Tetrahedron 69 (2013) 881–887

Contents lists available at SciVerse ScienceDirect

Tetrahedron

journal homepage: www.elsevier.com/locate/tet

# Copper-catalyzed click synthesis of functionalized 1,2,3-triazoles with 3,4-dihydropyrimidinone or amide group via a one-pot four-component reaction

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ARTICLE INFO

*Article history:*
Received 3 July 2012
Received in revised form
28 September 2012
Accepted 9 October 2012
Available online 8 November 2012

*Keywords:*
1,2,3-Triazoles
Cu (I)-catalyzed azide–alkyl cycloadition
*N*3-substituted dihydropyrimidinones
Amides

ABSTRACT

A Cu (I) generated in situ from $Cu(OAc)_2 \cdot H_2O$/sodium ascorbate catalyzed one-pot multicomponent reaction for the synthesis of a series of *N*-functionalized 1,2,3-triazoles with 3,4-dihydropyrimidione from 3,4-dihydropyrimidiones, paraformaldehyde, sodium azide and alkynes is described. Remarkably *N*-functionalized 1,2,3-triazoles with amide were prepared by this method. This procedure eliminates the need to handle organic halides or organic azides, as they are generated in situ, making this already powerful click process even more user-friendly and safe.



## 1. Introduction

Multicomponent reactions (MCRs) were increasingly important in organic and medicinal chemistry, because they offered significant advantages over conventional linear-type syntheses.[1] For example, MCRs themselves were chemo- and regioselective, convergent step-efficient procedures and took place with high atom economy.[2] Another important feature implied the diminution of waste production due to the decrease of synthetic or isolation steps along with saving time.[3]

Since copper (I)-catalyzed azide–alkyne cycloaddition (CuAAC) was reported independently by the groups of Sharpless and Meldal in 2002.[4] It proceeded highly regioselectively when using terminal alkynes, thereby lead to exclusively 1,4-disubstituted 1,2,3-triazoles as the sole products. The *N*-heterocyclic compound of 1,2,3-triazoles has rapidly become one of the most popular structures owing to their diverse uses, ranging from medicinal,[5] material,[6] to biological[7] research. Recent efforts have been aimed at the investigation of the chemical and biological properties of this unique heterocycle.[8] A few methods were designed to circumvent the handling of azides, whose synthesis and isolation can be problematic due to their potential explosive or unstable nature. For example, three-component copper catalyzed reactions in which azides were generated in situ from corresponding alkyl or aryl halides and sodium azide in the presence of terminal alkynes gave access to diversely substituted 1,2,3-triazoles.[9]

3,4-Dihydropyrimidinones (DHPMs) have attracted considerable interest due to their interesting pharmacological properties, such as calcium channel modulator, antihypertensive, $\alpha_{1a}$-adrenergic agonists mitotic kinesin inhibitor and hepatitis B virus replication suppressor.[10] Among DHPM derivatives, most of the pharmacologically attractive forms are *N*3-substituted analogues.[11] For example, *N*3-functionalized 4-aryl-3,4-dihydropy rimidine-2(1*H*)-ones exhibited a broad range of biological effects[11b] and have recently appeared as, e.g., antihypertensive agents SQ32547, SQ32926 and $\alpha_{1a}$-adrenergic receptor antagonists.[12]

We recently reported a regioselective synthesis of the *N*3-functionalized DHPMs by reaction of DHPMs with paraformaldehyde and various reagents in the presence of trimethyl chlorosilicane (TMSCl).[13] In the context, we became interested in combining click chemistry (azide–acetylene cycloadditions) with MCR strategies. Herein, we reported an efficient approach for the one-pot synthesis of libraries including both 3,4-dihydropyrimidinones/amides and 1,2,3-triazole rings in their structures.

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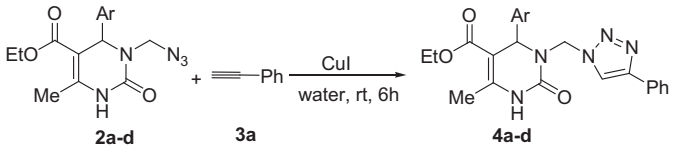
http://dx.doi.org/10.1016/j.tet.2012.10.097

## 2. Results and discussion

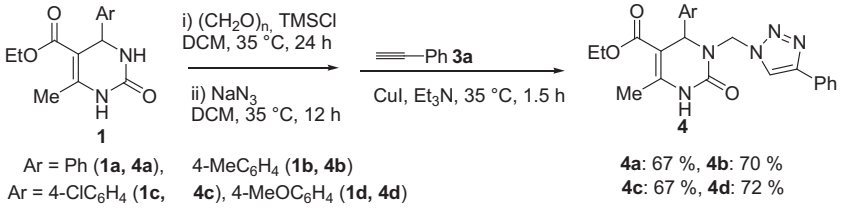
Initially, the desired products **4a**–**d** were synthesized via the 1,3-dipolar cycloaddition between *N*3-azide functionalized DHPMs **2a**–**d**, which can be conveniently prepared according to our reported process,[13] with phenylacetylene **3a** using water as the reaction medium in the presence of 10 mol % of CuI (Scheme 1).




**Scheme 1.** Fractional-step synthesis of triazoles using *N*3-azide functionalized DHPMs.

Then, we moved to the development of the one-pot three-step version of this transformation. By heating the mixture of DHPM **1** with paraformaldehyde in the presence of TMSCl in dichloromethane (DCM) at 35 °C for 24 h and subsequently adding $NaN_3$ for another 12 h gave the intermediate **2**. Without isolation of the compound **2**, then phenylacetylene **3a**, triethylamine ($Et_3N$) and 10 mol % CuI were added to the reaction mixture and the mixture was stirred at refluxing for another 1.5 h giving the cycloaddition products **4a**–**d** in a total yields of 67–72% (Scheme 2).

Quinazolinones **5** were also exposed to the standard reaction conditions, resulting in the formation of *N*-functionalized quinazolinones with 1,2,3-triazole derivatives **6a**–**c** (Scheme 3). It is noteworthy that this four-component one-pot synthesis involved the formation of three C–N bonds in a highly selective fashion. It was obvious that the one-pot method didn't need the separation of organic azides and had greater advantages due to simplifying the experimental procedure.



