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PII: S0040-4020(19)30387-4

DOI: https://doi.org/10.1016/j.tet.2019.03.058

Reference: TET 30244

To appear in: *Tetrahedron*

Received Date: 17 February 2019

Revised Date: 23 March 2019

Accepted Date: 29 March 2019

Please cite this article as: Xu H, Xu L, Luo X, Wang J, Zhou X, Yang B, Li D, Luo Z, Liu Y, Liao S, Transition-metal-free insertion of benzyl bromides into 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehyde: One-pot switchable syntheses of benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones and 3-arylquinolin-4-ones mediated by base, *Tetrahedron* (2019), doi: https://doi.org/10.1016/j.tet.2019.03.058.

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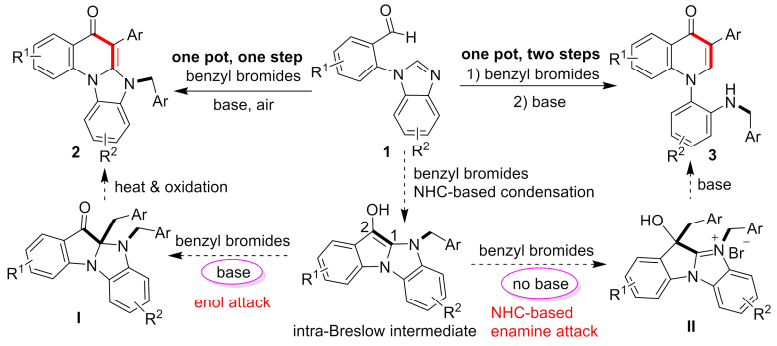
[a]*College of Chemical Engineering, Anhui University of Science and Technology, Huainan 232001, P. R. China*
[b]*CAS Key Laboratory of Tropical Marine Bio-Resources and Ecology, Guangdong Key Laboratory of Marine Materia Medica, Research Center for Marine Microbes, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China*
[c]*School of Pharmaceutical Sciences, Sun Yat-Sen University, Guangzhou 510006, PR China.*



Tetrahedron
journal homepage: www.elsevier.com

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[a]*College of Chemical Engineering, Anhui University of Science and Technology, Huainan 232001, P. R. China*
[b]*CAS Key Laboratory of Tropical Marine Bio-Resources and Ecology, Guangdong Key Laboratory of Marine Materia Medica, Research Center for Marine Microbes, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China*
[c]*School of Pharmaceutical Sciences, Sun Yat-Sen University, Guangzhou 510006, PR China.*

ARTICLE INFO

Article history:
Received
Received in revised form
Accepted
Available online

Keywords:
Quinolin-4-one derivatives
One-pot strategy
Intra-Breslow intermediate
Enol attack
NHC-based enamine attack

ABSTRACT

A transition-metal-free insertion of benzyl group between aldehyde and imidazole of 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehyde was achieved for the first time. Two diverse sets of quinolin-4-one derivatives: benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones (**2**) and 3-arylquinolin-4-ones (**3**) were synthesized based on identical starting materials 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehydes (**1**) and benzyl bromides. In the preparations, two key intermediates **I** and **II** were involved and might be synthesized in situ through the reaction of an intra-Breslow intermediate with benzyl bromide via an enol attack in the presence of base or a NHC-based enamine attack in the absence of base, respectively, in which the intra-Breslow intermediate might function as a nucleophilic reagent by following two novel different pathways.

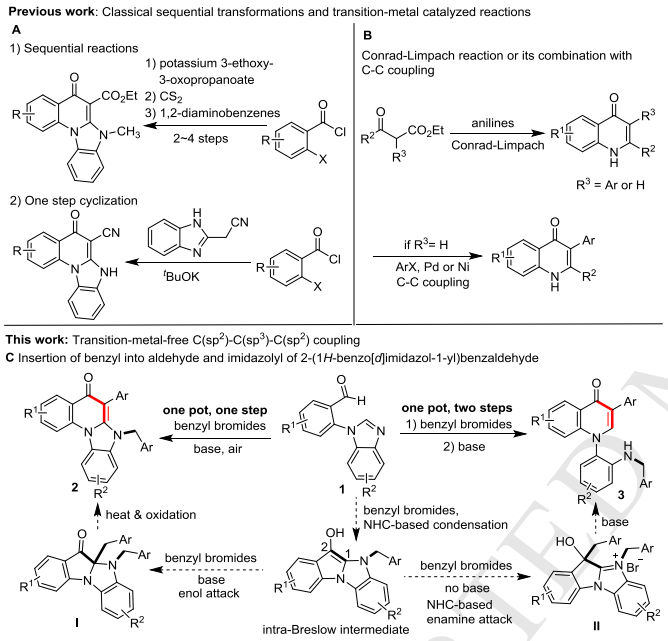
1. Introduction

The benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones and 3-arylquinolin-4-ones are two kinds of significant quinolin-4-one derivatives and possess a variety of fascinating biological activities. For example, the former have been investigated as cell proliferation inhibitors, or quadruplex nucleotide stabilizers in DNA[1]. The latter have been extensively studied as anticancer[2] and antimalarial[3] agents, carbonic anhydrase[4] and efflux pumps inhibitors[5], or human estrogen receptor activators[6]. Due to these diverse and significant pharmaceutical applications, a number of synthetic methods have been developed. The general route to the benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones is through a sequential reactions of 2-fluorobenzoyl chlorides with potassium 3-ethoxy-3-oxopropanoate, CS_2, and 1,2-diaminobenzenes, respectively[1,7] (Scheme 1, A1). This route is feasible but requires multistep process thus is laborious. Then a direct cyclocondensation (Scheme 1, A2) between 2-halobenzoyl chlorides and 2-(1*H*-benzo[*d*]imidazol-2-yl)acetonitriles has been employed but requires strong base (^{t}BuOK) and electron withdrawing substitution (CN)[8]. Similarly, the strategies for the synthesis of 3-arylquinolin-4-ones mainly relies on the known classical reaction Conrad-Limpach[2-3,5,9] (Scheme 1, B) or its variant cyclizations[6,10]. In recent years, the transition-metal catalyzed C-C bond couplings[11] or the methods of combining the couplings with the Conrad-Limpach cyclization[3c-e] (Scheme 1, B) have been used increasingly. Besides, Meinwald rearrangement from the epoxide substrate could also conveniently deliver 3-arylquinolin-4-ones with acid (TfOH or BF_3) catalysis[12]. Indeed, these elegant methods can furnish the target compounds smoothly; however, they generally suffer from some limitations including: 1) tedious operations for the synthesis of complex substrates, and 2) expensive transition-metal catalyst recruited in the reaction. Therefore, development of novel strategies for their rapid, efficient, and economical preparations still attracts high interest.

The imidazolin-2-ylidene-based NHC organocatalysis can avoid multistep operations in constructing numerous complicated organic molecules with high efficiency[13]. In our ongoing research project of exploring anticancer agents, we synthesized 7-benzyl-9,10-dimethyl-6-phenylbenzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-one (**2a**) by heating 2-(5,6-dimethyl-1*H*-benzo[*d*]imidazol-1-yl)benzaldehyde (**1a**) with benzyl bromide in the presence of base via a one-pot operation, and 1-(2-(benzylamino)-4,5-dimethylphenyl)-3-phenylquinolin-4(1*H*)-one (**3a**) by heating the

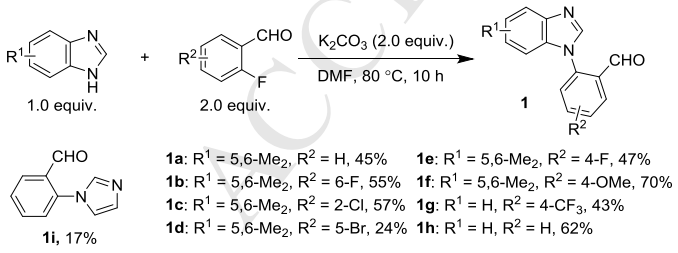
Corresponding author. E-mail address: ljrss@126.com (S. L.); yonghongliu@scsio.ac.cn (Y. L.); luozi139@163.com (Z. L.); liding@mail.sysu.edu.cn (D. L.)

above two reaction partners firstly in toluene followed with adjusting the reaction mixture to basic condition (Scheme 1, C). During these processes, we found that a novel unusual insertion of benzyl group between aldehyde and imidazole of 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehydes has been realized for the first time, and a benzo[*d*]imidazolyl intra-Breslow intermediate could function as nucleophilic reagent to react with benzyl bromide via an enol attack or a NHC-based enamine attack, respectively, with subsequent rearrangement to form new C(sp^2)-C(sp^2)-C(sp^2) bond. This is different from that reported in previous studies, which had benzo[*d*]imidazolium or imidazolium salt (NHC precursor) used directly as nucleophilic reagent[14]. This one-pot strategy can be employed to efficiently build bioactive *N*-heteroaromatic compounds, while avoiding the usage of transition-metal catalyst and multistep protocols. Herein, we report these two novel insertion modes for the facile preparation of compounds **2** and **3** in detail.



