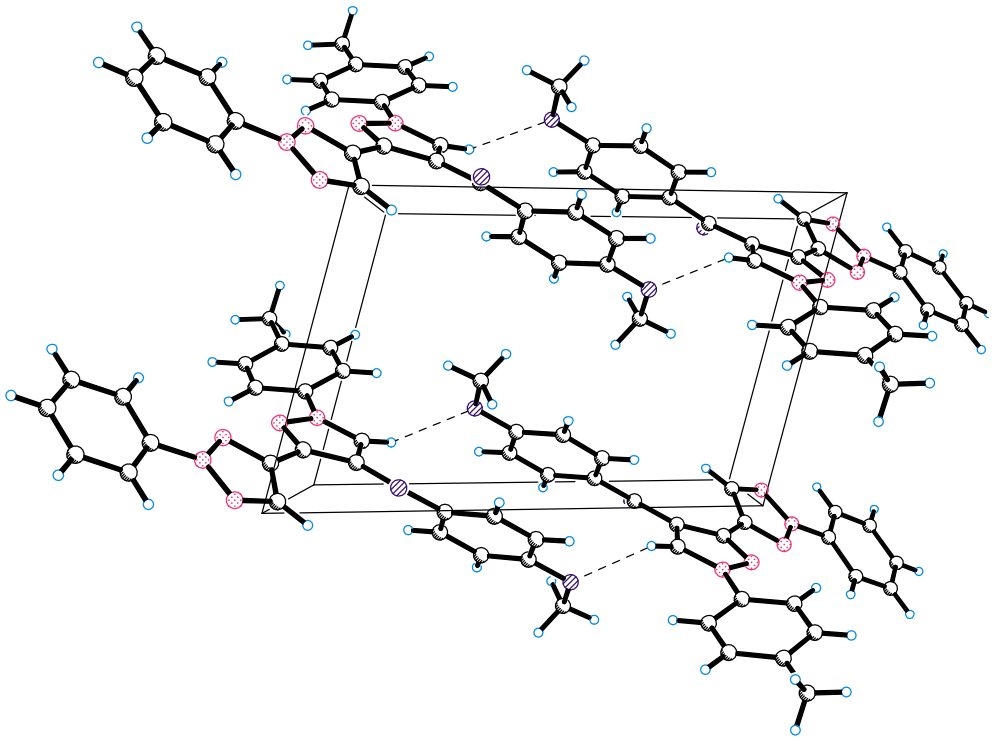


Figure 4. The molecular packing of **5f**. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

(4-Nitrophenyl)(3-(4-tolyl)-5-(2-phenyl-2H-1,2,3-triazol-4-yl)-4,5-dihydroisoxazol-4-yl) methanone (5h). This compound was obtained as white crystals in yield 33%, mp 161–162°C; IR (KBr) ν: 3136 (Ar-H), 2958 (CH), 1688 (C=O), 1592, 1495 (C=N) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.16–7.79 (m, 14H, Ar-H and N=C-H), 6.03–6.02(d,1H, Ha, J_{ab} = 5.60 Hz), 5.92–5.91 (d, 1H, Hb, J_{ab} = 5.60 Hz), 2.33 (s, 3H, CH_3); MS: *m/z*:453(M^+), 350, 186, 164(100%), 136, 77, 51; *Anal.* Calcd for $C_{25}H_{19}N_5O_4$: C, 66.22; H, 4,22; N, 15.44. Found: C, 66.20; H, 4.25; N, 15.48.

General procedure for the preparation 1-(4-substitued-phenyl)-3-(4-substitued-benzoyl)-4-(2-phenyl-1,2,3-triazol-4-yl)-pyrazoles (7a–h). 3-Arylsydnone **6** (1 mmol) and chalcones **3** (1 mmol) were dissolved in 10 mL dry xylene and refluxed for 3–4 h. After completion of the reaction (monitored by TLC and evolution of CO2), the solvent was removed by distillation under reduced pressure. The resulting crude product was purified by column chromatography with ethylacetate: petroleum ether (1:5; v/v) as eulent to afford the corresponding pyrazole derivatives **7a–h**.

Phenyl-(phenyl-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7a). This compound was obtained as white crystals in yield 63%, mp 197–198°C; IR(KBr) ν: 2950 (Ar-H), 1655 (C=O), 1587, 1512, 1472 (C=N, C=C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.42 (s, 1H, C=C-H), 8.33 (s, 1H, N=C-H), 8.01–7.40 (m, 15H, Ar-H); MS: *m/z*:391 (M^+), 362, 314, 196, 105, 91, 77 (100%), 64, 51; *Anal.* Calcd for $C_{24}H_{17}N_5O$: C, 73.64; H, 4.38; N, 17.89. Found: C, 73.62; H, 4.40; N, 17.87.