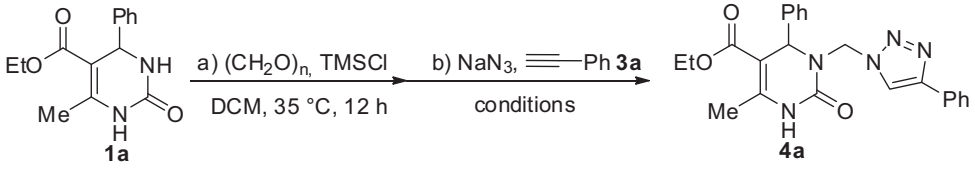

**Scheme 2.** One-pot three-step synthesis of triazoles from DHPMs.

Subsequently, we probed a modular synthesis of triazoles **4** through a click chemistry of four components by a one-pot two-step method. Treatment the DHMP **1a** with paraformaldehyde and TMSCl in DCM at 35 °C for 12 h and subsequently adding $NaN_3$ and phenylacetylene **3a** for another 8 h gave the product **4a**. Various copper salts were tested, Cu (I) salts, for example, CuCl, CuBr and CuI all gave good yields (Table 1, entries 1–3). $Cu(OAc)_2\cdot H_2O$ was ineffective and most starting materials (**2**) were recovered (entry 4). Improved yields were obtained when $Cu(OAc)_2\cdot H_2O$/NaAsc and $CuSO_4\cdot 5H_2O$/NaAsc were screened (entries 5 and 6). The reaction was obviously enhanced by addition of $Et_3N$ (entries 7–8). Thus we used $Cu(OAc)_2\cdot H_2O$/NaAsc as the optimal catalyst system.

With the optimized conditions in hand, we used DHPMs and diverse set of alkynes to test the reaction scope. In general, good to excellent yields were obtained under the standard reaction conditions. Therefore, a variety of triazoles **4** were obtained (Table 2), displaying both electron-rich (entries 1–4) as well as functionalized electron-deficient (entries 5 and 6) aryl-substituents of DHPMs, while *o*-chloro group on the phenyl ring give a slightly lower yield (entry 5). Sulfur-containing analogues of DHPMs **1** exhibited a slightly lower reactivity, the yields of the desired products decreased about 20% (entries 9 and 10). The structures of the final product **4d** were characterized by X-ray crystallographic analysis (Fig. 1).[14] Good to moderate yields of desired 1,2,3-triazole derivatives were obtained employing terminal alkynes with different groups, including alkyl and aryl alkynes (entries 11–15).

To explore the scope of differentiated substrates in the one-pot two-step reaction, extensive amides **7** were exposed to the standard reaction conditions at rt, resulting in the formation of 1,2,3-triazole products **8a**–**e** (Table 3). As depicted in Table 3, all the two-step reactions can be carried out at room temperature (rt) within shorter reaction times (total 12 h) and good yields of azide–alkyne cycloaddition products were obtained.

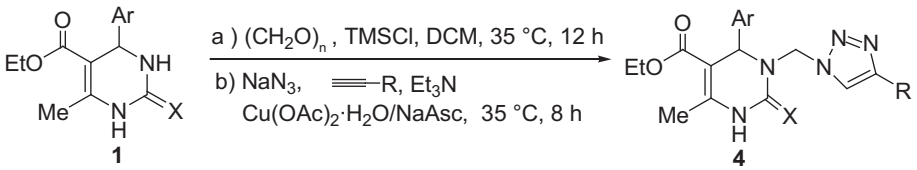
**Table 1**
Optimization of the sequential azide–alkyne cycloaddition[a]




| Entry | Catalysts (mol %) | Base | Time (h) | Yield[b] (%) |
|---|---|---|---|---|
| 1 | CuI (10) | $Et_3N$ | 8 | 73 |
| 2 | CuBr (10) | $Et_3N$ | 8 | 72 |
| 3 | CuCl (10) | $Et_3N$ | 8 | 70 |
| 4 | $Cu(OAc)_2\cdot H_2O$ (20) | $Et_3N$ | 8 | 48 |
| 5 | $Cu(OAc)_2\cdot H_2O$ (20)/NaAsc (40) | $Et_3N$ | 8 | 76 |
| 6 | $CuSO_4\cdot 5H_2O$ (20)/NaAsc (40) | $Et_3N$ | 8 | 73 |
| 7 | $Cu(OAc)_2\cdot H_2O$ (20)/NaAsc (40) | — | 12 | 10 |
| 8 | $Cu(OAc)_2\cdot H_2O$ (20) | — | 12 | 5 |

[a] Reaction conditions: the compound **2a** was prepared to our previous procedure and not isolated. DHPM (**1a**, 0.5 mmol), phenylacetylene (**3a**, 0.6 mmol), triethylamine (1 mmol), catalyst, 35 °C.
[b] Isolated yields.

**Table 2**
Sequential copper-catalyzed synthesis functionalized 1,2,3-triazoles[a]




| Entry | Ar | R | X | Product | Yield (%)[b] |
|---|---|---|---|---|---|
| 1 | Ph | Phenyl | O | **4a** | 76 |
| 2 | 4-$MeC_6H_4$ | Phenyl | O | **4b** | 73 |
| 3 | 4-$ClC_6H_4$ | Phenyl | O | **4c** | 72 |
| 4 | 4-$NO_2C_6H_4$ | Phenyl | O | **4d** | 68 |
| 5 | 2-$ClC_6H_4$ | Phenyl | O | **4e** | 65 |
| 6 | 4-$MeOC_6H_4$ | Phenyl | O | **4f** | 72 |
| 7 | 4-$BrC_6H_4$ | Phenyl | O | **4g** | 75 |
| 8 | 4-$FC_6H_4$ | Phenyl | O | **4h** | 72 |
| 9 | 4-$MeC_6H_4$ | Phenyl | S | **4i** | 57 |
| 10 | 4-$MeOC_6H_4$ | Phenyl | S | **4j** | 56 |
| 11 | Ph | Pentyl | O | **4k** | 73 |
| 12 | 4-$MeC_6H_4$ | Pentyl | O | **4l** | 70 |
| 13 | 4-$MeC_6H_4$ | (4-Nitrophenoxy)methyl | O | **4m** | 73 |
| 14 | 4-$MeOC_6H_4$ | (4-Nitrophenoxy)methyl | O | **4n** | 71 |
| 15 | Ph | (4-Formylphenoxy)methyl | O | **4o** | 69 |

[a] One-pot reaction conditions: (a) DHPMs (0.5 mmol), paraformaldehyde (2 mmol), TMSCl (1.25 mmol), DCM (5 mL), 35 °C, 12 h; (b) $NaN_3$ (1 mmol), alkynes (0.6 mmol), $Cu(OAc)_2{\cdot}H_2O$ (0.1 mmol)/NaAsc (0.2 mmol), $Et_3N$ (1 mmol), 35 °C, 8 h.
[b] Isolated yields of the one-pot method.