Scheme 1. Routes to benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones (**2**) and 3-arylquinolin-4-ones (**3**).

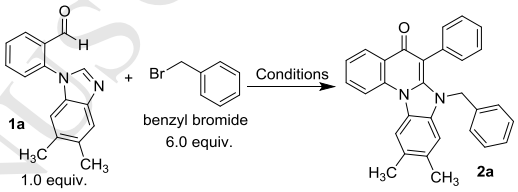
2. Results and discussion



Scheme 2. Synthesis of compound **1**.

The substrates (compound **1**) used in these two one-pot strategies were synthesized readily in 17-70% yields (Scheme 2). Based on the discovery of the reaction for synthesis of compound **2a**, compound **1a** and benzyl bromide were selected as the model substrates (Table 1). A series of bases were examined in order to improve the yield (Table 1, entries 1-10), and Na_2CO_3 was found to be the best in 71% yield when using sulfolane as the solvent (Table 1, entry 1). Of note was that a large amount of dibenzyl carbonate was generated in the product mixture when Cs_2CO_3 (Table 1, entry 2) or $CsHCO_3$ (Table 1, entry 3) was used as the base. The organic base DIPEA could also afford 38% yield (Table 1, entry 10), however, other organic bases such as Et_3N, DBU were avoided because of their reactions with benzyl bromide. Other solvents (Table 1, entries 11-15), and lower (Table 1, entry 16) or higher reaction temperature (Table 1, entry 17) showed varied low efficiencies. Changes of the molar ratio for Na_2CO_3 (Table 1, entries 18-19) or benzyl bromide (Table 1, entries 20-21) resulted in lower yields. Surprisingly, benzyl chloride (Table 1, entry 22) as an electrophile instead of bromide caused a significantly decreased yield (4%). Under O_2 atmosphere (Table 1, entry 23) moderate yield (48%) was accomplished, whereas under N_2 atmosphere (Table 1, entry 24) relatively low yield (18%) was obtained. Using other oxidants such as DDQ, $Na_2S_2O_8$, or Oxone (Table 1, entry 25), no any product was found. Thus, the optimal conditions were obtained for molar ratio of **1a** : benzyl bromide : Na_2CO_3 = 1 : 6 : 2, and the reaction mixture should be heated at 90 ˚C for 18 h using sulfolane (0.4 M) as the solvent.

Table 1. Optimization of conditions for the synthesis of compound **2a**[a]

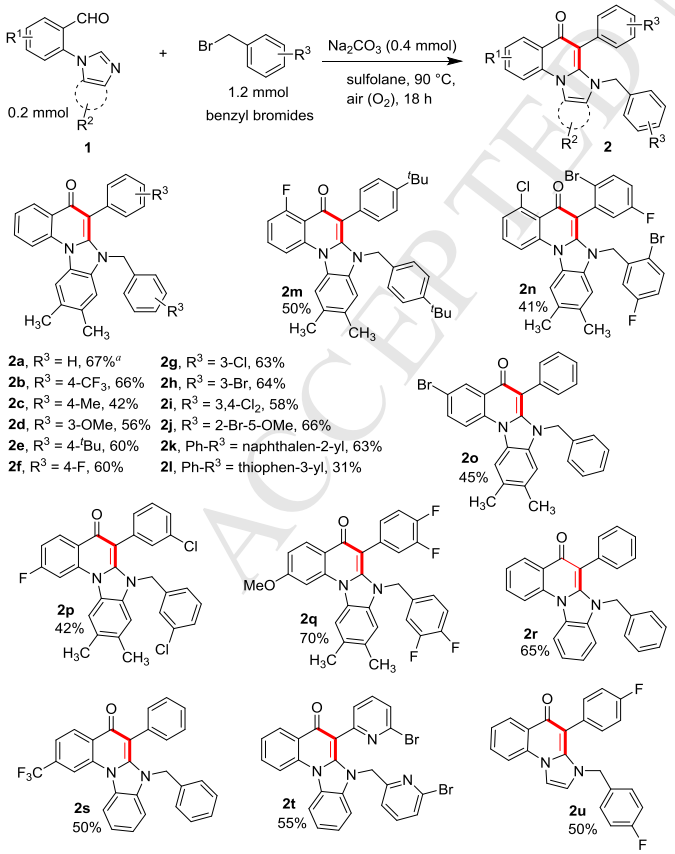


Entry	Base (equiv.)	Solvent	Temp. (˚C)	Yield(%) **2a**[b]
1	Na_2CO_3 (2.0)	Sulfolane	90	71(67[c])
2[d]	Cs_2CO_3 (2.0)	Sulfolane	90	40
3[e]	$CsHCO_3$ (2.0)	Sulfolane	90	31
4	K_2CO_3 (2.0)	Sulfolane	90	1
5	NaO^{t}Bu (2.0)	Sulfolane	90	1
6	NaOH (2.0)	Sulfolane	90	12
7	NaOAc (2.0)	Sulfolane	90	20
8	$NaHCO_3$ (2.0)	Sulfolane	90	trace
9	K_3PO_3 (2.0)	Sulfolane	90	0
10	DIPEA (2.0)	Sulfolane	90	38
11	Na_2CO_3 (2.0)	DMF	90	27
12	Na_2CO_3 (2.0)	DMSO	90	46
13	Na_2CO_3 (2.0)	NMO	90	21
14	Na_2CO_3 (2.0)	Diphenyl ether	90	0
15	Na_2CO_3 (2.0)	Toluene	90	1
16	Na_2CO_3 (2.0)	Sulfolane	60	8
17	Na_2CO_3 (2.0)	Sulfolane	120	60
18	Na_2CO_3 (1.0)	Sulfolane	90	30
19	Na_2CO_3 (4.0)	Sulfolane	90	63
20[f]	Na_2CO_3 (2.0)	Sulfolane	90	62
21[g]	Na_2CO_3 (2.0)	Sulfolane	90	65
22[h]	Na_2CO_3 (2.0)	Sulfolane	90	4
23[i]	Na_2CO_3 (2.0)	Sulfolane	90	48
24[j]	Na_2CO_3 (2.0)	Sulfolane	90	18
25[k]	Na_2CO_3 (2.0)	Sulfolane	90	0

[a]The reactions were performed on a 0.1 mmol scale under air atmosphere for 18 h.
[b]The yields were determined by using NMR with 1,3,5-trimethoxybenzene as an internal standard.
[c]Isolated yield on a 0.2 mmol scale.
[d]Dibenzyl carbonate (64% yield) was found in the reaction.
[e]Dibenzyl carbonate (16% yield) was found in the reaction.
[f]4.0 equiv. BnBr was used.
[g]8.0 equiv. BnBr was used.
[h]6.0 equiv. BnCl replaced the BnBr.

[i]Under O_2 atmosphere.
[j]Under N_2 atmosphere.
[k]DDQ, $Na_2S_2O_8$, or Oxone was used as oxidant.

With the optimized conditions in hand, the reaction scope for the synthesis of compound **2** was investigated through introduction of various substitutive groups to the substrates. As shown in Scheme 3, different substitutions of R^3, such as H, electron-withdrawing groups (CF_3), electron-donating groups (Me, OMe, ^{t}Bu), halides (F, Cl, Br), on the phenyl ring of the benzyl bromides (**2a-i**) were allowed in moderate yields (42-67%). The electron withdrawing substitutions (**2b**, **2f-i**) seems to be slightly superior to the electron donating ones (**2c-e**) for the reaction. Surprisingly, compound **2j** with steric congesting 2-Br-5-MeO still provided a moderate yield (66%). Naphthalenyl function (**2k**) could also contribute a moderate yield (63%) by replacing the phenyl group. The thiophen-3-yl function was suitable (**2l**) but the product must be carefully treated due to its instability during the purification. Further studies showed that substitutive groups such as F (**2m** and **2p**), Cl (**2n**), Br (**2o**), electron-donating OMe (**2q**) on the benzaldehyde ring, were all tolerated, whereas the halo-functionalized derivatives (**2m-p**) afforded slightly lower yields (41-50%) than that (70%) of the OMe-substituted compound (**2q**). These results indicated that the electron donating groups on the benzaldehyde ring might be favorable to the reaction. Meanwhile, when 5,6-dimethylbenzo[*d*]imidazole moiety was replaced by benzo[*d*]imidazole (**2r-t**) or imidazole unit (**2u**), the reaction still went on smoothly. Of note was that 2-bromo-6-(bromomethyl)pyridine as the electrophile was also compatible to this cyclization (e.g. synthesis of **2t**).

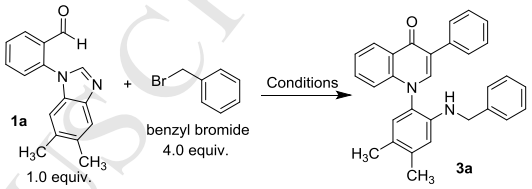


Scheme 3. Scope study for the synthesis of benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-one **2**

[a]Isolated yields were indicated.

