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One-Pot Synthesis of Triazoloquinazolinones *via* Copper-Catalyzed Tandem Click and Intramolecular C–H Amidation

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Abstract: A novel and highly efficient copper-catalyzed tandem synthesis of triazoloquinazolinones is explored. The synthetic strategy involves a sequential one-pot click reaction followed by aerobic intramolecular C–H amidation. Two distinct and important transformations were carried out in one-pot by employing a single cost-effective copper catalyst. The milder, rapid and ligand-free reaction conditions as well as a broader substrate scope are the salient features of this novel protocol.

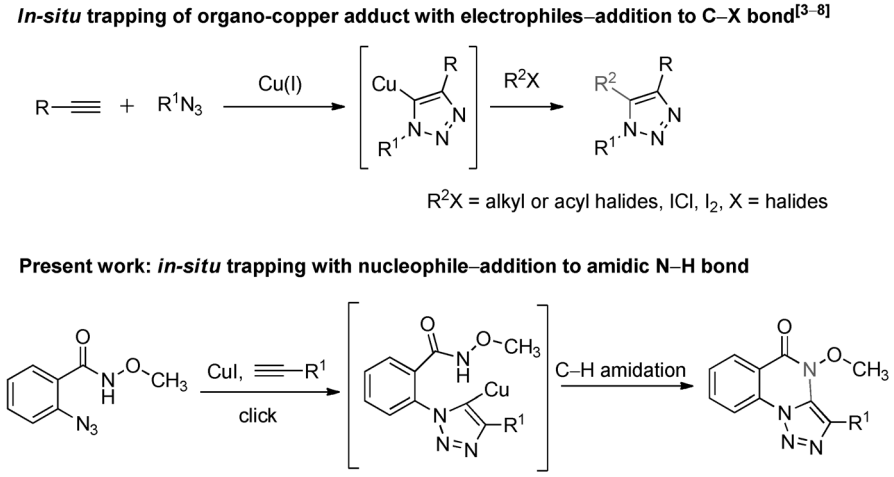
Keywords: C–H amidation; copper-catalyzed reaction; one-pot protocol; tandem reactions; triazoloquinazolinones

Introduction

The copper-catalyzed azide–alkyne cycloaddition (CuAAC) reaction fusing organic azides and terminal alkynes is one of the most powerful synthetic tools to synthesize triazoles by virtue of simple reaction conditions, broader substrate scope and exceptional atom economy. This transformation has a wide range of applications in the fields of organic chemistry, medicinal chemistry, chemical biology and materials science.[1] It is known that this copper-catalyzed cycloaddition proceeds with the formation of a copper-triazole adduct as a reactive intermediate which undergoes rapid protonation to furnish the triazole product.[2] Recently this organo-copper adduct was employed as an intermediate for the *in-situ* functionalization of the triazole by trapping with an excess of electrophiles such as ICl, alkyl, aryl and acyl halides.[3] Jeng et al. utilized ICl as a trapping agent for the formation of 5-iodotriazole as a suitable substrate for the various cross-coupling reactions.[4] In addition, cuprated triazoles were caught successfully with excess allyl iodides by Zhang et al.[5] Very recently, Ding and co-workers demonstrated the intramolecular interception of 5-cuprated 1,2,3-triazoles with aryl iodides for the Ullmann coupling reaction.[6] Van der Eycken's group also carried out a post-Ugi modification with the organocopper intermediate for C–N bond formation.[7] Predominantly, these transformations involve the insertion of the intermediate into the electrophilic carbon-halide bond of electrophiles which requires stoichiometric copper catalysts and excess of trapping agents.[3–5] In the current study, we have contemplated and explored the notion that it is possible to couple the triazole formation with C–H amidation for C–N bond formation by intramolecular trapping of the nucleophilic amidic N–H bond at ambient temperature[8] (Scheme 1).

Metal-catalyzed cross-coupling reactions are one of the most powerful methods available for the construction of carbon-carbon and carbon-heteroatom bonds. Most C–H bond activations have been demonstrated on expensive palladium, rhodium and ruthenium complexes.[9] Currently copper-catalyzed C–H functionalization is receiving much attention because of the harmless and inexpensive copper catalysts. For instance, many copper-catalyzed C–H amidation/amination reactions were developed for the functionalization of various heterocycles such as azoles, benzimidazoles and imidazoles.[10]

Triazoloquinazolinones are an important class of nitrogen-containing heterocycles which exhibit a wide range of biological applications such as anticancer and antihypertensive agents. These tricyclic heterocycles show moderate affinity towards benzodiazepine receptors, A_1 and A_{2A} adenosine receptors and they can act as ligands against $GABA_A$ receptors.[11–14] Additionally, the 1,2,3-triazole core is a prominent structural motif in medicinal chemistry and is frequently found in medicinally important compounds.[15] Given the prevalence of this privileged core in biologically active molecules, it has received relatively less atten-



Scheme 1. Synthetic strategy for the formation of triazoloquinazolinones *via* one-pot CuAAC C–H amidation.

tion so far and the direct synthetic methods available in the literature are very limited. The only common approach available for the synthesis of 1,2,3-triazoloquinazolines is the reaction of azidobenzoic acid with substituted acetonitriles.[16] Prerequisite starting materials, longer reaction times, harsh reaction conditions are some of the setbacks associated with this method. Hence there is a demand for an elegant and alternate strategy to access this attractive scaffold. We demonstrate here that triazole synthesis can be coupled with intramolecular C–N bond formation for the rapid assembly of biologically important triazoloquinazolinones. Notably, there is no example of constructing N-heterocycles *via* sequential click reaction with aerobic oxidative C–H amidation. This unprecedented transformation uses air rather than metal salts as the oxidant and proceeds under very mild conditions without the use of any ligands or additives.