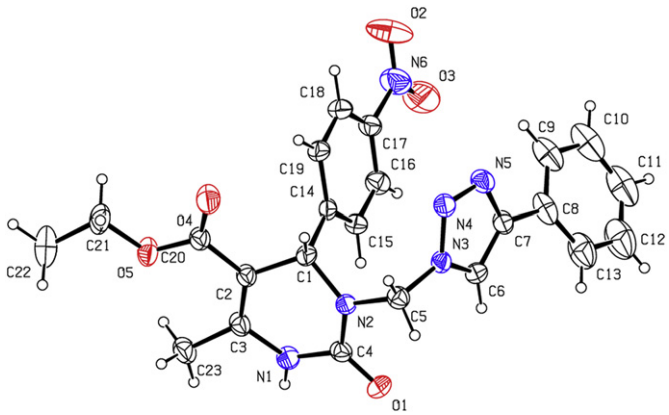



**Fig. 1.** X-ray crystal structure of **4d**.

The unsaturated *N*-methylcinnamamide was also well tolerated (entry 2), as substituted *N*-methylbenzamide and *N*-methyl-2-phenoxyacetamide (entries 3–5).

## 3. Conclusion

In summary, we have developed a one-pot two-step protocol for the synthesis of a series of functionalized 1,2,3-triazoles derivatives in good yields. Especially, *N*-functionalized 1,2,3-triazoles with amide or DHPM were prepared by this method. This procedure eliminates the need to handle organic halides or organic azides, as they are generated in situ, making this already powerful click process even more user-friendly and safe.

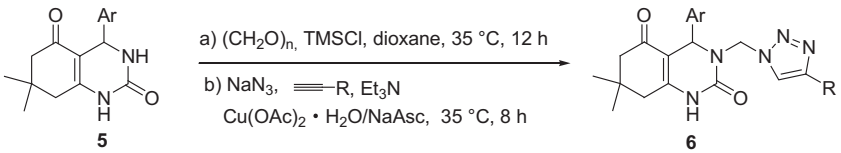
## 4. Experimental section

### 4.1. General

Melting points were determined on an XT-4 electrothermal micromelting point apparatus and uncorrected. NMR spectra were recorded at 400 ($^1$H) and 100 ($^{13}$C) MHz, respectively, on a Varian Mercury plus-400 instrument using $CDCl_3$ and DMSO-$d_6$ as solvent and TMS as internal standard. IR spectra were obtained using an Alpha centauri FTIR spectrophotometer and only major peaks were reported in $cm^{-1}$. Mass-spectra were recorded on a TRACE DSQ instrument. Elemental analyses were performed on a Carlo-Erba 1106 Elemental Analysis instrument. TLC was performed on 5×10 cm aluminium plates coated with silica gel 60F-254 in an appropriate solvent. All reagents were obtained commercially and used without further purification.

### 4.2. General procedure for the synthesis of *N*3-functionalized pyrimidines with 1,2,3-triazole 4

The mixture of 3,4-dihydropyrimidinone (0.5 mmol), paraformaldehyde (2 mmol) and trimethyl chlorosilicane (1.5 mmol) in $CH_2Cl_2$ (5 mL) was stirred vigorously for 12 h at 35 °C. Then, sodium azide (1 mmol), acetylene (0.6 mmol), triethylamine (1 mmol),

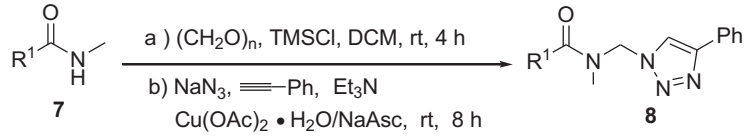


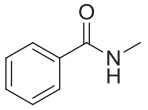
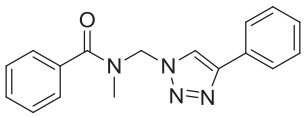
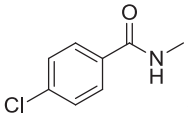
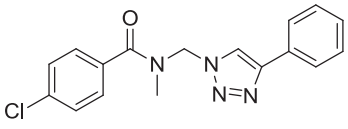
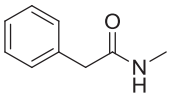
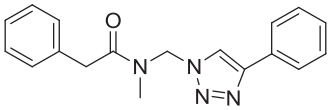
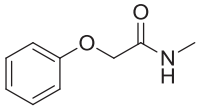
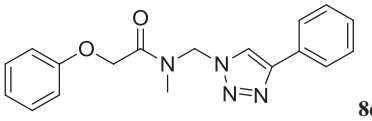
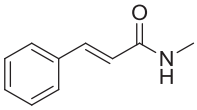
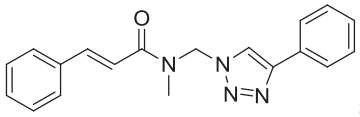

Ar = Ph; R = Ph (**5a, 6a**) Ar = Ph; R = 4-$NO_2C_6H_4OCH_2$ (**5b, 6b**)
Ar = 4-$MeC_6H_4$; R = 4-$NO_2C_6H_4OCH_2$ (**5c, 6c**)

**6a**: 73% **6b**: 70%
**6c**: 71%

**Scheme 3.** One-pot two-step synthesis of functional triazoles from quinazolinones.

**Table 3**
Sequential synthesis of *N*-functionalized 1,2,3-triazoles with amide




| Entry | Material | Product | Yield[a] (%) |
|---|---|---|---|
| 1 |  **7a** |  **8a** | 78 |
| 2 |  **7b** |  **8b** | 69 |
| 3 |  **7c** |  **8c** | 73 |
| 4 |  **7d** |  **8d** | 72 |
| 5 |  **7e** |  **8e** | 71 |

[a] Isolated yield under the reaction condition: (a) amides (0.5 mmol), paraformaldehyde (2 mmol), TMSCl (1.25 mmol), DCM (5 mL), rt, 4 h; (b) $NaN_3$ (1 mmol), alkynes (0.6 mmol), $Cu(OAc)_2 \cdot H_2O$ (0.1 mmol)/NaAsc (0.2 mmol), $Et_3N$ (1 mmol), rt, 8 h.

$Cu(OAc)_2 \cdot H_2O$ (0.01 mmol) and sodium ascorbate (0.02 mmol) were added into the mixture. After completion monitored by TLC, the reaction mixture was quenched into 15 mL of saturated aqueous $NH_4Cl$ solution, mixed and separated. The aqueous phase was extracted with $3\times15$ mL of $CH_2Cl_2$ and the combined organic phases were dried over $Na_2SO_4$ and concentrated. The products were separated by silica gel column chromatography eluted with ethyl acetate/petroleum ether.

For the analogous reaction of the *N*-methyl carbamate **7** (0.5 mmol), the reaction was performed at rt for 4 h (first step) and 8 h (second step) giving the products **8**.