As a comparative study, the synthesis of 3-arylquinolin-4-ones (**3**) was performed on the basis of a two-step, one-pot operation. In the first step, compound **1** was just heated together with benzyl bromide until the completion of the starting materials, and then the base was added. Extensive exploration of reaction conditions revealed that the optimal reaction conditions are (Table 2, entry 1): the reaction was heated at 130 ˚C for 15 h in toluene (0.4 M) at step 1, and then stirred at ambient temperature in methanol (0.1 M) in the presence of DBU for 4 h at step 2, with molar ratio of **1a**: benzyl bromide : DBU = 1 : 4 : 2. Of particular note was that the concentration of **1a** in toluene must not be less than 0.4 M in order to prevent the formation of 7,8-dimethyl-11*H*-benzo[4,5]imidazo[1,2-*a*]indol-11-one[15], which was an intramolecular by-product of **1a**.

Table 2. Optimization of conditions for the synthesis of compound **3a**

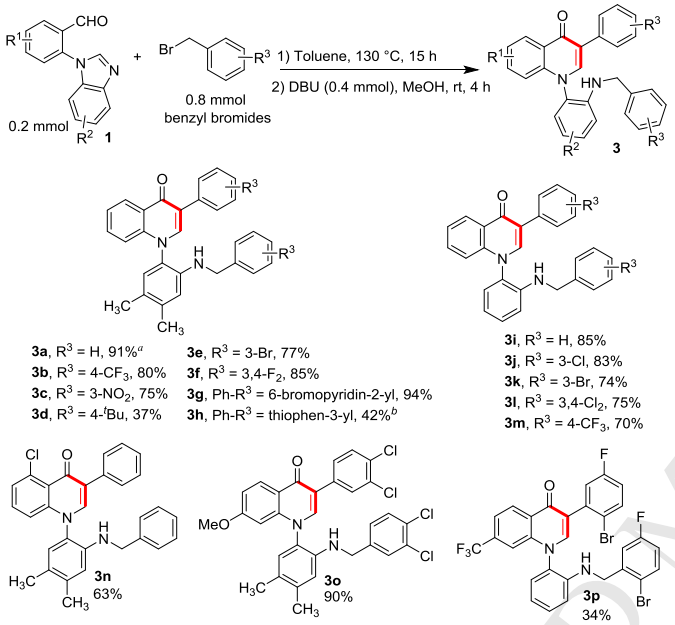


Entry	Solvent	Base(equiv., step 2)	Yield(%) **3a**[b]
1[a]	step 1: Toluene; step 2: MeOH	DBU (2.0)	91
2	step 1: Xylene; step 2: MeOH	DBU (2.0)	20
3	step 1: Sulfolane; step 2:MeOH	DBU (2.0)	17
4	step 1: Dioxane; step 2: MeOH	DBU (2.0)	70
5	step 1: DMF; step 2: MeOH	DBU (2.0)	51
6	step 1: $CHCl_3$; step 2: MeOH	DBU (2.0)	76
7	step 1: Toluene; step 2: MeOH	Et_3N (2.0)	12
8	step 1: Toluene; step 2: MeOH	DIPEA (2.0)	10
9	step 1: Toluene; step 2: MeOH	NaOH (2.0)	85
10	step 1: Toluene; step 2: MeOH	Cs_2CO_3 (2.0)	88
11	step 1: Toluene; step 2: MeOH	K_2CO_3 (2.0)	81
12	step 1: Toluene; step 2: MeOH	K_3PO_3 (2.0)	17
13	step 1: Toluene; step 2: MeOH	DBU (1.0)	51
14	step 1: Toluene; step 2: MeOH	DBU (3.0)	87
15[c]	step 1: Toluene; step 2: MeOH	DBU (2.0)	58
16[d]	step 1: Toluene; step 2: MeOH	DBU (2.0)	80
17	step 1: Toluene; step 2: DCM	DBU (2.0)	53
18	step 1: Toluene; step 2: DMF	DBU (2.0)	27
19	step 1: Toluene; step 2: Sulfolane	DBU (2.0)	12
20[e]	step 1: Toluene; step 2: MeOH	DBU (2.0)	36
21[f]	step 1: Toluene; step 2: MeOH	DBU (2.0)	62
22[g]	step 1: Toluene; step 2: MeOH	DBU (2.0)	9

[a]The reactions were performed on a 0.2 mmol scale in a sealed tube at 130 ˚C for 15 h in step 1, and then at rt for 4 h in step 2.
[b]Isolated yields.
[c]2.0 equiv. BnBr was used.
[d]6.0 equiv. BnBr was used.
[e]The reaction was heated at 90 ˚C in step 1.
[f]The reaction was heated at 90 ˚C for 24 h in step 2.
[g]4.0 equiv. BnCl instead of BnBr.

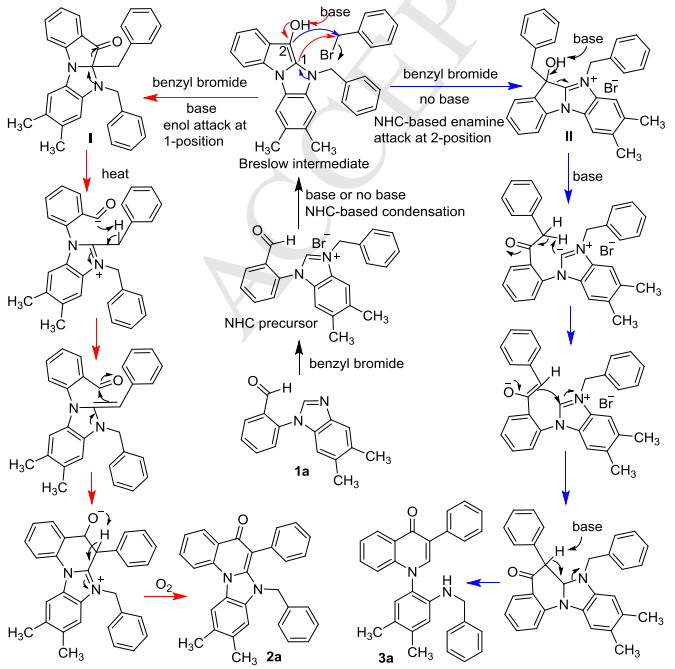
Following the optimal conditions, the scope for the synthesis of compound **3** was also examined. As shown in Scheme 4, substitutive groups on benzyl bromide such as H (**3a**), electron withdrawing CF_3 (**3b**), NO_2 (**3c**), halides (**3e-f**), were all suitable in good to high yields (75-91%), while the electron donating ^{t}Bu (**3d**) showed much less efficiency (37%), which indicated that the electron withdrawing groups might be beneficial. It was further confirmed by compound **3g** with an electron withdrawing 2-

bromo-6-(bromomethyl)pyridine unit, giving an excellent 94% yield. Of note was that when the benzene ring was replaced by the thiophen-3-yl group (**3h**), the reaction should be performed at a lower temperature (90 ºC) in step 1. Not surprisingly, the benzo[*d*]imidazole substrates (**3i-m**) could also provide good yields (70-85%). Furthermore, substitutive groups such as Cl (**3n**), OMe (**3o**), and CF_3 (**3p**) at the benzaldehyde ring were permitted, nevertheless, the electron donating group (**3o**) is superior to the electron withdrawing ones (**3n** and **3p**) for the reaction. The structures of **2c** and **3i** were unambiguously determined by using X-ray crystallographic analysis (see the Supporting Information).



Scheme 4. Scope study for the synthesis of 3-arylquinolin-4-one **3**.

[a]Isolated yields were indicated.
[b]Heated at 90 ˚C in step 1.



Scheme 5. Possible mechanisms for syntheses of compounds **2** and **3**.

In order to understand the mechanisms for the transformations, the two key intermediates **I** and **II** for the synthesis of compounds **2** and **3**, respectively, were isolated and characterized by using ^{1}H, ^{13}C-NMR, and HRMS. Compound **I** was further determined by using X-ray crystallographic analysis (see the Supporting Information). We speculated, in terms of their structures, that 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehyde was firstly benzylated to form a NHC precursor 3-benzyl-1-(2-formylphenyl)-1*H*-benzo[*d*]imidazol-3-ium salt, which was rapidly transformed into an intra-Breslow intermediate (Scheme 5) no matter whether there was base or not. Then, if the base was added simultaneously with the substrates, an additional benzylation would take place immediately at the 1-position of the Breslow intermediate via an enol attack fashion to form the intermediate **I**, which was then converted into the final product **2a** smoothly. If base was absent in the first step, the benzylation would happen at the 2-position via a NHC-based enamine attack to produce intermediate **II**. This process might be supported by two previous articles that the C-C coupling between the aldehydes and the benzyl bromides was successful under the thiazol-2-ylidene-NHC catalysts[16]. Additionally, using deuterium-labeled (d_4) methanol as the solvent in step 2, only one hydrogen atom in product **3a** was deuterated (measured by HRMS, see Supporting Information). This deuterium should originate from the last protonation step of the benzyl amine moiety, which demonstrated that the proposed mechanistic transformation for conversion of **II** to **3a** is reasonable (Scheme 5).