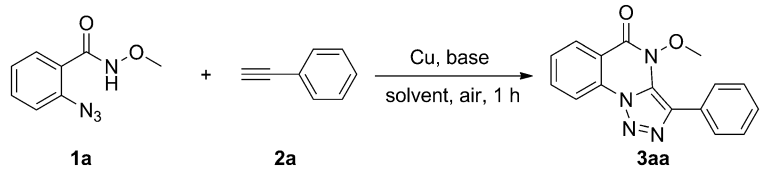
Results and Discussion

To explore the idea of trapping the organo-copper intermediate in the copper-catalyzed click reaction, we commenced our study with the reaction of various benzamides and phenylacetylene. Benzamide and *N*-butyl-/*N*-arylbenzamides did not yield the desired products in this transformation but furnished only the uncyclized triazoles. Interestingly *N*-methoxybenzamide **1a** (1 equiv.) with phenyl acetylene **2a** (1 equiv.) and diisoproylethylamine (DIPEA) (1.2 equiv.) in the presence of CuI (10 mol%) in THF under air at room temperature for 1 h delivered the cyclized product **3aa** in 80% yield (Table 1, entry 1). Screening of the various copper sources revealed that CuI is the most suitable catalyst for this transformation. Among the other copper sources tested, a relatively lower yield was observed in the case of CuBr (25%) and CuCl (30%) (Table 1, entries 2 and 3). No reaction was observed with $Cu(OAc)_2$ and $CuSO_4{\cdot}5H_2O$ in the presence of sodium ascorbate as an additive (Table 1, entries 4 and 5). Also, the reaction did not proceed at all in the absence of either copper catalyst or base (Table 1, entries 6 and 7). It was found that employing DIPEA as the base showed best transformation (entry 1, 80%) and a relatively lower yield (52%) was obtained when Et_3N was used as base (entry 8). The various inorganic bases such as K_2CO_3, Cs_2CO_3 and NaOAc were less effective. From the brief survey of various solvents, THF was chosen as the optimal solvent. Other solvents such as acetone, DCM and DMF gave the products in poor yields under the same conditions (Table 1, entries 12, 13 and 15). However, when methanol was used as the solvent, the reaction ceased with the non-cyclized product (**4aa** in Scheme 4) and only traces of the fused product were observed (Table 1, entry 14).

From this observation, it is inferred that, in the presence of a protic solvent, the triazole-copper adduct undergoes rapid protonation rather than cyclization. An attempt to utilize oxygen as an oxidant and an increase in temperature did not improve the reaction yield. Only a trace amount of product was observed when the reaction was performed under a nitrogen atmosphere and the large amount of uncyclized triazole product **4aa** was isolated. (Table 1, entry 16) This anticipated result confirmed that the oxygen in the air acts as a primary oxidant for this C–H amidation. Finally the most favorable conditions were identified as 10 mol% CuI, 1.2 equivalents of DIPEA as a base in THF at room temperature for one hour.

Subsequently, we probed into the scope and generality of this domino process under the optimized conditions. As shown in Scheme 2, various substituted 2-azido-*N*-methoxybenzamides could be converted into

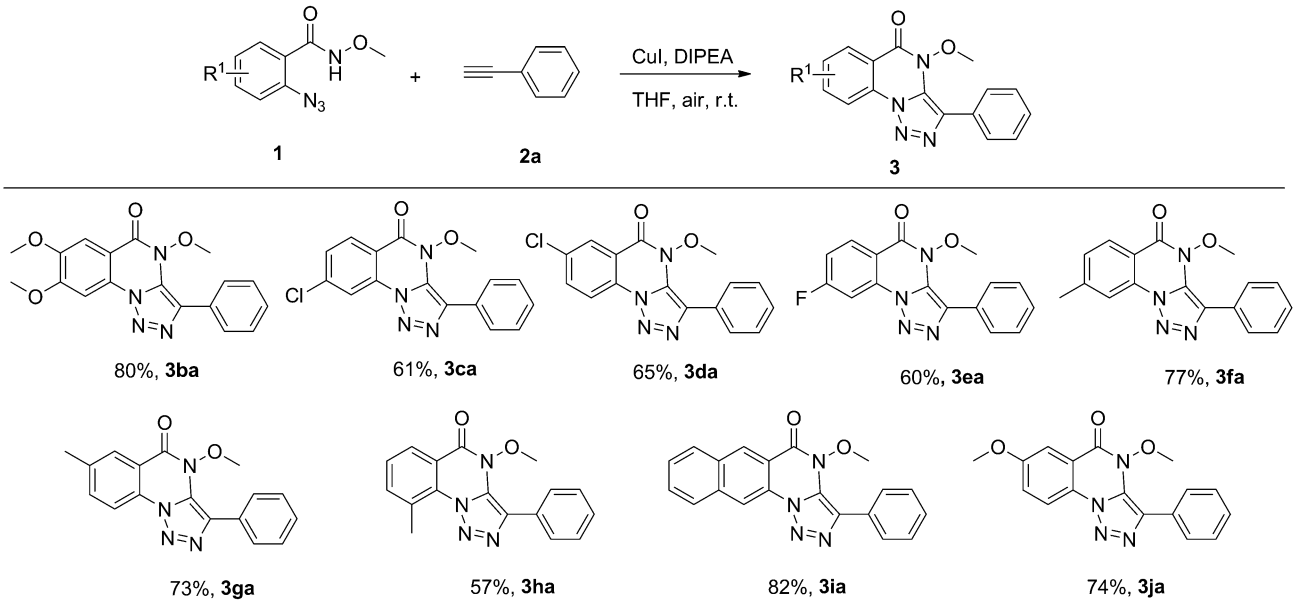
Table 1. Optimization of the conditions for the reaction of 2-azido-*N*-methoxybenzamide**1a** and phenylacetylene **2a**.[a]