*4.2.1. Ethyl 6-methyl-2-oxo-4-phenyl-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4a**).* White solid, mp 210–212 °C; yield: 76% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.95 (s, 1H, CH), 7.80 (d, $J$=8.8 Hz, 2H, ArH), 7.44 (br s, 1H, NH), 7.42–7.26 (m, 8H, ArH), 6.13 (d, $J$=14 Hz, 1H, $CH_2$), 5.57 (s, 1H, CH), 5.48 (d, $J$=14 Hz, 1H, $CH_2$), 4.06–4.01 (m, 2H, $CH_2$), 2.36 (s, 3H, $CH_3$), 1.15 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.75, 152.33, 148.44, 144.63, 140.58, 130.23, 128.80, 128.77, 128.54, 128.28, 127.71, 125.74, 120.16, 102.74, 60.33, 60.27, 57.64, 18.51, 14.03; IR (KBr): 3218, 3102, 2965, 1708, 1687, 1632, 1456, 1241, 1082, 801 cm$^{-1}$; EI-MS $m/z$: 417 ($M^+$), 271 (100%); Anal. Calcd for $C_{23}H_{23}N_5O_3$ (417.18): C, 66.17; H, 5.55; N, 16.78. Found: C, 66.25; H, 5.47; N, 16.80.

*4.2.2. Ethyl 6-methyl-2-oxo-4-(4-methylphenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4b**).* White solid, mp 204–206 °C; yield: 73% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.09 (s, 1H, NH), 7.90 (s, 1H, CH), 7.79 (d, $J$=8.4 Hz, 2H, ArH), 7.44–7.30 (m, 5H, ArH), 7.11 (d, $J$=8 Hz, 2H, ArH), 6.10 (d, $J$=14 Hz, 1H, $CH_2$), 5.53 (d, $J$=14 Hz, 1H, $CH_2$), 5.52 (s, 1H, CH), 4.06–4.01 (m, 2H, $CH_2$), 2.37 (s, 3H, $CH_3$), 2.27 (s, 3H, $CH_3$), 1.16 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.82, 152.58, 148.39, 144.55, 138.37, 137.68, 130.24, 129.39, 128.78, 128.23, 127.55, 125.70, 120.09, 102.86, 60.23, 60.09, 57.73, 21.06, 18.44, 14.04; IR (KBr): 3223, 3104, 2984, 1708, 1686, 1641, 1460, 1248, 1084, 768 cm$^{-1}$; EI-MS $m/z$: 431 ($M^+$), 285 (100%); Anal. Calcd for $C_{24}H_{25}N_5O_3$ (431.19): C, 66.81; H, 5.58; N, 16.23. Found: C, 66.88; H, 5.57; N, 16.19.

*4.2.3. Ethyl 6-methyl-2-oxo-4-(4-chlorophenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4c**).* White solid, mp 208–210 °C; yield: 72% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.94 (s, 1H, CH), 7.79 (d, $J$=7.2 Hz, 2H, ArH), 7.59 (s, 1H, NH), 7.44–7.28 (m, 7H, ArH), 6.12 (d, $J$=14 Hz, 1H, $CH_2$), 5.55 (s, 1H, CH), 5.48 (d, $J$=14 Hz, 1H, $CH_2$), 4.12–3.98 (m, 2H, $CH_2$), 2.36 (s, 3H, $CH_3$), 1.16 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.54, 152.02, 148.60, 144.74, 139.09, 134.43, 130.10, 129.08, 128.95, 128.84, 128.37, 125.75, 120.11, 102.11, 60.42, 59.67, 57.58, 18.62, 14.07; IR (KBr): 3236, 3122, 2978, 1702, 1681, 1654, 1456, 1261, 1086, 766 cm$^{-1}$; EI-MS $m/z$: 453 ($M^+$+2), 451 ($M^+$), 305 (100%); Anal. Calcd for $C_{23}H_{22}ClN_5O_3$ (451.14): C, 61.13; H, 4.91; N, 15.50. Found: C, 61.21; H, 4.81; N, 16.01.

*4.2.4. Ethyl 6-methyl-2-oxo-4-(4-nitrophenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4d**).* White solid, mp 243–244 °C; yield: 68% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.14 (d, $J$=8.8 Hz, 2H,

ArH), 7.92 (s, 1H, CH), 7.73 (d, $J$=8.4 Hz, 2H, ArH), 7.67 (s, 1H, NH), 7.43–7.32 (m, 5H, ArH), 6.08 (d, $J$=14 Hz, 1H, $CH_2$), 5.70 (s, 1H, CH), 5.61 (d, $J$=14 Hz, 1H, $CH_2$), 4.10–4.06 (m, 2H, $CH_2$), 2.39 (s, 3H, $CH_3$), 1.19 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$=164.46, 151.30, 148.86, 147.72, 146.80, 146.75, 130.24, 128.84, 128.13, 128.02, 125.26, 123.70, 121.34, 100.20, 59.81, 59.04, 58.80, 17.65, 14.06; IR (KBr): 3224, 3130, 2988, 1699, 1672, 1641, 1448, 1344, 1244, 1117, 769 cm$^{-1}$; EI-MS $m/z$: 462 ($M^+$), 300 (100%); Anal. Calcd for $C_{23}H_{22}N_6O_5$ (462.16): C, 59.73; H, 4.79; N, 18.17. Found: C, 59.81; H, 4.70; N, 18.26.

*4.2.5. Ethyl 6-methyl-2-oxo-4-(2-chlorophenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4e**).* White solid, mp 201–203 °C; yield: 65% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.99 (s, 1H, NH), 7.96 (s, 1H, CH), 7.80 (d, $J$=8.4 Hz, 2H, ArH), 7.51 (d, $J$=6.8 Hz, 1H, ArH), 7.42 (t, $J$=8 Hz, 2H, ArH), 7.38–7.22 (m, 5H, ArH), 6.15 (s, 1H, CH), 6.09 (d, $J$=14 Hz, 1H, $CH_2$), 5.53 (d, $J$=14 Hz, 1H, $CH_2$), 4.05–3.98 (m, 2H, $CH_2$), 2.39 (s, 3H, $CH_3$), 1.12 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.62, 152.02, 145.62, 145.64, 137.88, 133.13, 130.77, 130.30, 130.12, 129.89, 128.79, 128.21, 127.55, 125.71, 120.20, 101.21, 60.30, 58.02, 57.90, 18.41, 13.98; IR (KBr): 3225, 3119, 2989, 1703, 1688, 1651, 1458, 1273, 1082, 792 cm$^{-1}$; EI-MS $m/z$: 453 ($M^+$+2), 451 ($M^+$), 305 (100%); Anal. Calcd for $C_{23}H_{22}ClN_5O_3$ (451.14): C, 61.13; H, 4.91; N, 15.50. Found: C, 61.21; H, 4.70; N, 15.89.