3. Conclusion

In summary, we established two novel one-pot strategies for the insertion of benzyl group between aldehyde and imidazole of 2-(1*H*-benzo[*d*]imidazol-1-yl)benzaldehyde under transition-metal-free conditions, and realized the facile syntheses of fused benzo[4,5]imidazo[1,2-*a*]quinolin-5(7*H*)-ones and 3-arylquinolin-4-ones with the formation of new C(sp^2)-C(sp^2)-C(sp^2) bond. Mechanistic study demonstrated that the bifurcation for the synthesis of compound **2** and **3** was attributed to the different position of intra-Breslow intermediate nucleophilic attack to benzyl bromide. These easily-operated methods might be employed to efficiently construct a variety of N-heterocycles for the development of bioactive agents.

4. Experimental section

4.1 General information

Solvents such as DMF, DMSO, MeOH, and DME were obtained from commercial suppliers and kept with 4Å MS (stored under N_2 atmosphere). Toluene, xylene, and dioxane were dried under CaH_2 and distilled. $CHCl_3$ and CH_2Cl_2 were dried under $CaCl_2$ and distilled. NMO, sulfolane, and diphenyl ether were dried using 4Å MS and distilled. Unless otherwise noted, other chemicals obtained from commercial suppliers were used without further purification. Melting points (m.p.) were determined by using a SRSO-ptiMelt automated melting point instrument without correction. Analytical thin layer chromatography was performed on Polygram SIL HSGF254 plates. Visualization was accomplished with short wave UV light, or I_2 staining. Flash column chromatography was performed using silica gel (200-300 mesh). The NMR spectra were recorded on Bruker AC 500 or 700 NMR spectrometer with TMS as an internal standard. The residual solvent peaks were used for the chemical shifts as an internal references (ppm): ^{1}H ($CDCl_3$: δ = 7.26, DMSO-d_6: δ = 2.50, $CO(CD_3)_2$: δ = 2.05, MeOD: δ = 3.31), ^{13}C ($CDCl_3$: δ = 77.0, DMSO-d_6: δ = 39.5,

MeOD: δ = 49.0, $CO(CD_3)_2$: δ = 206). ^{19}F (CF_3CO_2H: -76, PhF: -113). The data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, and m = multiplet), integration, and coupling constant in Hz. Mass spectrometry data were collected with a Bruker maXis/Q-TOF instrument for high-resolution or a Bruker amaZon SL instrument for low-resolution with both by using ESI ionization. No effort was taken to optimize substrate yields.

*4.2 Synthesis of compound **1***

General procedure A: To a 25 mL flask, 2-flurobenzaldehydes (2.0 equiv., 13.6 mmol), benzo[*d*]imidazoles (1.0 equiv., 6.8 mmol), and K_2CO_3 (2.0 equiv., 13.6 mmol, 1.88 g) in DMF (5.0 mL) were added, and the reaction was stirred at 80 ˚C for 10 h. Upon the completion of the starting materials, the solvent was removed under the reduced pressure, and the residue was dissolved in AcOEt (150 mL). The organic layer was washed with H_2O (40 mL × 3), dried over anhydrous Na_2SO_4, and removed under the reduced pressure. The crude was purified with silica gel column chromatography (PE/EA=5:1-1:2 as the eluents) to afford the target compound **1**.

*4.2.1. 2-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)benzaldehyde (**1a**)*

Following the general procedure A, compound **1a** was obtained as a white solid in 45% yield (0.77 g), mp: 128-130 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 9.72 (s, 1H), 8.14 (d, *J* = 7.8 Hz, 1H), 7.96 (s, 1H), 7.81 (t, *J* = 7.6 Hz, 1H), 7.72 – 7.61 (m, 2H), 7.48 (d, *J* = 7.8 Hz, 1H), 6.99 (s, 1H), 2.39 (s, 3H), 2.32 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 188.52, 142.48, 141.90, 138.32, 135.39, 134.40, 133.80, 132.31, 131.60, 129.35, 129.26, 127.81, 120.61, 109.94, 20.51, 20.21. FTIR (neat): 2941, 2860, 1693, 1599, 1490, 1468, 1274, 1192, 843, 770 cm^{-1}. ESI-MS (m/z): 251.1 $[M + H]^+$.

*4.2.2. 2-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)-6-fluorobenzaldehyde (**1b**)*

Following the general procedure A, compound **1b** was obtained as a white solid in 55% yield (1.0 g), mp: 149-151 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 9.94 (s, 1H), 7.90 (s, 1H), 7.75 (td, *J* = 8.2, 5.8 Hz, 1H), 7.63 (s, 1H), 7.36 (t, *J* = 9.2 Hz, 1H), 7.30 (d, *J* = 7.9 Hz, 1H), 6.96 (s, 1H), 2.38 (s, 3H), 2.32 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 185.51, 163.55 (d, J_{FC} = 263.75 Hz), 142.33, 141.89, 137.92, 135.91 (d, J_{FC} = 13.75 Hz), 133.60, 133.52, 132.23, 123.96, 120.65, 117.35 (d, J_{FC} = 21.25 Hz), 109.95, 20.50, 20.19. FTIR (neat): 2962, 2918, 1690, 1608, 1571, 1492, 1462, 1244, 1186, 897, 841, 810 cm^{-1}. ESI-MS (m/z): 269.1 $[M + H]^+$.

*4.2.3. 2-chloro-6-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)benzaldehyde (**1c**)*

Following the general procedure A, compound **1c** was obtained as a white solid in 57% yield (1.1 g), mp: 129-131 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 10.11 (s, 1H), 7.88 (s, 1H), 7.70 – 7.64 (m, 2H), 7.63 (s, 1H), 7.41 (dd, *J* = 6.7, 2.3 Hz, 1H), 6.91 (s, 1H), 2.39 (s, 3H), 2.32 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.72, 142.51, 141.93, 137.91, 137.45, 134.30, 133.50, 133.47, 132.12, 131.61, 129.47, 127.24, 120.68, 109.95, 20.51, 20.22. FTIR (neat): 2920, 1697, 1585, 1489, 1456, 1229, 1188, 849, 797 cm^{-1}. ESI-MS (m/z): 285.1 $[M + H]^+$

*4.2.4. 5-bromo-2-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)benzaldehyde (**1d**)*

Following the general procedure A, compound **1d** was obtained as a slight yellow solid in 24% yield (0.54 g), mp: 188-190 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 9.63 (s, 1H), 8.23 (d, *J* = 2.3 Hz, 1H), 7.92 (s, 1H), 7.90 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.63 (s, 1H), 7.37 (d, *J* = 8.4 Hz, 1H), 6.96 (s, 1H), 2.38 (s, 3H), 2.32 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.06, 142.16, 141.83, 138.20, 137.09, 134.16, 134.08, 132.70, 132.58, 132.14, 129.38, 123.54, 120.69, 109.70, 20.49, 20.18. FTIR (neat): 2962, 2891, 1691, 1585, 1450, 1230, 1180, 999, 920, 839, 785 cm^{-1}. ESI-MS (m/z): 329.0, 331.0 $[M + H]^+$

*4.2.5. 2-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)-4-fluorobenzaldehyde (**1e**)*

Following the general procedure A, compound **1e** was obtained as a white solid in 47% yield (0.86 g), mp: 114-116 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 9.67 (s, 1H), 8.19 (dd, *J* = 8.8, 6.2 Hz, 1H), 7.95 (s, 1H), 7.66 (s, 1H), 7.36 (td, *J* = 8.3, 2.3 Hz, 1H), 7.22 (dd, *J* = 8.5, 2.4 Hz, 1H), 7.02 (s, 1H), 2.40 (s, 3H), 2.34 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.01, 166.36 (d, J_{FC} = 258.75 Hz), 142.16, 141.97, 140.41 (d, J_{FC} = 10.0 Hz), 134.19, 133.98, 132.71, 131.97 (d, J_{FC} = 11.25 Hz), 128.23 (d, J_{FC} = 2.5 Hz), 120.83, 116.92 (d, J_{FC} = 21.25 Hz), 115.02 (d, J_{FC} = 23.75 Hz), 109.82, 20.55, 20.22. FTIR (neat): 2922, 2880, 1695, 1602, 1489, 1469, 1201, 1105, 883, 840, 734 cm^{-1}. ESI-MS (m/z): 269.1 $[M + H]^+$.