1a **2a** **3aa**

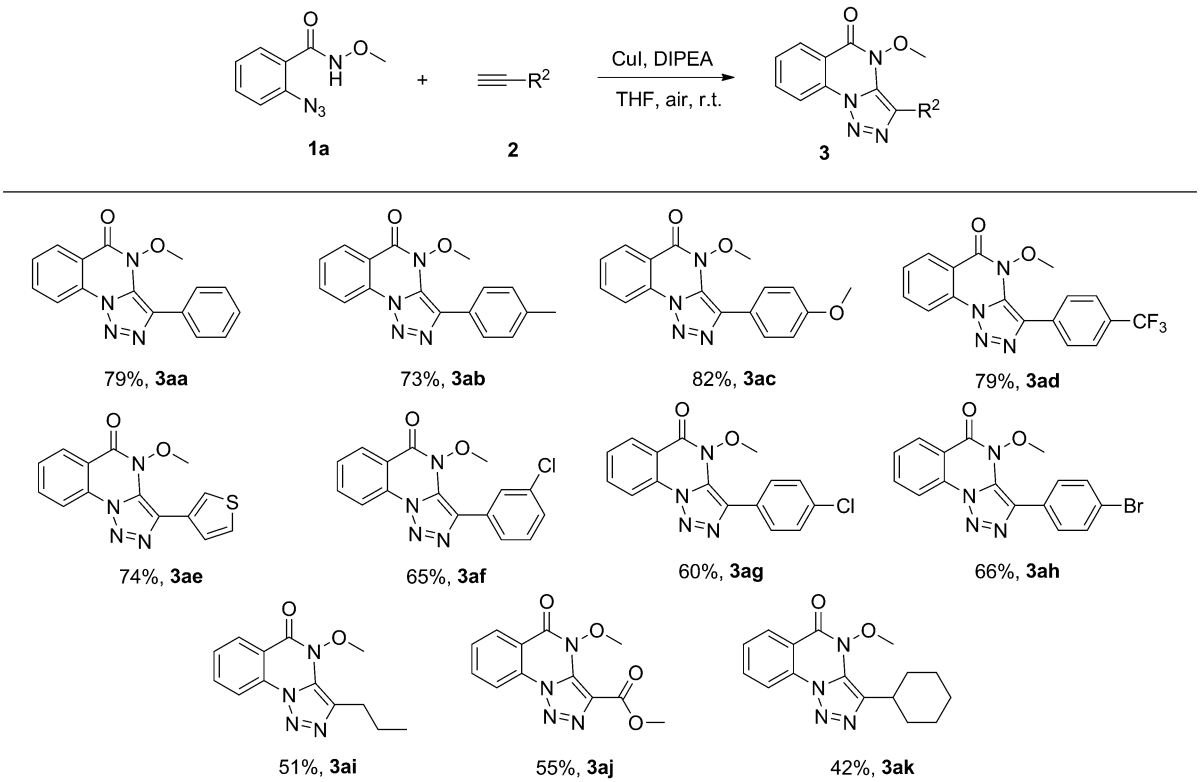
Entry	Catalyst	Base	Solvent	Yield [%][b]
1	CuI	DIPEA	THF	80
2	CuBr	DIPEA	THF	30
3	CuCl	DIPEA	THF	25
4	$Cu(OAc)_2$	DIPEA	THF	5[c]
5	$CuSO_4 \cdot 5H_2O$	DIPEA	$EtOH/H_2O$	0[c]
6	–	DIPEA	THF	0
7	CuI	–	THF	0
8	CuI	Et_3N	THF	52
9	CuI	K_2CO_3	THF	35
10	CuI	Cs_2CO_3	THF	22
11	CuI	NaOAc	THF	20
12	CuI	DIPEA	acetone	41
13	CuI	DIPEA	DCM	36
14	CuI	DIPEA	MeOH	5[d]
15	CuI	DIPEA	DMF	43
16	CuI	DIPEA	THF	8[e]

[a] *Reaction conditions:* **1a** (0.3 mmol), **2a** (0.3 mmol), catalyst (10 mol%), base (0.36 mmol), solvent (2 mL) under air at room temperature.
[b] Isolated yield.
[c] Added sodium ascorbate as an additive.
[d] Large amount of non-cyclized product (**4aa**) isolated.
[e] Under nitrogen.



Scheme 2. Substrate scope for the reaction of 2-azido-*N*-methoxybenzamides **1** and phenylacetylene **2a**.