(4-Methoxyphenyl)(phenyl-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7b). This compound was obtained as white crystals in yield 76%, mp 171–172°C; IR(KBr) ν: 2977 (Ar-H), 1656(C=O), 1583, 1522, 1461 (C=N, C=C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.35 (s, 1H, C=C-H), 8.27 (s, 1H, N=C-H), 8.01–7.55 (m, 14H, Ar-H), 3.84 (s, 3H, OCH_3); MS: *m/z*:421 (M^+,100%), 392, 362,314, 196, 135, 92, 77, 57; *Anal.* Calcd for $C_{25}H_{19}N_5O_2$: C, 71.25; H, 4.54; N, 16.62. Found: C, 71.23; H, 4.55; N, 16.64.

(4-Chlorophenyl)(phenyl-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7c). This compound was obtained as white crystals in yield 71%, mp 224–225°C; IR(KBr) ν: 2954 (Ar-H), 1633(C=O), 1589, 1516, 1474 (C=N, C=C), 755(C-Cl) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.44 (s, 1H, C=C-H), 8.36 (s, 1H, N=C-H), 8.08–7.41 (m, 14H, Ar-H); MS: *m/z*:427 (M^++2), 425 (M^+,100%,), 396, 362, 314, 196, 139, 111, 77, 51; *Anal.* Calcd for $C_{24}H_{16}ClN_5O$: C, 67.69; H, 3.79; N, 16.44. Found: C,67.66; H, 3.81; N, 16.46.

(4-Nitrophenyl)(phenyl-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7d). This compound was obtained as white crystals in yield 68%, mp 201–202°C; IR(KBr) ν: 3002 (Ar-H), 1656 (C=O), 1576, 1520, 1461 (C=N, C=C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.45 (s, 1H, C=C-H), 8.37 (s, 1H, N=C-H), 8.00–7.54 (m, 14H, Ar-H); MS: *m/z*:436 (M^+, 100%), 407, 361, 314, 196, 150, 91, 64; *Anal.* Calcd for $C_{24}H_{16}N_6O_3$: C, 66.05; H, 3.70; N, 19.26. Found: C, 66.02; H, 3.72; N, 19.24.

Phenyl-(1-(4-methylphenyl)-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7e). This compound was obtained as white crystals in yield 74%, mp 149–151°C; IR(KBr) ν: 3011 (Ar-H), 1675 (C=O), 1588, 1508, 1459 (C=N, C=C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.43 (s, 1H, C=C-H), 8.33 (s, 1H, N=C-H), 8.01–7.13 (m, 14H, Ar-H), 2.43 (s, 3H, CH_3); MS: *m/z*:405 (M^+, 100%), 376, 328, 210, 118, 91, 65; *Anal.* Calcd for $C_{25}H_{19}N_5O$: C, 74.06; H, 4.72; N, 17.27. Found: C, 74.03; H, 4.74; N, 17.26.

(4-Methoxyphenyl)(1-(4-methylphenyl)-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7f). This compound was obtained as white crystals in yield 73%, mp 139–140°C; IR

(KBr) ν: 2989 (Ar-H), 1657 (C═O), 1571, 1522, 1472 (C═N, C═C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.35 (s, 1H, C═C-H), 8.26 (s, 1H, N═C-H), 8.02–7.63 (m, 13H, Ar-H), 3.85 (s, 3H, OCH_3), 2.42 (s, 3H, CH_3); MS: *m/z*:435 (M^+, 100%), 406, 328, 210, 135, 118, 91, 77, 64, 51; *Anal*. Calcd for $C_{26}H_{21}N_5O_2$: C, 71.71; H, 4.86; N, 16.08. Found: C, 71.70; H, 4.87; N, 16.10.

(4-Chlorophenyl)(1-(4-methylphenyl)-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7g). This compound was obtained as white crystals in yield 71%, mp 168–170°C; IR (KBr) ν: 2923 (Ar-H), 1650 (C═O), 1597, 1526, 1497 (C═N, C═C), 758(C-Cl) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.46 (s, 1H, C═C-H), 8.37 (s, 1H, N═C-H), 8.00–7.18 (m, 13H, Ar-H), 2.44 (s, 3H, CH_3); MS: *m/z*:441 (M^++2), 439 (M^+, 100%), 410, 376, 328, 210, 139, 111, 91, 77, 64, 51; *Anal*. Calcd for $C_{25}H_{18}ClN_5O$: C, 68.26; H, 4.12; N, 15.92. Found: C, 68.24; H, 4.13; N, 15.90.

(4-Nitrophenyl)(1-(4-methylphenyl)-4-(2-phenyl-2H-1,2,3-triazol-4-yl)-pyrazol-3-yl) methanone (7h). This compound was obtained as white crystals in yield 69%, mp 234–235°C; IR(KBr) ν: 2956 (Ar-H), 1677 (C═O), 1582, 1511, 1470 (C═N, C═C) cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ: 8.41 (s, 1H, C═C-H), 8.32 (s, 1H, N═C-H), 8.03–7.63 (m, 13H, Ar-H), 2.42 (s, 3H, CH_3); MS: *m/z*:450 (M^+, 100%), 420, 328, 210, 120, 91, 77, 65, 57; *Anal*. Calcd for $C_{25}H_{18}N_6O_3$: C, 66.66; H, 4.03; N, 18.66. Found: C, 66.65; H, 4.04; N, 18.68.

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