*4.2.6. 2-(5,6-dimethyl-1H-benzo[d]imidazol-1-yl)-4-methoxybenzaldehyde (**1f**)*

Following the general procedure A, compound **1f** was obtained as a white solid in 70% yield (1.3 g), mp: 125-128 ˚C. ^1H NMR (500 MHz, $CDCl_3$) δ 9.57 (s, 1H), 8.08 (d, *J* = 8.8 Hz, 1H), 7.94 (s, 1H), 7.62 (s, 1H), 7.12 (dd, *J* = 8.8, 2.1 Hz, 1H), 7.02 (s, 1H), 6.92 (d, *J* = 2.4 Hz, 1H), 3.92 (s, 3H), 2.38 (s, 3H), 2.32 (s, 3H).^{13}C NMR (125 MHz, $CDCl_3$) δ 187.21, 165.03, 142.35, 141.84, 140.25, 134.18, 133.68, 132.19, 131.23, 124.92, 120.53, 115.06, 112.67, 110.02, 55.98, 20.45, 20.14. FTIR (neat): 2964, 2924, 2877, 1682, 1599, 1491, 1458, 1246, 1209, 1182, 1024, 871, 837 cm^{-1}. ESI-MS (m/z): 281.1 $[M + H]^+$.

*4.2.7. 2-(1H-benzo[d]imidazol-1-yl)-4-(trifluoromethyl)benzaldehyde (**1g**)*

Following the general procedure A, compound **1g** was obtained as a slight yellow oil in 43% yield (0.85 g). ^1H NMR (500 MHz, $CDCl_3$) δ 9.76 (s, 1H), 8.27 (d, *J* = 8.1 Hz, 1H), 8.09 (s, 1H), 7.92 (dd, *J* = 13.5, 7.8 Hz, 2H), 7.80 (s, 1H), 7.43 – 7.32 (m, 2H), 7.22 (d, *J* = 7.5 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.19, 143.38, 142.86, 138.25, 136.87 (q, J_{FC} = 32.5 Hz), 135.44, 133.87, 130.41, 126.31 (q, J_{FC} = 3.75 Hz), 125.06 (q, J_{FC} = 3.75 Hz), 124.85, 123.73, 122.64 (q, J_{FC} = 272.5 Hz), 121.01, 109.54. ^{19}F NMR (470 MHz, $CDCl_3$) δ -63.13. FTIR (neat): 2862, 1703, 1612, 1490, 1461, 1313, 1174, 1131, 1070, 842, 744 cm^{-1}. ESI-MS (m/z): 291.1 $[M + H]^+$.

*4.2.8. 2-(1H-benzo[d]imidazol-1-yl)benzaldehyde (**1h**)*[17]

Following the general procedure A, compound **1h** was obtained as a colorless oil in 62% yield (0.94 g). ^1H NMR (500 MHz, $CDCl_3$) δ 9.71 (s, 1H), 8.14 (d, *J* = 7.7 Hz, 1H), 8.07 (s, 1H), 7.90 (d, *J* = 7.9 Hz, 1H), 7.81 (t, *J* = 7.6 Hz, 1H), 7.68 (t, *J* = 7.6 Hz, 1H), 7.50 (d, *J* = 7.8 Hz, 1H), 7.34 (dt, *J* = 14.9, 7.2 Hz, 2H), 7.22 (d, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 188.29, 143.29, 143.22, 137.77, 135.69, 135.40, 131.59, 129.56, 129.53, 127.87, 124.34, 123.22, 120.67, 109.88. FTIR (neat): 2858, 2760, 1693, 1597, 1489, 1460, 1286, 1228, 1193, 823, 740 cm^{-1}. ESI-MS (m/z): 223.1 $[M + H]^+$.

*4.2.9. 2-(1H-imidazol-1-yl)benzaldehyde (**1i**)*[18]

Following the general procedure A, compound **1i** was obtained as a colorless oil in 17% yield (0.2 g). ^1H NMR (500 MHz, $CDCl_3$) δ 9.76 (s, 1H), 8.05 – 7.96 (m, 1H), 7.77 – 7.65 (m, 2H), 7.60 – 7.55 (m, 1H), 7.40 (d, *J* = 7.9 Hz, 1H), 7.22 (d, *J* = 0.8 Hz, 1H), 7.19 (d, *J* = 1.2 Hz, 1H). ^{13}C NMR (125 MHz,

$CDCl_3$) δ 188.36, 139.26, 138.24, 134.96, 130.76, 130.24, 129.15, 128.88, 126.83, 121.85. FTIR (neat): 2924, 2852, 1687, 1599, 1494, 1400, 1303, 1242, 1193, 1056, 822, 766, 660 cm^{-1}. ESI-MS (m/z): 173.1 $[M + H]^+$.

*4.3 Synthesis of compound **2***

General procedure B: To a 5 mL vial back-filled with dried air, compound **1** (1.0 equiv., 0.2 mmol), benzyl bromides (6.0 equiv., 1.2 mmol), and Na_2CO_3 (2.0 equiv. 0.4 mmol, 42 mg) in sulfolane (0.5 mL) were added, and the reaction was heated at 90 ˚C for 18 h. Upon the completion of the starting materials, the reaction mixture was dissolved in 100 mL H_2O, and extracted with dichloromethane (40 mL × 3). The organic layers were combined, dried over anhydrous Na_2SO_4, and removed. The crude was purified by using silica gel column chromatography (PE/EA = 10:1 – 1:2 as eluents) to afford the target compound **2**.

*4.3.1 7-benzyl-9,10-dimethyl-6-phenylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2a**)*

Following the general procedure B, compound **2a** was obtained as a white solid in 67% yield (57.3 mg), mp: 233-235 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.67 (dd, *J* = 7.9, 1.1 Hz, 1H), 8.47 (d, *J* = 8.5 Hz, 1H), 8.04 (s, 1H), 7.84 – 7.77 (m, 1H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.25 – 7.21 (m, 1H), 7.21 – 7.14 (m, 7H), 6.87 (s, 1H), 6.70 (d, *J* = 6.7 Hz, 2H), 4.85 (s, 2H), 2.47 (s, 3H), 2.31 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.85, 146.19, 135.49, 135.31, 133.74, 133.43, 133.19, 132.00, 131.29, 130.92, 128.84, 128.47, 128.18, 128.06, 127.36, 127.33, 127.25, 125.55, 124.41, 115.26, 114.33, 110.59, 102.67, 47.83, 20.54, 20.20. FTIR (neat): 2957, 2922, 2853, 1726, 1597, 1533, 1494, 1418, 1256, 1074, 746, 700 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{25}N_2O$ $[M+H]^+$ 429.1961, found 429.1979.

*4.3.2. 9,10-dimethyl-7-(4-(trifluoromethyl)benzyl)-6-(4-(trifluoromethyl)phenyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2b**)*

Following the general procedure B, compound **2b** was obtained as a white solid in 66% yield (77.4 mg), mp: 285-287 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.61 (d, *J* = 7.9 Hz, 1H), 8.48 (d, *J* = 8.5 Hz, 1H), 8.07 (s, 1H), 7.82 (t, *J* = 7.8 Hz, 1H), 7.52 (t, *J* = 7.5 Hz, 1H), 7.44 (d, *J* = 8.0 Hz, 2H), 7.35 (d, *J* = 7.9 Hz, 2H), 7.26 (d, *J* = 7.4 Hz, 2H), 6.90 (s, 1H), 6.77 (d, *J* = 7.9 Hz, 2H), 4.90 (s, 2H), 2.50 (s, 3H), 2.34 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.69, 146.09, 139.11, 137.79, 135.55, 134.05, 133.10, 132.50, 132.12, 131.42, 130.09 (q, J_{FC} = 67.33 Hz), 129.33 (q, J_{FC} = 64.32 Hz), 129.03, 127.98, 127.23, 125.62, 125.42, 124.81, 124.78, 124.26 (d, J_{FC} = 271 Hz), 123.86 (d, J_{FC} = 270 Hz), 115.47, 114.59, 110.29, 110.17, 48.34, 20.57, 20.23. FTIR (neat): 2958, 2920, 2852, 1726, 1600, 1539, 1516, 1321, 1153, 1107, 1066, 1018, 821, 766 cm^{-1}. HRMS (ESI): m/z calcd for $C_{32}H_{23}F_6N_2O$ $[M+H]^+$ 565.1709, found 565.1721.

*4.3.3. 9,10-dimethyl-7-(4-methylbenzyl)-6-(p-tolyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2c**)*

Following the general procedure B, compound **2c** was obtained as a white solid in 42% yield (38.3 mg), mp: 253-156 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.66 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.44 (d, *J* = 8.5 Hz, 1H), 8.00 (s, 1H), 7.78 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.11 (d, *J* = 7.9 Hz, 2H), 7.03 (d, *J* = 7.8 Hz, 2H), 6.97 (d, *J* = 7.9 Hz, 2H), 6.86 (s, 1H), 6.63 (d, *J* = 8.0 Hz, 2H), 4.82 (s, 2H), 2.45 (s, 3H), 2.33 (s, 3H), 2.29 (s, 3H), 2.28 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.01, 146.36, 137.01, 136.81, 135.49, 133.23, 133.18, 132.50, 131.74, 131.01, 130.75, 130.72, 129.07, 128.99, 128.09, 127.35, 125.73, 125.64, 124.26, 115.19, 114.23, 110.69, 102.47, 47.56, 21.31, 21.03, 20.49, 20.18. FTIR (neat): 2918, 2850, 1625, 1587, 1541, 1479, 1415, 1303, 1182, 813, 750 cm^{-1}. HRMS (ESI): m/z calcd for $C_{32}H_{29}N_2O$ $[M+H]^+$ 457.2274, found 457.2290.