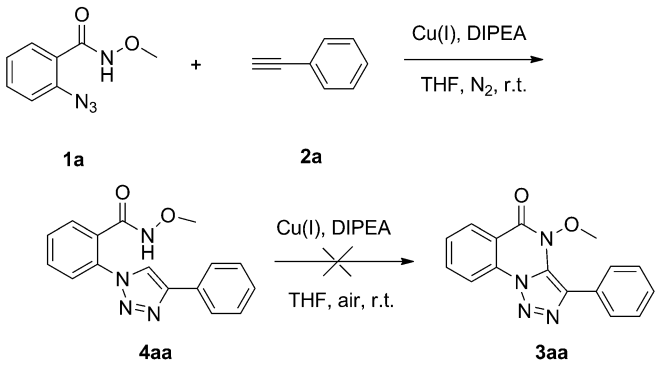
their corresponding products in good to excellent yields. Results showed that 2-azido-*N*-methoxybenzamides substituted with a methyl group at various positions could react with phenylacetylene in good yields (Scheme 3, **3fa**, **3ga** and **3ha**). The substitution at an *ortho* position retards the reaction with a longer



Scheme 3. Substrate scope for the reaction of 2-azido-*N*-methoxybenzamide **1a** and terminal alkynes **2**.

reaction time (6 h) and diminished yield (57%) possibly due to its steric hindrance (Scheme 3, **3ha**).

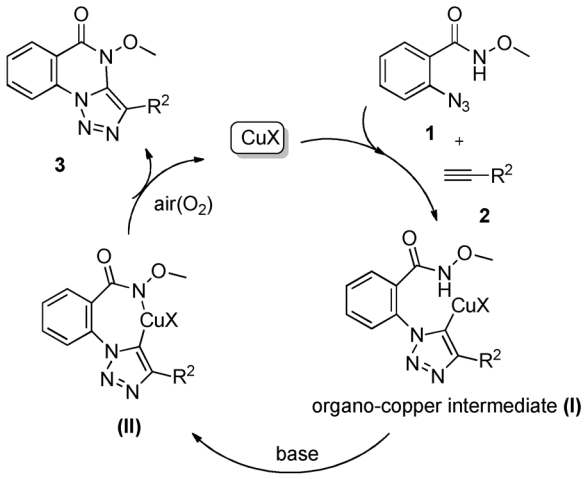
Electron-withdrawing substrates such as those with chloro, and fluoro substituents at the aromatic ring of 2-azido-*N*-methoxybenzamides were all well tolerated with moderate yields which provided the possibility for further derivatization (Scheme 3, **3ca**, **3da**, **3ea**). Interestingly substrates with electron-donating methoxy substitutents and naphthyl-substituted azidoamides furnished the desired products in good yields (Scheme 2, **3ba**, **3ia** and **3ja**). Thus, the electronic nature of the substituent on the aromatic ring exerted a considerable influence on the reactivity. The substrates containing electron-donating groups at various position provided better yields and those with electron-withdrawing groups furnished the products in diminished yields. It is possible that the electron-withdrawing groups may weaken the stability of the intermediate during the cyclization process. The reaction scope with respect to the alkyne coupling partner was also investigated and it was found to be compatible with a variety of different terminal alkynes, including alkyl-, aryl-, and heterocyclic alkynes. For some of the aromatic alkynes, we observed the homocoupling diyne as a side product with the very minimum yields (1–5%) under these conditions.



Scheme 4. Control experiments for the formation of **3aa**.

Both electron-rich and electron-deficient terminal alkynes react smoothly to furnish the desired products. Many valuable functional groups such as methyl, methoxy, chloro, bromo, and CF_3 (Scheme 3, **3ab**, **3ac**, **3ad**, **3ag**, **3ah**, **3ai**) were well tolerated to provide ample opportunity for further functionalization of the products. Importantly terminal alkynes containing the heterocyclic thiophene moiety smoothly reacted to furnish the corresponding triazoloquinazolinones in 74% yields. It is worthy of mention that aliphatic linear as well as cyclic terminal alkynes, e.g., pent-1-yne, methyl propiolate and ethynylcyclohexane, could also be converted into the target compound which broadens the substrate scope (Scheme 3, **3ai**, **3aj**, **3ak**).

Control experiments were performed to elucidate the reaction mechanism for the synthesis of quinazoli-



Scheme 5. Plausible mechanism for the formation of **3**.

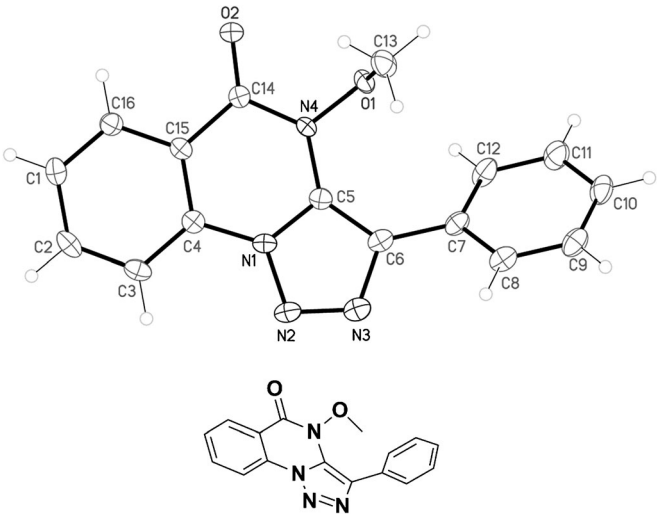


Figure 1. ORTEP diagram of compound **3aa**.