*4.2.6. Ethyl 6-methyl-2-oxo-4-(4-methoxylphenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)-methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4f**).* White solid, mp 190–192 °C; yield: 72% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.95 (s, 1H, NH), 7.92 (s, 1H, CH), 7.79 (d, $J$=8.4 Hz, 2H, ArH), 7.44–7.31 (m, 5H, ArH), 6.83 (d, $J$=8.4 Hz, 2H, ArH), 6.11 (d, $J$=14 Hz, 1H, $CH_2$), 5.53 (d, $J$=14 Hz, 1H, $CH_2$), 5.50 (s, 1H, CH), 4.11–3.96 (m, 2H, $CH_2$), 3.73 (s, 3H, $CH_3$), 2.37 (s, 3H, $CH_3$), 1.16 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.83, 159.61, 152.40, 148.43, 144.29, 132.74, 130.22, 128.94, 128.79, 128.26, 125.71, 120.08, 114.03, 102.96, 60.23, 59.76, 57.59, 55.20, 18.46, 14.06; IR (KBr): 3214, 3094, 2956, 1707, 1686, 1638, 1461, 1242, 1086, 772 cm$^{-1}$; EI-MS $m/z$: 447 ($M^+$), 301 (100%); Anal. Calcd for $C_{24}H_{25}N_5O_4$ (447.19): C, 64.42; H, 5.63; N, 15.65. Found: C, 64.53; H, 5.59; N, 15.73.

*4.2.7. Ethyl 6-methyl-2-oxo-4-(4-bromophenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)-methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4g**).* White solid, mp 201–203 °C; yield: 75% (ethyl acetate/petroleum ether: 1/3). $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.93 (s, 1H, CH), 7.79 (d, $J$=7.2 Hz, 2H, ArH), 7.69 (s, 1H, NH), 7.46–7.33 (m, 5H, ArH), 7.30 (d, $J$=8 Hz, 2H, ArH), 6.12 (d, $J$=14 Hz, 1H, $CH_2$), 5.54 (s, 1H, CH), 5.48 (d, $J$=14 Hz, 1H, $CH_2$), 4.10–4.00 (m, 2H, $CH_2$), 2.36 (s, 3H, $CH_3$), 1.17 (t, $J$=7.6 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.53, 152.04, 148.68, 144.79, 139.61, 131.91, 130.09, 129.37, 128.85, 128.37, 125.76, 122.59, 120.10, 102.43, 60.43, 59.74, 57.60, 18.61, 14.08; IR (KBr): 3220, 3118, 2974, 1701, 1683, 1653, 1458, 1260, 1082, 764 cm$^{-1}$; EI-MS $m/z$: 497 ($M^+$+2), 495 ($M^+$), 350 (100%); Anal. Calcd for $C_{23}H_{22}BrN_5O_3$ (495.09): C, 55.65; H, 4.47; N, 14.11. Found: C, 55.76; H, 4.36; N, 14.26.

*4.2.8. Ethyl 6-methyl-2-oxo-4-(4-flourophenyl)-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)-methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4h**).* White solid, mp 206–209 °C; yield: 72% (ethyl acetate/petroleum ether: 1/3). $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=7.95 (s, 1H, CH), 7.79 (d, $J$=8 Hz, 2H, ArH), 7.61 (s, 1H, NH), 7.44–7.32 (m, 5H, ArH), 7.01 (t, $J$=8.8 Hz, 2H, ArH), 6.13 (d, $J$=14 Hz, 1H, $CH_2$), 5.56 (s, 1H, CH), 5.48 (d, $J$=14 Hz, 1H, $CH_2$), 4.12–3.97 (m, 2H, $CH_2$), 2.37 (s, 3H, $CH_3$), 1.15 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.60, 152.06, 148.56, 144.55, 136.46, 130.13, 129.55, 129.47, 128.84, 128.35, 125.72, 120.11, 115.80, 115.59, 102.72, 60.35, 59.60, 57.51, 18.57, 14.05; IR (KBr): 3235, 3114, 2964, 1702, 1680, 1643, 1465, 1241, 1113, 772 cm$^{-1}$; EI-MS $m/z$: 435 ($M^+$), 289 (100%); Anal. Calcd for $C_{23}H_{22}FN_5O_3$ (435.17): C, 63.44; H, 5.09; N, 16.08. Found: C, 63.59; H, 4.98; N, 16.29.

*4.2.9. Ethyl 6-methyl-1-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-2-thioxo-4-p-tolyl-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4i**).* White solid, mp 134–136 °C; yield: 57% (ethyl acetate/petroleum ether: 1/6); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.26 (s, 1H, CH), 7.81 (s, 1H, NH), 7.80 (d, $J$=8.4 Hz, 2H, ArH), 7.44–7.27 (m, 5H, ArH), 7.12 (d, $J$=8.4 Hz, 2H, ArH), 6.82 (d, $J$=14 Hz, 1H, $CH_2$), 5.92 (d, $J$=14 Hz, 1H, $CH_2$), 5.67 (s, 1H, CH), 4.13–4.02 (m, 2H, $CH_2$), 2.34 (s, 3H, $CH_3$), 2.26 (s, 3H, $CH_3$), 1.19 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=176.64, 164.43, 148.19, 140.90, 138.80, 136.97, 130.17, 129.56, 128.77, 128.26, 127.53, 125.79, 120.61, 104.40, 62.44, 60.59, 60.23, 21.07, 18.12, 14.05; IR (KBr): 3126, 3097, 2923, 1703, 1679, 1647, 1535, 1454, 1240, 1159, 1095, 763 cm$^{-1}$; EI-MS $m/z$: 447 ($M^+$), 302 (100%); Anal. Calcd for $C_{24}H_{25}N_5O_2S$ (447.17): C, 64.41; H, 5.63; N, 15.65. Found: C, 64.53; H, 5.57; N, 15.78.

*4.2.10. Ethyl 6-methyl-3-[(4-phenyl-1H-1,2,3-triazol-1-yl)methyl]-2-thioxo-4-(methoxylphenyl)-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4j**).* White solid, mp 165–167 °C; yield: 56% (ethyl acetate/petroleum ether: 1/6); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.27 (s, 1H, CH), 7.99 (s, 1H, NH), 7.80 (d, $J$=7.2 Hz, 2H, ArH), 7.44–7.30 (m, 5H, ArH), 6.85–6.82 (m, 3H, ArH, $CH_2$), 5.92 (d, $J$=14 Hz, 1H, $CH_2$), 5.65 (s, 1H, CH), 4.15–4.01 (m, 2H, $CH_2$), 3.72 (s, 3H, $CH_3$), 2.35 (s, 3H, $CH_3$), 1.18 (t, $J$=7.6 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=176.51, 164.47, 159.86, 148.22, 140.83, 132.08, 130.15, 128.98, 128.78, 125.29, 125.80, 120.59, 114.21, 104.47, 62.31, 60.56, 60.39, 18.04, 14.17, 14.05; IR (KBr): 3124, 3095, 2956, 1708, 1689, 1652, 1539, 1460, 1244, 1161, 763 cm$^{-1}$; EI-MS $m/z$: 463 ($M^+$), 333 (100%); Anal. Calcd for $C_{24}H_{25}N_5O_3S$ (463.17): C, 62.18; H, 5.44; N, 15.11. Found: C, 62.31; H, 5.35; N, 15.26.