*4.3.4. 7-(3-methoxybenzyl)-6-(3-methoxyphenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2d**)*

Following the general procedure B, compound **2d** was obtained as a white solid in 56% yield (54.7 mg), mp: 106-108 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.66 (dd, *J* = 8.0, 1.4 Hz, 1H), 8.46 (d, *J* = 8.5 Hz, 1H), 8.03 (s, 1H), 7.84 – 7.75 (m, 1H), 7.52 (t, *J* = 7.5 Hz, 1H), 7.22 – 7.14 (m, 1H), 7.09 (t, *J* = 7.9 Hz, 1H), 6.93 – 6.78 (m, 3H), 6.73 (dd, *J* = 8.2, 2.2 Hz, 1H), 6.65 (d, *J* = 1.4 Hz, 1H), 6.30 (d, *J* = 7.7 Hz, 1H), 6.24 (s, 1H), 4.84 (d, *J* = 4.2 Hz, 2H), 3.70 (s, 3H), 3.51 (s, 3H), 2.47 (s, 3H), 2.31 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.80, 159.76, 159.35, 146.07, 137.26, 135.49, 135.14, 133.41, 133.25, 131.25, 130.89, 129.57, 129.14, 128.08, 127.20, 125.61, 124.49, 124.39, 117.69, 116.40, 115.25, 114.33, 112.45, 111.50, 110.50, 102.57, 55.14, 54.77, 47.69, 20.50, 20.18. FTIR (neat): 2922, 2878, 1595, 1533, 1489, 1415, 1263, 1037, 754, 686 cm^{-1}. HRMS (ESI): m/z calcd for $C_{32}H_{29}N_2O_3$ $[M+H]^+$ 489.2173, found 489.2184.

*4.3.5. 7-(4-(tert-butyl)benzyl)-6-(4-(tert-butyl)phenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2e**)*

Following the general procedure B, compound **2e** was obtained as a white solid in 60% yield (64.8 mg), mp: 290-292 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.65 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.45 (d, *J* = 8.5 Hz, 1H), 8.02 (s, 1H), 7.78 (ddd, *J* = 8.6, 7.2, 1.7 Hz, 1H), 7.54 – 7.48 (m, 1H), 7.16 (d, *J* = 8.4 Hz, 2H), 7.14 – 7.11 (m, 2H), 7.08 – 7.04 (m, 2H), 6.92 (s, 1H), 6.57 (d, *J* = 8.4 Hz, 2H), 4.83 (s, 2H), 2.47 (s, 3H), 2.32 (s, 3H), 1.30 (s, 9H), 1.28 (s, 9H).^{13}C NMR (125 MHz, $CDCl_3$) δ 173.92, 150.25, 149.55, 146.39, 135.48, 133.63, 133.26, 132.42, 131.55, 131.01, 130.73, 130.45, 128.09, 127.30, 125.68, 125.18, 124.85, 124.25, 115.18, 114.22, 110.48, 102.55, 47.85, 34.43, 34.41, 31.36, 31.32, 20.50, 20.15. FTIR (neat): 2920, 2870, 1625, 1601, 1545, 1523, 1487, 1344, 1136, 1095, 804, 731, 671 cm^{-1}. HRMS (ESI): m/z calcd for $C_{38}H_{41}N_2O$ $[M+H]^+$ 541.3213, found 541.3229.

*4.3.6. 7-(4-fluorobenzyl)-6-(4-fluorophenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2f**)*

Following the general procedure B, compound **2f** was obtained as a white solid in 60% yield (55.7 mg), mp: 263-266 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.70 (d, *J* = 7.5 Hz, 1H), 8.48 (d, *J* = 8.5 Hz, 1H), 8.06 (s, 1H), 7.82 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.18 – 7.11 (m, 2H), 6.95 – 6.84 (m, 5H), 6.67 (dd, *J* = 8.6, 5.2 Hz, 2H), 4.87 (s, 2H), 2.48 (s, 3H), 2.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.03, 162.16 (d, J_{FC} = 245 Hz), 162.10 (d, J_{FC} = 245 Hz), 146.11, 135.50, 133.62 (d, J_{FC} = 7.5 Hz), 133.56, 133.02, 131.52, 131.07, 130.83 (d, J_{FC} = 1.25 Hz), 129.63 (d, J_{FC} = 3.75 Hz), 128.02, 127.27, 127.05 (d, J_{FC} = 7.0 Hz), 125.48, 124.52, 115.55 (d, J_{FC} = 21.25 Hz), 115.28, 115.05 (d, J_{FC} = 21.25 Hz), 114.40, 110.36, 101.33, 47.34, 20.51, 20.20. ^{19}F NMR (470 MHz, $CDCl_3$) δ -108.50, -112.87. FTIR (neat): 2954, 2922, 2852, 1721, 1595, 1537, 1504, 1415, 1220, 1153, 815, 759, 737 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{23}F_2N_2O$ $[M+H]^+$ 465.1773, found 465.1793.

*4.3.7. 7-(3-chlorobenzyl)-6-(3-chlorophenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2g**)*

Following the general procedure B, compound **2g** was obtained as a white solid in 63% yield (62.5 mg), mp: 244-246

°C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.63 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.46 (d, *J* = 8.5 Hz, 1H), 8.04 (s, 1H), 7.81 (ddd, *J* = 8.7, 7.2, 1.7 Hz, 1H), 7.57 – 7.50 (m, 1H), 7.24 (ddd, *J* = 8.0, 2.0, 1.2 Hz, 1H), 7.20 (d, *J* = 8.7 Hz, 1H), 7.17 – 7.09 (m, 4H), 6.87 (s, 1H), 6.68 (s, 1H), 6.58 (d, *J* = 7.7 Hz, 1H), 4.86 (s, 2H), 2.48 (s, 3H), 2.34 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.74, 145.95, 137.10, 135.58, 135.53, 134.75, 134.14, 133.75, 133.05, 132.15, 131.75, 131.21, 130.44, 129.99, 129.18, 128.05, 127.92, 127.55, 127.22, 125.52, 125.48, 124.65, 123.38, 115.35, 114.48, 110.27, 101.28, 47.76, 20.53, 20.22. FTIR (neat): 2924, 2852, 1721, 1599, 1539, 1485, 1417, 1039, 771, 748, 677 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{23}Cl_2N_2O$ $[M+H]^+$ 497.1182, found 497.1188.

*4.3.8. 7-(3-bromobenzyl)-6-(3-bromophenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2h**)*

Following the general procedure B, compound **2h** was obtained as a white solid in 64% yield (74.8 mg), mp: 245-248 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.64 (dd, *J* = 8.0, 1.4 Hz, 1H), 8.47 (d, *J* = 8.5 Hz, 1H), 8.05 (s, 1H), 7.82 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.39 (ddd, *J* = 18.1, 9.9, 5.1 Hz, 2H), 7.29 (t, *J* = 1.7 Hz, 1H), 7.15 (d, *J* = 7.6 Hz, 1H), 7.09 (dd, *J* = 15.1, 7.7 Hz, 2H), 6.88 (s, 1H), 6.84 (s, 1H), 6.63 (d, *J* = 7.8 Hz, 1H), 4.87 (s, 2H), 2.49 (s, 3H), 2.34 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.78, 145.96, 137.34, 135.89, 135.54, 134.94, 133.74, 133.06, 131.74, 131.20, 130.93, 130.44, 130.28, 129.42, 128.45, 128.06, 127.23, 125.51, 124.64, 123.82, 122.96, 122.39, 115.35, 114.47, 110.26, 101.23, 47.74, 20.53, 20.21. FTIR (neat): 2922, 2852, 1718, 1601, 1581, 1539, 1483, 1415, 1261, 1071, 769, 748, 675 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{23}Br_2N_2O$ $[M+H]^+$ 585.0172, found 585.0178, 587.0165, 589.0143.