none derivatives as shown in Scheme 4. When the reaction was carried out under a nitrogen atmosphere (exclusion of air), the target product was formed only in a trace amount and the reaction furnished the non-cyclized compound **4aa** as the major product. This indicates that the subsequent intramolecular C–H amidation requires oxygen as the oxidant. Furthermore, the reaction of compound **4aa** under the optimized conditions did not progress to the final product which suggests that the transformation is concerted and excludes the two-step sequential pathway.[1f] Although the mechanism of copper-catalyzed C–N bond formation has been proposed, the details remain uncertain where the possibility of both Cu^{2+} and Cu^{3+} intermediates was discussed.[17] Based on the aforementioned observations and earlier literature evidence, a putative mechanism for the one-pot synthesis of triazoloquinazolinones by this novel copper-catalyzed domino reaction is proposed in Scheme 5.[4–8]

Initially, the reactive C–Cu intermediate (**I**) was formed during the copper-catalyzed azide–alkyne cycloaddition which then inserted into the amidic N–H bond in the presence of base to furnish the cyclized intermediate (**II**). Upon reductive elimination, the intermediate (**II**) provided the desired product under an aerobic atmosphere. An alternative pathway could be the initial formation of a base-promoted copper-benzamidato complex which would then catalyze the cycloaddition followed by C–N bond formation. However, the isolation of uncyclized triazole product during the control experiments and the major formation of this product in a protic solvent (Table 1, entry 14) exclude this possible pathway. Finally, the structure of the newly synthesized triazoloquinazolinones was unambigously ascertained by single crystal X-ray diffraction studies[18] (Figure 1).

Conclusions

An unprecedented one-pot protocol for the synthesis of triazoloquinazolinones by the reaction of azidoamides and terminal alkynes was successfully discovered. The overall domino process comprising the formation of a C–N bond and two new rings involves an initial intramolecular trapping of the organocopper intermediate with amide and subsequent C–H amidation. This protocol features air as the oxidant, ligand-free reaction conditions, impressive substrate scope for both coupling partners and excellent functional group tolerance. The accessibility and generality of this process make it highly valuable and it will open a new window to many other useful transformations in organic synthesis.

Experimental Section

Typical Procedure for the Synthesis of 3aa

To 2-azidobenzoic amide **1a** (0.1 g, 0.52 mmol) in THF was added CuI (0.019 g, 10 mol%), DIPEA (0.08 g, 0.62 mmol) followed by phenylacetylene (0.053 g, 0.52 mmol) at room temperature and the resulting reaction mixture was allowed to stir at room temperature for one hour under the open air atmosphere. After the completion of the reaction, the mixture was filtered through a pad of celite and washed with dichloromethane. The filtrate was concentrated and the residue was purified by silica-gel column chromatography (30% ethyl acetate/hexane) to afford the desired product **3aa**; yield: 80%.

4-Methoxy-3-phenyl[1,2,3]triazolo[1,5-a]quinazolin-5(4*H*)-one (3aa): ^{1}H NMR (300 MHz, $CDCl_3$): $\delta = 8.50$ (d, $J = 8.2$ Hz, 1H), 8.43 (d, $J = 7.9$ Hz, 1H), 7.93 (t, $J = 7.95$ Hz, 1H), 7.80 (dd, $J = 7.8$, 1.2 Hz, 2H), 7.66 (t, $J = 7.7$ Hz, 1H), 7.56–7.41 (m, 3H), 3.70 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta = 155.6$, 135.4, 134.2, 130.4, 129.6, 129.2, 129.0,

128.4, 128.2, 128.1, 116.5, 115.8, 64.2; MS (ESI): $m/z=293$ (MH^+); HR-MS (ESI): $m/z=293.1026$ (M+H), calcd. for $C_{16}H_{12}N_4O_2$ [MH^+]: 293.1033; IR (KBr): $\nu=2915$, 2850, 1695, 1606, 1571 cm^{-1}.

4-Methoxy-3-(*para*-tolyl)[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ab): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.48$ (d, $J=8.5$ Hz, 1H), 8.41 (dd, $J=8.0$, 1.3 Hz, 1H), 7.92 (td, 8.7, 1.3 Hz, 1H), 7.70 (d, $J=8.1$ Hz, 2H), 7.62 (td, $J=8.1$, 1.3 Hz, 1H), 7.29 (d, $J=7.7$ Hz, 2H), 3.70 (s, 3H), 2.44 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.6$, 138.3, 135.4, 134.2, 130.5, 130.2, 129.4, 129.2, 128.9, 128.0, 126.1, 116.5, 115.7, 64.2, 21.3; MS (ESI): $m/z=307$ (MH^+); HR-MS (ESI): $m/z=307.1187$, calcd. for $C_{17}H_{14}N_4O_2$ [MH^+]: 307.1190; IR (KBr): $\nu=2915$, 2850, 1695, 1617, 1598 cm^{-1}.