*4.2.11. Ethyl 6-methyl-2-oxo-3-[(4-pentyl-1H-1,2,3-triazol-1-yl)methyl]-4-phenyl-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4k**).* White solid, mp 131–133 °C; yield: 73% (ethyl acetate/petroleum ether: 1/4); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.54 (s, 1H, NH), 7.44 (s, 1H, CH), 7.42–7.28 (m, 5H, ArH), 6.04 (d, $J$=14 Hz, 1H, $CH_2$), 5.51 (s, 1H, CH), 5.43 (d, $J$=13.6 Hz, 1H, $CH_2$), 4.09–3.99 (m, 2H, $CH_2$), 2.66 (t, $J$=7.6 Hz, 2H, $CH_2$), 2.38 (s, 3H, $CH_3$), 1.67–1.60 (m, 2H, $CH_2$), 1.37–1.31 (m, 4H, $-CH_2CH_2-$), 1.15 (t, $J$=7.2 Hz, 3H, $CH_3$), 0.90 (t, $J$=7.6 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.89, 152.57, 149.18, 144.66, 138.22, 137.76, 129.35, 127.57, 121.02, 102.80, 60.19, 59.87, 57.38, 31.47, 28.96, 25.59, 22.38, 21.13, 18.40, 14.04, 13.98; IR (KBr): 3230, 3101, 3028, 2958, 1712, 1682, 1639, 1472, 1240, 1085, 761, 703 cm$^{-1}$; EI-MS $m/z$: 411 ($M^+$), 271 (100%); Anal. Calcd for $C_{22}H_{29}N_5O_3$ (411.23): C, 64.21; H, 7.10; N, 17.02. Found: C, 64.31; H, 7.01; N, 17.15.

*4.2.12. Ethyl 6-methyl-2-oxo-3-[(4-pentyl-1H-1,2,3-triazol-1-yl)methyl]-4-p-tolyl-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4l**).* White solid, mp 142–144 °C; yield: 70% (ethyl acetate/petroleum ether: 1/4); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.09 (s, 1H, NH), 7.44 (s, 1H, CH), 7.29 (d, $J$=8 Hz, 2H, ArH), 7.12 (d, $J$=7.6 Hz, 2H, ArH), 6.02 (d, $J$=14 Hz, 1H, $CH_2$), 5.47 (s, 1H, CH), 5.41 (d, $J$=14.4 Hz, 1H, $CH_2$), 4.08–3.99 (m, 2H, $CH_2$), 2.66 (t, $J$=8.8 Hz, 2H, $CH_2$), 2.35 (s, 3H, $CH_3$), 2.33 (s, 3H, $CH_3$), 1.65–1.61 (m, 2H, $CH_2$), 1.37–1.31 (m, 4H, $-CH_2CH_2-$), 1.16 (t, $J$=7.6 Hz, 3H, $CH_3$), 0.90 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.85, 152.74, 149.18, 145.05, 140.73, 128.68, 128.41, 127.66, 121.01, 102.57, 60.18, 60.14, 57.40, 31.42, 28.93, 25.56, 22.36, 18.30, 14.00, 13.95; IR (KBr): 3234, 3114, 2954, 1713, 1686, 1641, 1554, 1470, 1236, 1088, 792, 709 cm$^{-1}$; EI-MS $m/z$: 425 ($M^+$), 285 (100%); Anal. Calcd for $C_{23}H_{31}N_5O_3$ (425.24): C, 64.92; H, 7.34; N, 16.46. Found: C, 65.03; H, 7.25; N, 16.59.

*4.2.13. Ethyl 6-methyl-2-oxo-4-p-tolyl-3-[(4-(4-(nitrophenoxy)methyl)-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4m**).* White solid; mp 194–196 °C; yield: 73% (ethyl

acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.21 (d, $J$=9.2 Hz, 2H, ArH), 7.87 (s, 1H, CH), 7.58 (s, 1H, NH), 7.28 (d, $J$=7.6 Hz, 2H, ArH), 7.13 (d, $J$=8 Hz, 2H, ArH), 7.08 (d, $J$=7.6 Hz, 2H, ArH), 6.07 (d, $J$=13.6 Hz, 1H, $CH_2$), 5.50 (s, 1H, CH), 5.46 (d, $J$=13.6Hz, 1H, $CH_2$), 5.26 (s, 2H, $CH_2$), 4.09–4.00 (m, 2H, $CH_2$), 2.34 (s, 3H, $CH_3$), 2.32 (s, 3H, $CH_3$), 1.17 (t, $J$=7.6 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.78, 163.06, 152.30, 144.27, 143.32, 138.46, 137.54, 129.47, 127.54, 125.95, 123.86, 114.79, 102.94, 62.29, 60.33, 60.26, 57.80, 21.15, 18.53, 14.06; IR (KBr): 3230, 3112, 2980, 1716, 1688, 1641, 1472, 1224, 1085, 792 cm$^{-1}$; EI-MS $m/z$: 506 ($M^+$), 271 (100%); Anal. Calcd for $C_{25}H_{26}N_6O_6$ (506.19): C, 59.28; H, 5.17; N, 16.59. Found: C, 59.36; H, 5.07; N, 16.71.

*4.2.14. Ethyl 6-methyl-2-oxo-4-(4-methoxylphenyl)-3-[(4-(4-(nitrophenoxy)methyl)-1H-1,2,3-triazol-1-yl)methyl]-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4n**).* White solid, mp 180–182 °C; yield: 71% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.21 (d, $J$=9.2 Hz, 2H, ArH), 7.87 (s, 1H, CH), 7.87 (s, 1H, NH), 7.32 (d, $J$=8.8 Hz, 2H, ArH), 7.08 (d, $J$=7.4 Hz, 2H, ArH), 6.83 (d, $J$=8.8 Hz, 2H, ArH), 6.06 (d, $J$=14 Hz, 1H, $CH_2$), 5.49 (d, $J$=13.6 Hz, 1H, $CH_2$), 5.48 (s, 1H, CH), 5.26 (s, 2H, $CH_2$), 4.10–4.01 (m, 2H, $CH_2$), 3.79 (s, 3H, $CH_3$), 2.35 (s, 3H, $CH_3$), 1.17 (t, $J$=7.6 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=164.81, 1163.04, 159.66, 152.37, 144.18, 143.33, 141.88, 132.61, 128.88, 125.93, 123.82, 114.78, 114.08, 102.99, 62.26, 60.31, 60.01, 57.77, 55.27, 18.46, 14.08; IR (KBr): 3228, 3112, 2963, 1709, 1689, 1645, 1465, 1238, 1113, 1082, 796 cm$^{-1}$; EI-MS $m/z$: 522 ($M^+$), 301 (100%); Anal. Calcd for $C_{25}H_{26}N_6O_7$ (522.19): C, 57.47; H, 5.02; N, 16.08. Found: C, 57.59; H, 4.92; N, 16.17.