*4.3.9. 7-(3,4-dichlorobenzyl)-6-(3,4-dichlorophenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2i**)*

Following the general procedure B, compound **2i** was obtained as a white solid in 58% yield (65.4 mg), mp: 275-278 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.61 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.46 (d, *J* = 8.5 Hz, 1H), 8.05 (s, 1H), 7.82 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.54 (t, *J* = 7.3 Hz, 1H), 7.32 (dd, *J* = 13.7, 8.2 Hz, 2H), 7.18 (d, *J* = 2.0 Hz, 1H), 7.11 (dd, *J* = 8.1, 2.0 Hz, 1H), 6.88 (s, 1H), 6.82 (d, *J* = 2.0 Hz, 1H), 6.56 (dd, *J* = 8.3, 2.1 Hz, 1H), 4.86 (d, *J* = 2.7 Hz, 2H), 2.49 (s, 3H), 2.35 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.75, 145.89, 135.51, 135.10, 133.97, 133.90, 133.82, 133.24, 132.88, 132.27, 132.08, 132.06, 131.68, 131.59, 131.42, 130.76, 129.88, 128.02, 127.26, 127.22, 125.37, 124.81, 124.51, 115.40, 114.58, 110.14, 100.11, 47.61, 20.56, 20.25. FTIR (neat): 2918, 2849, 1721, 1599, 1529, 1487, 1418, 1130, 1030, 756, 732 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{21}Cl_4N_2O$ $[M+H]^+$ 565.0403, found 565.0403.

*4.3.10. 7-(2-bromo-5-methoxybenzyl)-6-(2-bromo-5-methoxyphenyl)-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2j**)*

Following the general procedure B, compound **2j** was obtained as a white solid in 66% yield (85.0 mg), mp: 254-255 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.67 (dd, *J* = 7.9, 1.3 Hz, 1H), 8.48 (d, *J* = 8.5 Hz, 1H), 8.06 (s, 1H), 7.82 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.45 (d, *J* = 8.9 Hz, 1H), 7.35 (d, *J* = 8.7 Hz, 1H), 6.86 (s, 1H), 6.69 (dd, *J* = 8.9, 3.1 Hz, 1H), 6.63 (dd, *J* = 8.7, 3.0 Hz, 1H), 6.47 (d, *J* = 3.0 Hz, 1H), 6.19 (d, *J* = 2.9 Hz, 1H), 4.87 (q, *J* = 18.5 Hz, 2H), 3.60 (s, 3H), 3.42 (s, 3H), 2.48 (s, 3H), 2.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.12, 159.03, 158.45, 145.72, 135.67, 135.38, 135.21, 133.68, 133.33, 132.92, 132.81, 131.64, 131.14, 128.22, 127.21, 125.47, 124.53, 118.25, 118.00, 116.63, 115.30, 114.52, 113.90, 112.81, 111.92, 110.11, 102.32, 55.41, 54.91, 48.37, 20.53, 20.14. FTIR (neat): 2922, 2850, 1730, 1591, 1539, 1485, 1294, 1234, 1055, 1012, 810, 758 cm^{-1}. HRMS (ESI): m/z calcd for $C_{32}H_{27}Br_2N_2O_3$ $[M+H]^+$ 645.0383, found 645.0392, 647.0384, 649.0361.

*4.3.11. 9,10-dimethyl-6-(naphthalen-2-yl)-7-(naphthalen-2-ylmethyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2k**)*

Following the general procedure B, compound **2k** was obtained as a white solid in 63% yield (66.5 mg), mp: 164-166 °C. ^{1}H NMR (500 MHz, Acetone) δ 8.78 (d, *J* = 8.5 Hz, 1H), 8.50 (dd, *J* = 7.9, 1.6 Hz, 1H), 8.37 (s, 1H), 7.87 (ddd, *J* = 8.7, 7.2, 1.7 Hz, 1H), 7.82 (d, *J* = 8.2 Hz, 1H), 7.77 (d, *J* = 7.9 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 1H), 7.67 (s, 1H), 7.61 (d, *J* = 7.9 Hz, 1H), 7.57 (d, *J* = 8.6 Hz, 1H), 7.56 – 7.52 (m, 1H), 7.48 – 7.42 (m, 2H), 7.40 (ddd, *J* = 8.3, 3.4, 1.7 Hz, 2H), 7.30 (d, *J* = 11.1 Hz, 2H), 7.26 – 7.22 (m, 1H), 7.19 (s, 1H), 6.80 (dd, *J* = 8.5, 1.7 Hz, 1H), 5.10 (q, *J* = 17.4 Hz, 2H), 2.47 (s, 3H), 2.28 (s, 3H).^{13}C NMR (125 MHz, $CO(CD_3)_2$) δ 173.73, 147.64, 136.62, 134.32, 134.00, 133.99, 133.56, 133.30, 133.11, 132.06, 131.87, 131.61, 128.86, 128.40, 128.31, 128.28, 128.27, 128.09, 128.03, 127.46, 126.88, 126.64, 126.55, 126.33, 126.12, 125.36, 124.77, 124.58, 121.47, 116.88, 115.10, 111.65, 102.41, 48.83, 20.09, 19.90. FTIR (neat): 2920, 2850, 1595, 1531, 1485, 1416, 1271, 1186, 841, 808, 756, 738 cm^{-1}. HRMS (ESI): m/z calcd for $C_{38}H_{29}N_2O$ $[M+H]^+$ 529.2274, found 529.2288.

*4.3.12. 9,10-dimethyl-6-(thiophen-3-yl)-7-(thiophen-3-ylmethyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2l**)*

Following the general procedure B, compound **2l** was obtained as a white solid in 31% yield (27.3 mg), mp: 249-250 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.71 (d, *J* = 7.9 Hz, 1H), 8.47 (d, *J* = 8.5 Hz, 1H), 8.05 (s, 1H), 7.81 (t, *J* = 7.4 Hz, 1H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.31 (dd, *J* = 4.6, 3.0 Hz, 1H), 7.19 (dd, *J* = 4.9, 3.0 Hz, 1H), 7.13 (d, *J* = 2.1 Hz, 1H), 7.04 (d, *J* = 5.3 Hz, 2H), 6.66 (s, 1H), 6.58 (d, *J* = 4.9 Hz, 1H), 4.92 (s, 2H), 2.45 (s, 3H), 2.36 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.90, 145.88, 136.10, 135.23, 133.93, 132.89, 132.49, 131.86, 131.22, 130.88, 128.07, 127.19, 126.50, 125.77, 125.72, 124.91, 124.75, 124.69, 121.28, 115.33, 114.49, 110.82, 97.37, 44.36, 20.55, 20.26. FTIR (neat): 3057, 2918, 2854, 1593, 1539, 1514, 1427, 1298, 1182, 1072, 1031, 831, 750 cm^{-1}. HRMS (ESI): m/z calcd for $C_{26}H_{21}N_2OS_2$ $[M+H]^+$ 441.1090, found 441.1088.

*4.3.13. 7-(4-(tert-butyl)benzyl)-6-(4-(tert-butyl)phenyl)-4-fluoro-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2m**)*

Following the general procedure B, compound **2m** was obtained as a white solid in 50% yield (55.8 mg), mp: 299-300 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.7 Hz, 1H), 7.95 (s, 1H), 7.68 (td, *J* = 8.4, 5.2 Hz, 1H), 7.16 (d, *J* = 8.4 Hz, 2H), 7.12 (dd, *J* = 10.7, 8.5 Hz, 3H), 7.04 (d, *J* = 8.3 Hz, 2H), 6.89 (s, 1H), 6.57 (d, *J* = 8.3 Hz, 2H), 4.78 (s, 2H), 2.45 (s, 3H), 2.31 (s, 3H), 1.29 (s, 9H), 1.28 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.28 (d, J_{FC} = 2.5 Hz), 162.61 (d, J_{FC} = 262.5 Hz), 150.28, 149.64, 145.98, 137.40 (d, J_{FC} = 3.75 Hz), 133.81, 133.59, 132.30, 131.64, 130.95 (d, J_{FC} = 10.0 Hz), 130.93, 129.84, 127.15, 125.19, 125.17, 124.77, 115.63 (d, J_{FC} = 6.25 Hz), 114.27, 111.70 (d, J_{FC} = 22.5 Hz), 111.16 (d, J_{FC} = 3.75 Hz), 110.49, 103.54, 47.80, 34.43, 34.40, 31.34, 31.31, 20.48, 20.13. FTIR (neat): 2955, 2880, 2840, 1599, 1583, 1539, 1514, 1259, 1027, 970, 813 cm^{-1}. HRMS (ESI): m/z calcd for $C_{38}H_{40}FN_2O$ $[M+H]^+$ 559.3119, found 559.3133.