4-Methoxy-3-(4-methoxyphenyl)[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ac): ^1H NMR (300 MHz, $CDCl_3$): $\delta=$ 8.42 (d, $J=8.4$ Hz, 1H), 8.36 (d, $J=7.8$ Hz, 1H), 7.89 (t, $J=$ 8.4 Hz, 1H), 7.71 (d, $J=8.7$ Hz, 2H), 7.61 (t, $J=7.7$ Hz, 1H), 6.99 (d, $J=8.7$ Hz, 2H), 3.87 (s, 3H), 3.69 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=159.7$, 155.5, 135.3, 134.2, 130.9, 130.2, 130.0, 129.2, 128.0, 121.4, 116.5, 115.7, 113.6, 64.2, 55.3; MS (ESI): $m/z=323$ (MH^+); HR-MS (ESI): $m/z=323.1145$ (MH^+), calcd. for $C_{17}H_{14}N_4O_3$ [MH^+]: 323.1139; IR (KBr): $\nu=2937$, 2836, 1695, 1573 cm^{-1}.

4-Methoxy-3-[4-(trifluoromethyl)phenyl][1,2,3]triazolo-[1,5-*a*]quinazolin-5(4H)-one (3ad): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.41$ (d, $J=8.4$ Hz, 1H), 8.37(d, J=8.1 Hz, 1H), 7.96–7.88 (m, 3H), 7.72 (d, $J=7.5$ Hz, 2H), 7.63 (t, $J=$ 7.5 Hz, 1H), 3.73 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=$ 155.4, 135.5, 134.0, 132.7, 130.9, 130.4, 130.0, 129.7, 129.2, 128.9, 128.3, 125.9, 125.1, 122.2, 116.4, 115.7, 64.2; MS (ESI): $m/z=361$ (MH^+); HR-MS (ESI): $m/z=361.0910$ (M+H), calcd. for $C_{17}H_{11}F_3N_4O_2$ [MH^+]: 361.0907; IR (KBr): $\nu=$ 2938, 2917, 1698, 1617, 1508 cm^{-1}.

4-Methoxy-3-(thiophen-3-yl)[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ae): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.39$ (d, $J=8.7$ Hz, 1H), 8.35 (dd, $J=8.7$, 1.5 Hz, 1H), 7.88 (td, $J=8.7$, 1.5 Hz, 1H), 7.73–7.72 (m, 1H), 7.65–7.55 (m, 2H), 7.42–7.39 (m, 1H), 3.83 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.4$, 135.4, 134.1, 129.8, 129.3, 129.1, 128.5, 128.0, 126.3, 125.4, 124.3, 116.4, 115.7, 64.5; MS (ESI): $m/z=$ 299 (MH^+); HR-MS (ESI): $m/z=299.0601$ (M+H), calcd. for $C_{14}H_{10}N_4O_2S$ [MH^+]: 299.0597; IR (KBr): $\nu=3106$, 2938, 1695, 1606, 1508 cm^{-1}.

3-(3-Chlorophenyl)-4-methoxy[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3af): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.45$ (d, $J=8.4$, 1H), 8.39 (dd, $J=8.1$, 1.4 Hz), 7.92 (td, $J=7.2$, 1.4 Hz), 7.83- 7.80 (m, 1H), 7.75–7.60 (m, 2H), 7.47–7.37 (m, 2H), 3.74 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.5$, 135.5, 134.1, 130.8, 130.6, 129.4, 129.2, 129.0, 128.4, 128.2, 127.6, 116.5, 115.8, 64.2; MS (ESI): $m/z=327$ (MH^+); HR-MS (ESI): $m/z=327.0644$ (M+H), calcd. for $C_{16}H_{11}ClN_4O_2$ [MH^+]: 327.0643; IR (KBr): $\nu=3070$, 2938, 1697, 1604, 1571 cm^{-1}.

3-(4-Chlorophenyl)-4-methoxy[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ag): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.47$ (d, $J=8.4$, 1H), 8.41 (d, $J=8.1$ Hz, 1H), 7.94 (t, $J=7.8$ Hz, 1H), 7.77 (d, $J=8.6$ Hz, 2H), 7.66 (t, $J=7.8$ Hz, 1H), 7.47 (d, $J=8.6$ Hz, 2H), 3.74 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.5$, 146.5, 135.5, 134.5, 134.2, 133.7, 133.6, 130.8, 130.5, 129.3, 128.8, 128.4, 128.2, 127.5, 124.9, 116.5, 115.8, 64.4; MS (ESI): $m/z=327$ (MH^+); HR-MS (ESI): $m/z=327.0645$ (M+H), calcd. for $C_{16}H_{11}ClN_4O_2$ [MH^+]: 327.0643; IR (KBr): $\nu=2915$, 2848, 1689, 1619, 1567 cm^{-1}.

3-(4-Bromophenyl)-4-methoxy[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ah): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.41$ (d, $J=8.4$, 1H), 8.36 (dd, $J=8.1$, 1.4 Hz, 1H), 7.90 (td, $J=$ 8.7, 1.4 Hz, 1H) 7.74–7.66 (m, 2H), 7.64–7.54 (m, 3H), 3.72 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.4$, 135.5, 134.1, 131.4, 131.0, 130.5, 129.2, 128.21, 128.0, 122.7, 116.5, 115.7, 64.2; MS (ESI): $m/z=371$ (MH^+); HR-MS (ESI): $m/z=$ 371.0137 (M+H), calcd. for $C_{16}H_{11}BrN_4O_2$ [MH^+]: 371.0138; IR (KBr): $\nu=3068$, 2994, 1693, 1619,1571 cm^{-1}.