*4.2.15. Ethyl 6-methyl-3-[(4-(4-formylphenoxy)methyl)-1H-1,2,3-triazol-1-yl]methyl]-2-oxo-4-phenyl-1,2,3,4-tetrahydropyrimidine-5-carboxylate (**4o**).* White solid, mp 165–167 °C; yield: 69% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=9.90 (s, 1H, CHO), 7.86 (s, 1H, CH), 7.85 (d, $J$=7.2 Hz, 2H, ArH), 7.54 (s, 1H, NH), 7.40–7.28 (m, 5H, ArH), 7.10 (d, $J$=8.8 Hz, 2H, ArH), 6.06 (d, $J$=14 Hz, 1H, $CH_2$), 5.54 (s, 1H, CH), 5.49 (d, $J$=14 Hz, 1H, $CH_2$), 5.27 (s, 2H, $CH_2$), 4.10–4.01 (m, 2H, $CH_2$), 2.35 (s, 3H, $CH_3$), 1.16 (t, $J$=7.2 Hz, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=190.76, 164.70, 163.06, 152.24, 144.50, 143.77, 140.51, 132.00, 130.34, 128.77, 128.55, 127.59, 123.68, 115.01, 102.82, 61.95, 60.55, 60.33, 57.89, 18.55, 14.05; IR (KBr): 3230, 3109, 2850, 1689, 1643, 1556, 1461, 1244, 1157, 875, cm$^{-1}$; EI-MS $m/z$: 475 ($M^+$), 271 (100%); Anal. Calcd for C25H25N5O5 (475.19): C, 63.15; H, 5.30; N, 14.73. Found: C, 63.29; H, 5.21; N, 14.82.

*4.2.16. 7,7-Dimethyl-4-phenyl-3-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)-3,4,7,8-tetrahydroquinazoline-2,5(1H,6H)-dione (**6a**).* White solid, mp 172–174 °C; yield: 73% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.32 (br s, 1H, NH), 7.96 (s, 1H, CH), 7.80 (d, $J$=7.2 Hz, 2H, ArH), 7.46–7.31 (m, 8H, ArH), 6.18 (d, $J$=14 Hz, 1H, $CH_2$), 5.64 (s, 1H, CH), 5.50 (d, $J$=14 Hz, 1H, $CH_2$), 2.43–2.27 (m, 2H, $CH_2$), 2.22–2.11 (m, 2H, $CH_2$), 1.09 (s, 3H, $CH_3$), 0.96 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=193.13, 152.56, 148.11, 140.06, 130.27, 128.91, 128.82, 128.53, 128.31, 127.41, 125.77, 120.26, 110.15, 58.59, 57.97, 50.11, 40.12, 32.78, 29.34, 27.17; IR (KBr): 3226, 3118, 2955, 2887, 1689, 1668, 1641, 1554, 1450, 1337, 1259, 1089, 769 cm$^{-1}$; EI-MS $m/z$: 427 ($M^+$), 281 (100%); Anal. Calcd for $C_{25}H_{25}N_5O_2$ (427.20): C, 70.24; H, 5.89; N, 16.38. Found: C, 70.31; H, 5.76; N, 16.72.

*4.2.17. 7,7-Dimethyl-3-((4-((4-nitrophenoxy)methyl)-1H-1,2,3-triazol-1-yl)methyl)-4-phenyl-3,4,7,8-tetrahydroquinazoline-2,5(1H,6H)-dione (**6b**).* White solid, mp 196–199 °C; yield: 70% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.21 (d, $J$=8.4 Hz, 2H, ArH), 8.03 (s, 1H, CH), 7.91 (s, 1H, NH), 7.41–7.29 (m, 5H, ArH), 7.07 (d, $J$=8 Hz, 2H, ArH), 6.15 (d, $J$=13.2 Hz, 1H, $CH_2$), 5.60 (s, 1H, CH), 5.50 (d, $J$=12.8 Hz, 1H, $CH_2$), 5.26 (s, 2H, $CH_2$), 2.42–2.26 (m, 2H, $CH_2$), 2.22–2.11 (m, 2H, $CH_2$), 1.09 (s, 3H, $CH_3$), 0.95 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=193.18, 163.00, 152.31, 148.09, 142.18, 139.89, 128.88, 128.52, 127.24, 125.92, 114.78, 110.13, 109.88, 62.03, 58.64, 58.21, 50.07, 40.10, 32.79, 29.25, 27.18; IR (KBr): 3232, 3112, 2960, 1679, 1677, 1636, 1595, 1497, 1443, 1377, 1248, 1110, 784 cm$^{-1}$; EI-MS $m/z$: 502 ($M^+$), 281 (100%); Anal. Calcd for $C_{26}H_{26}N_6O_5$ (502.20): C, 62.14; H, 5.21; N, 16.72. Found: C, 62.23; H, 5.11; N, 16.79.

*4.2.18. 7,7-Dimethyl-3-((4-((4-nitrophenoxy)methyl)-1H-1,2,3-triazol-1-yl)methyl)-4-p-tolyl-3,4,7,8-tetrahydroquinazoline-2,5(1H,6H)-dione (**6c**).* White solid, mp 220–222 °C; yield: 71% (ethyl acetate/petroleum ether: 1/2); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.21 (d, $J$=9.2 Hz, 2H, ArH), 7.85 (s, 1H, CH), 7.75 (s, 1H, NH), 7.30 (d, $J$=8 Hz, 2H, ArH), 7.13 (d, $J$=8 Hz, 2H, ArH), 7.07 (d, $J$=9.2 Hz, 2H, ArH), 6.13 (d, $J$=14.0 Hz, 1H, $CH_2$), 5.53 (s, 1H, CH), 5.43 (d, $J$=14.0 Hz, 1H, $CH_2$), 5.26 (s, 2H, $CH_2$), 2.40–2.23 (m, 2H, $CH_2$), 2.31 (s, 3H, $CH_3$), 2.21–2.10 (m, 2H, $CH_2$), 1.08 (s, 3H, $CH_3$), 0.96 (s, 3H, $CH_3$). $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=193.19, 163.02, 147.82, 143.21, 138.42, 136.92, 129.59, 127.28, 125.94, 123.82, 114.78, 110.20, 109.73, 62.31, 58.33, 57.88, 50.09, 40.15, 32.80, 29.27, 27.22, 21.16; IR (KBr): 3231, 3102, 2951, 1682, 1675, 1647, 1589, 1481, 1439, 1341, 1253, 1097, 792 cm$^{-1}$; EI-MS $m/z$: 516 ($M^+$), 295 (100%); Anal. Calcd for $C_{26}H_{26}N_6O_5$ (516.21): C, 62.78; H, 5.46; N, 16.27. Found: C, 62.85; H, 5.39; N, 16.31.