4,7-Dimethoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ai): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.37$ (t, $J=$ 7.8 Hz, 2H), 7.87 (t, $J=7.5$ Hz, 1H), 7.59 (t, $J=7.8$ Hz, 1H), 4.17 (s, 3H), 2.93 (t, $J=7.5$ Hz, 2H), 1.86 (t, $J=7.5$ Hz, 2H), 1.04 (t, $J=7.5$ Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=$ 155.6, 135.2, 134.3, 130.7, 129.7, 129.1,127.7, 116., 115.6, 64.5, 26.9, 23.1, 13.8; MS (ESI): $m/z=259$ (MH^+); HR-MS (ESI): $m/z=259.1189$ (MH^+), calcd. for $C_{13}H_{14}N_4O_2$ [MH^+]: 259.1190; IR (KBr): $\nu=2962$, 2937, 2871, 1693, 1619, 1577 cm^{-1}.

Methyl 4-methoxy-5-oxo-4,5-dihydro[1,2,3]triazolo[1,5-*a*]quinazoline-3-carboxylate (3aj): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.49$ (d, $J=8.2$ Hz, 1H), 8.42 (d, $J=7.8$ Hz, 1H), 7.96 (t, $J=7.5$ Hz, 1H), 7.70 (t, $J=7.5$ Hz, 1H), 4.28 (s, 3H), 4.04 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=159.8$, 156.1, 135.8, 135.6, 133.8, 129.2, 128.8, 122.5, 116.4, 116.1, 65.7, 52.6; MS (ESI): $m/z=275$ (MH^+); HR-MS (ESI): $m/z=$ 297.0594 (M+Na), calcd. for $C_{12}H_{10}N_4O_4$ [MNa^+]: 297.0594; IR (KBr): $\nu=2911$, 2850, 1733, 1697, 1558 cm^{-1}.

3-Cyclohexyl-4-methoxy[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ak): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.42$ (d, $J=8.3$ Hz, 1H), 8.38 (d, 8.3 Hz, 1H) 7.88 (t, $J=7.7$ Hz, 1H), 7.60 (t, $J=7.7$ Hz, 1H), 4.19 (s, 3H), 3.11–2.93 (m, 1H), 2.10–1.85 (m, 6H), 1.54–1.31 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.8$, 135.2, 134.7, 134.3, 129.5, 129.1, 127.7, 116.6, 115.6, 64.5, 34.8, 33.2, 26.6, 25.8; MS (ESI): $m/z=$ 299 (MH^+); HR-MS (ESI): $m/z=299.1499$ (M+H), calcd. for $C_{16}H_{18}N_4O_2$ [MH^+]: 299.1503; IR (KBr): $\nu=2929$, 2852, 1697, 1617, 1509 cm^{-1}.

4,7,8-Trimethoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ba): ^1H NMR (300 MHz, $CDCl_3$): $\delta=7.85$–7.81 (m, 3H), 7.79 (s, 1H), 7.67 (s, 1H), 7.54–7.38 (m, 3H), 4.11 (s, 3H), 4.02 (s, 3H), 3.68 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.4$, 149.4, 130.2, 130.2, 129.6, 129.1, 128.3, 128.1, 109.1, 108.4, 97.6, 64.2, 56.97, 56.5; MS (ESI): $m/z=$ 353 (MH^+); HR-MS (ESI): $m/z=353.1247$ (M+H), calcd. for $C_{18}H_{16}N_4O_4$ [MH^+]: 353.1244; IR (KBr): $\nu=2913$, 2848, 1677, 1621, 1517 cm^{-1}.

8-Chloro-4-methoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ca): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.48$ (d, $J=2.1$ Hz, 1H), 8.34 (d, $J=8.6$ Hz, 1H), 7.80 (dd, $J=7.9$, 2.1 Hz, 2H), 7.60 (dd, $J=8.6$, 2.o Hz, 1H), 7.56–7.39 (m, 3H), 3.69 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta=155.0$, 142.2, 134.8, 130.7, 129.6, 128.7, 128.6, 128.2, 115.9, 114.9; MS (ESI): $m/z=327$ (MH^+); HR-MS (ESI): $m/z=327.0643$ (M+H), calcd. for $C_{16}H_{11}ClN_4O_2$ [MH^+]: 327.0643; IR (KBr): $\nu=3056$, 2938, 1693, 1608, 1571, 1504 cm^{-1}.

7-Chloro-4-methoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3da): ^1H NMR (300 MHz, $CDCl_3$): $\delta=8.43$ (d, $J=8.8$ Hz, 1H), 8.37 (d, $J=2.2$ Hz, 1H), 7.88 (dd, $J=8.8$, 2.2 Hz, 1H), 7.79 (dd, $J=7.9$, 1.5 Hz, 2H), 7.56–7.43 (m,

3H), 3.69 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=154.6, 135.6, 134.2, 132.6, 130.6, 130.2, 129.6, 128.8, 128.7, 128.6, 128.2, 117.8, 117.4, 64.3; MS (ESI): m/z=327 (MH^+); HR-MS (ESI): m/z=327.0644 (M+H), calcd. for $C_{16}H_{11}ClN_4O_2$ [MH^+]: 327.0643; IR (KBr): ν=3052, 2937, 1695, 1608 cm^{-1}.