*4.2.19. N-Methyl-N-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)benzamide (**8a**).* White solid, mp 121–123 °C; yield: 78% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.25 (s, 1H, CH), 7.88 (d, $J$=8 Hz, 2H, ArH), 7.47–7.34 (m, 8H, ArH), 6.02 (s, 2H, $CH_2$), 3.15 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=148.41, 134.04, 130.78, 130.22, 128.85, 128.32, 127.39, 125.97, 125.76, 120.80, 60.37, 37.11; IR (KBr): 3055, 2962, 1641, 1620, 1552, 1477, 1460, 1392, 1236, 1068, 874 cm$^{-1}$; EI-MS $m/z$: 292 ($M^+$), 105 (100%); Anal. Calcd for $C_{17}H_{16}N_4O$ (292.13): C, 69.85; H, 5.52; N, 19.17. Found: C, 69.96; H, 5.42; N, 19.26.

*4.2.20. 4-Chloro-N-methyl-N-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)benzamide (**8b**).* White solid, mp 152–154 °C; yield: 69% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) 8.22 (s, 1H, CH), 7.78 (d, $J$=7.6 Hz, 2H, ArH), 7.46–7.26 (m, 7H, ArH), 5.99 (s, 2H, $CH_2$), 3.14 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=171.54, 148.38, 136.99, 132.36, 130.13, 128.95, 128.83, 128.33, 125.71, 120.78, 60.30, 37.10; IR (KBr): 3051, 2968, 1649, 1604, 1552, 1458, 1375, 1227, 1074, 768 cm$^{-1}$; EI-MS $m/z$: 328 ($M^+$+2), 326 ($M^+$), 139 (100%); Anal. Calcd for $C_{17}H_{15}N_4O$ (326.09): C, 62.48; H, 4.63; N, 17.15. Found: C, 62.52; H, 4.55; N, 17.23.

*4.2.21. N-Methyl-2-phenyl-N-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)acetamide (**8c**).* White solid, mp 98–100 °C; yield: 73% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.06 (s, 1H, CH), 7.83 (d, $J$=7.6 Hz, 2H, ArH), 7.46–7.27 (m, 6H, ArH), 7.20 (d, $J$=7.2 Hz, 2H, ArH), 5.88 (s, 2H, $CH_2$), 3.74 (s, 2H, $CH_2$), 3.19 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz, $CDCl_3$) $\delta$=172.54, 148.30, 133.54, 130.26, 129.38, 128.84, 128.80, 128.24, 127.21, 125.70, 120.55, 60.57, 40.71, 35.56; IR (KBr): 3061, 2967, 1646, 1629, 1478, 1398, 1236, 1072, 874 cm$^{-1}$; EI-MS $m/z$: 306 ($M^+$), 119 (100%); Anal. Calcd for $C_{18}H_{18}N_4O$ (306.15): C, 70.57; H, 5.92; N, 18.29. Found: C, 70.69; H, 5.81; N, 18.36.

*4.2.22. N-Methyl-2-phenoxy-N-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)acetamide (**8d**).* White solid, mp 125–127 °C; yield: 72% (ethyl acetate/petroleum ether: 1/3); $^1$H NMR (400 MHz, $CDCl_3$) $\delta$=8.00 (s, 1H, CH), 7.81 (d, $J$=8.8 Hz, 2H, ArH), 7.45–7.26 (m, 5H, ArH), 6.99 (t, $J$=7.4 Hz, 1H, ArH), 6.92 (d, $J$=8 Hz, 2H, ArH), 5.87 (s, 2H, $CH_2$), 4.73 (s, 2H, $CH_2$), 3.24 (s, 3H, $CH_3$); $^{13}$C NMR (100 MHz,

$CDCl_3$) $\delta$=169.47, 157.39, 148.40, 130.09, 129.64, 128.79, 128.29, 125.69, 121.97, 120.44, 114.53, 66.65, 60.45, 34.41; IR (KBr): 3056, 2964, 1641, 1591, 1461, 1323, 1234, 1068, 871 $cm^{-1}$; EI-MS *m*/*z*: 322 ($M^+$), 107 (100%); Anal. Calcd for $C_{18}H_{18}N_4O_2$ (322.14): C, 67.07; H, 5.63; N, 17.38. Found: C, 67.19; H, 5.53; N, 17.49.

*4.2.23. N-Methyl-N-((4-phenyl-1H-1,2,3-triazol-1-yl)methyl)cinnamamide (**8e**).* White solid, mp 129–131 °C; yield: 71% (ethyl acetate/petroleum ether: 1/3); $^1H$ NMR (400 MHz, $CDCl_3$) $\delta$=8.13 (s, 1H, CH), 7.85 (d, *J*=8 Hz, 2H, ArH), 7.80 (d, *J*=15.4 Hz, 1H, CH), 7.58–7.51 (m, 2H, ArH), 7.47–7.27 (m, 6H, ArH), 6.84 (d, *J*=15.4 Hz, 1H, CH), 5.99 (s, 2H, $CH_2$), 3.33 (s, 3H, $CH_3$), $^{13}C$ NMR (100 MHz, $CDCl_3$) $\delta$=167.57, 148.28, 145.23, 134.46, 130.30, 128.81, 128.10, 125.69, 120.59, 115.62, 60.75, 35.13; IR (KBr): 3024, 2920, 1677, 1639, 1600, 1498, 1446, 1253, 1068, 875 $cm^{-1}$; EI-MS *m*/*z*: 318 ($M^+$), 107 (100%); Anal. Calcd for $C_{19}H_{18}N_4O$ (318.15): C, 71.68; H, 5.70; N, 17.60. Found: C, 71.79; H, 5.61; N, 17.49.

## Acknowledgements

We are thankful for the financial support from the National Nature Science Foundation of China (Nos. 20902073 and 21062017), the Natural Science Foundation of Gansu Province (No. 096RJZA116), and the Scientific and Technological Innovation Engineering program of Northwest Normal University (Nos. nwnu-kjcxgc-03-64, nwnulkqn-10-15).

## Supplementary data

These data include the copies of the NMR of the compounds described in this article. Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.tet.2012.10.097.

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14. Crystal data for **4d**: formula: $C_{23}H_{22}N_6H_5$; unit cell parameters: $a$=29.117 (17), $b$=12.967 (8), $c$=12.067 (8); $\alpha$=90, $\beta$=90, $\gamma$=90. These data can be obtained free of charge. CCDC 856182 (**4d**) contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.