8-Fluoro-4-methoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ea): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.44 (dd, J=8.9, 5.5 Hz, 1H), 8.16 (dd, J=8.6, 2.4 Hz, 1H), 7.81 (dd, J=7.9, 1.5 Hz, 2H), 7.50–7.43 (m, 3H), 7.35 (td, 8.7, 2.4 Hz, 1H), 3.70 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=168.4, 165.0, 155.0, 135.8 (d, $J_{C,F}$=50.1 Hz), 132.4, (d, $J_{C,F}$=41.7 Hz), 130.7, (d, $J_{C,F}$=60.9 Hz) 129.6, 128.7, 128.5, 128.2, 116.4, (d, $J_{C,F}$=116.4 Hz) 113.0, 103.2, (d, $J_{C,F}$=109.8 Hz) 64.3; MS (ESI): m/z=311 (MH^+); HR-MS (ESI): m/z=311.0941 (M+H), calcd. for $C_{16}H_{11}FN_4O_2$ [MH^+]: 311.0939; IR (KBr): ν=3056, 2938, 1681, 1619 cm^{-1}.

4-Methoxy-7-methyl-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3fa): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.16 (d, J=8.1 Hz, 2H), 7.76 (d, J=6.9 Hz, 2H), 7.50–7.31 (m, 4H), 3.64 (s, 3H), 2.55 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=155.5, 147.1, 134.0, 130.4, 130.2, 129.5, 129.2, 129.1, 128.9, 128.3, 128.1, 115.57, 113.97, 64.16, 22.16; MS (ESI): m/z=307 (MH^+); HR-MS (ESI): m/z=$C_{17}H_{14}N_4O_2$ (M+H), calcd. for $C_{31}H_{33}N_6O_4$ [MH^+]: 307.1190; IR (KBr): ν=3056, 2937, 1695, 1625 cm^{-1}.

4-Methoxy-8-methyl-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4H)-one (3ga): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.30 (d, J=8.4 Hz, 1H), 8.14 (s, 1H), 7.79 (dd, J=8.0, 1.4 Hz, 2H), 7.69 (dd, J=8.4, 1.4 Hz, 1H), 7.53–7.37 (m, 3H), 3.67 (s, 3H), 2.52 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=155.6, 138.5, 136.4, 132.1, 130.3, 130.1, 129.6, 129.1, 128.8, 128.3, 128.1, 116.3, 115.6, 64.1, 21.2; MS (ESI): m/z=307 (MH^+); HR-MS (ESI): m/z=307.1195 (M+H), calcd. for $C_{17}H_{14}N_4O_2$ [MH^+]: 307.1190; IR (KBr): ν=3068, 2913, 1681, 1617, 1573 cm^{-1}.

4-Methoxy-8-methyl-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ha): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.48 (d, J=8.5 Hz, 1H), 8.40 (dd, J=8.0, 1.4 Hz, 1H), 7.91 (td, 8.7, 1.4 Hz, 1H), 7.70 (d, J=8.1 Hz, 2H), 7.62 (td, J=8.1, 1.4 Hz, 1H), 7.29–7.25 (m, 2H), 3.70 (s, 3H), 2.44 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=155.6, 138.3, 135.4, 134.2, 130.5, 130.2, 129.4, 129.2, 128.9, 128.0, 126.1, 116.56, 115.78, 64.2, 21.3; MS (ESI): m/z=307 (MH^+); HR-MS (ESI): m/z=307.1188 (M+H), calcd. for $C_{17}H_{14}N_4O_2$ [MH^+]: 307.1190; IR (KBr): ν=2921, 2852, 1693, 1608, 1508 cm^{-1}.

4-Methoxy-3-phenylbenzo[*g*][1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ia): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.84 (s, 1H), 8.68 (s, 1H), 7.98 (dd, J=8.2, 2.4 Hz, 2H), 7.82 (d, J=7.3 Hz, 2H), 7.68 (t, J=7.5 Hz, 1H), 7.58 (t, J=7.5 Hz, 1H), 7.48–7.40 (m, 3H), 3.69 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=155.7, 135.7, 131.4, 131.3, 130.7, 130.2, 130.1, 129.7, 129.6, 129.5, 129.1, 128.4, 128.1, 127.9, 127.5, 115.0, 113.3, 64.1; MS (ESI): m/z=343 (MH^+); HR-MS (ESI): m/z=343.1190 (M+H), calcd. for $C_{20}H_{14}N_4O_2$ [MH^+]: 343.1189; IR (KBr): ν=3050, 2913, 1687, 1631, 1587 cm^{-1}.

4,7-Dimethoxy-3-phenyl[1,2,3]triazolo[1,5-*a*]quinazolin-5(4*H*)-one (3ja): ^{1}H NMR (300 MHz, $CDCl_3$): δ=8.30 (d, J=9.0 Hz, 1H), 7.79 (dd, J=6.6, 1.5 Hz, 2H), 7.73 (d, J=2.7 Hz, 1H), 7.49–7.41 (m, 4H), 3.94 (s, 3H), 3.67 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ=159.19, 155.46,130.30, 129.59, 129.15, 128.83, 128.33, 128.17, 125.76, 124.20, 117.72, 117.40, 109.91, 64.17, 56.06; MS (ESI): m/z=323 (MH^+); HR-MS (ESI): m/z=323.1141 (MH^+), calcd. for $C_{17}H_{14}N_4O_3$ [MH^+]: 323.1139; IR (KBr): ν=3357, 2989, 2931, 1677, 1608, 1567 cm^{-1}.

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[18] CCDC 959467 contains the supplementary crystallographic data for the compound **3aa**. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre *via* www.ccdc.cam.ac.uk/data_request/cif.