*4.3.14. 7-(2-bromo-5-fluorobenzyl)-6-(2-bromo-5-fluorophenyl)-4-chloro-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2n**)*

Following the general procedure B, compound **2n** was obtained as a white solid in 41% yield (53.6 mg), mp: 305-306 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.43 (d, *J* = 8.5 Hz, 1H), 8.01 (s, 1H), 7.66 (t, *J* = 8.2 Hz, 1H), 7.53 (d, *J* = 7.8 Hz, 1H), 7.49 (dd, *J* = 8.8, 5.4 Hz, 1H), 7.42 (dd, *J* = 8.7, 5.1 Hz, 1H), 6.90 – 6.81 (m, 3H), 6.66 (dd, *J* = 8.9, 2.9 Hz, 1H), 6.35 (dd, *J* = 9.1, 2.8 Hz, 1H), 4.87 (dd, *J* = 56.1, 18.6 Hz, 2H), 2.48 (s, 3H), 2.35 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.68, 162.15 (d, J_{FC} = 247.5 Hz), 161.46 (d, J_{FC} = 246.25 Hz), 144.72, 138.08, 136.10 (d, J_{FC} = 16.25 Hz), 136.09 (d, J_{FC} = 2.5 Hz), 134.21 (d, J_{FC} = 16.25 Hz) , 134.20, 133.45 (d, J_{FC} = 8.75 Hz), 132.65, 131.94, 130.49, 128.50, 127.12, 122.23 (d, J_{FC} = 2.5 Hz), 121.98, 120.93 (d, J_{FC} = 21.25 Hz), 116.83 (d, J_{FC} = 22.5 Hz), 116.25 (d, J_{FC} = 21.25 Hz), 115.48 (d, J_{FC} = 2.5 Hz), 115.47, 114.79, 114.61, 114.10 (d, J_{FC} = 25.0 Hz), 109.95, 102.24, 48.22, 20.54, 20.16. FTIR (neat): 2924, 2871, 1609, 1578, 1547, 1464, 1265, 1024, 808, 738, 727 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{20}Br_2ClF_2N_2O$ $[M+H]^+$ 654.9593, found 654.9588, 656.9573, 658.9551.

*4.3.15. 7-benzyl-3-bromo-9,10-dimethyl-6-phenylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2o**)*

Following the general procedure B, compound **2o** was obtained as a white solid in 45% yield (45.5 mg), mp: 267-268 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.75 (d, *J* = 2.4 Hz, 1H), 8.33 (d, *J* = 9.0 Hz, 1H), 7.94 (s, 1H), 7.85 (dd, *J* = 9.0, 2.4 Hz, 1H), 7.26 – 7.23 (m, 1H), 7.22 – 7.15 (m, 7H), 6.87 (s, 1H), 6.69 (d, *J* = 6.9 Hz, 2H), 4.83 (s, 2H), 2.46 (s, 3H), 2.30 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.54, 146.21, 135.14, 134.19, 133.75, 133.63, 133.40, 133.18, 131.87, 131.52, 130.67, 128.50, 128.25, 127.47, 127.43, 127.30, 126.98, 125.51, 118.00, 117.05, 114.13, 110.77, 103.00, 47.88, 20.53, 20.20. FTIR (neat): 2968, 2929, 2860, 1603, 1575, 1531, 1492, 1300, 1253, 1074, 790, 738, 715, 696 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{24}BrN_2O$ $[M+H]^+$ 507.1067, found 507.1080, 509.1062.

*4.3.16. 7-(3-chlorobenzyl)-6-(3-chlorophenyl)-2-fluoro-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2p**)*

Following the general procedure B, compound **2p** was obtained as a white solid in 42% yield (43.2 mg), mp: 220-223 °C. ^{1}H NMR (500 MHz, Acetone) δ 8.49 (t, *J* = 6.4 Hz, 1H), 8.42 (d, *J* = 11.0 Hz, 1H), 8.35 (s, 1H), 7.32 (t, *J* = 8.2 Hz, 1H), 7.21 (dd, *J* = 24.8, 13.5 Hz, 7H), 6.87 (s, 1H), 6.79 (s, 1H), 5.05 (q, *J* = 17.6 Hz, 2H), 2.49 (s, 3H), 2.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.28, 164.43 (d, J_{FC} = 248.75 Hz), 146.30, 136.94, 136.29, 135.24, 134.79, 134.17 (d, J_{FC} = 6.25 Hz), 133.06, 132.11, 131.95, 130.75 (d, J_{FC} = 10.0 Hz), 130.38, 130.02, 129.23, 127.99, 127.68, 126.88, 125.50, 123.35, 122.11, 114.13, 112.90 (d, J_{FC} = 22.5 Hz), 110.37, 102.26 (d, J_{FC} = 27.5 Hz), 101.16, 47.76, 20.53, 20.25. FTIR (neat): 2949, 2924, 2854, 1620, 1583, 1541, 1479, 1402, 1307, 1223, 1184, 962, 825, 767, 688 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{22}Cl_2FN_2O$ $[M+H]^+$ 515.1088, found 515.1087.

*4.3.17. 7-(3,4-difluorobenzyl)-6-(3,4-difluorophenyl)-2-methoxy-9,10-dimethylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2q**)*

Following the general procedure B, compound **2q** was obtained as a white solid in 70% yield (74.2 mg), mp: 252-254 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.54 (d, *J* = 8.9 Hz, 1H), 7.97 (s, 1H), 7.87 (d, *J* = 2.1 Hz, 1H), 7.12 (dd, *J* = 8.9, 2.1 Hz, 1H), 7.08 – 6.95 (m, 3H), 6.94 – 6.88 (m, 1H), 6.84 (s, 1H), 6.60 – 6.53 (m, 1H), 6.46 (d, *J* = 8.5 Hz, 1H), 4.83 (d, *J* = 3.5 Hz, 2H), 4.04 (s, 3H), 2.47 (s, 3H), 2.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.83, 162.26, 150.56 (d, J_{FC} = 248.75 Hz), 150.46 (d, J_{FC} = 248.75 Hz), 149.85 (dt, J_{FC} = 247.5, 12.5 Hz), 149.72 (dt, J_{FC} = 247.5, 7.5 Hz), 146.15, 136.74, 133.79, 132.90, 132.02 (t, J_{FC} = 5.0 Hz), 131.72, 130.71 (q, J_{FC} = 2.5 Hz), 129.87, 128.35 (q, J_{FC} = 3.75 Hz), 127.19, 121.35 (q, J_{FC} = 2.5 Hz), 121.20 (d, J_{FC} = 15.0 Hz), 119.37, 117.71 (d, J_{FC} = 17.5 Hz), 116.75 (d, J_{FC} = 17.5 Hz), 114.52 (d, J_{FC} = 18.75 Hz), 114.38, 111.06, 110.14, 100.71, 99.69, 55.83, 47.24, 20.58, 20.22. FTIR (neat): 3008, 2927, 1601, 1537, 1504, 1462, 1415, 1278, 1211, 1112, 1040, 931, 817, 773, 734 cm^{-1}. HRMS (ESI): m/z calcd for $C_{31}H_{23}F_4N_2O_2$ $[M+H]^+$ 531.1690, found 531.1707.

*4.3.18. 7-benzyl-6-phenylbenzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2r**)*

Following the general procedure B, compound **2r** was obtained as a slight yellow oil in 65% yield (52.0 mg), mp: 188-190 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.67 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.48 (d, *J* = 8.5 Hz, 1H), 8.26 (d, *J* = 8.1 Hz, 1H), 7.80 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.58 – 7.51 (m, 1H), 7.37 – 7.32 (m, 1H), 7.29 (dd, *J* = 11.6, 4.4 Hz, 1H), 7.25 – 7.15 (m, 8H), 7.09 (d, *J* = 7.4 Hz, 1H), 6.76 – 6.72 (m, 2H), 4.88 (s, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.20, 146.39, 135.52, 135.06, 134.91, 133.58, 131.93, 131.09, 129.09, 128.51, 128.26, 128.14, 127.46, 127.43, 125.65, 125.60, 124.61, 124.49, 122.62, 115.24, 113.29, 109.87, 102.63, 47.93. FTIR (neat): 2980, 2900, 1601, 1533, 1495, 1417, 1311, 1265, 1207, 1095, 1024, 727, 694 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{21}N_2O$ $[M+H]^+$ 401.1648, found 401.1665.

*4.3.19. 7-benzyl-6-phenyl-2-(trifluoromethyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2s**)*

Following the general procedure B, compound **2s** was obtained as a white solid in 50% yield (46.8 mg), mp: 288-289 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.78 (d, *J* = 8.3 Hz, 1H), 8.74 (s, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.3 Hz, 1H), 7.46 – 7.38 (m, 1H), 7.34 (t, *J* = 7.5 Hz, 1H), 7.30 – 7.24 (m, 2H), 7.24 – 7.16 (m, 6H), 7.13 (d, *J* = 7.6 Hz, 1H), 6.76 – 6.70 (m, 2H), 4.90 (s, 2H).^{13}C NMR (125 MHz, $CDCl_3$) δ 173.22, 146.79, 135.04, 134.88, 134.75, 132.98, 132.65 (q, J_{FC} = 32.5 Hz), 131.77, 129.32, 128.68, 128.60, 128.40, 127.89, 127.73, 127.61, 125.54, 125.11, 123.88 (q, J_{FC} = 271.25 Hz), 123.17, 120.86 (q, J_{FC} = 2.5 Hz), 113.14, 112.78 (q, J_{FC} = 3.75 Hz), 110.27, 103.61, 48.02. FTIR (neat): 3005, 2922, 1601, 1531, 1487, 1417, 1311, 1269, 1205, 1116, 754, 734 cm^{-1}. HRMS (ESI): m/z calcd for $C_{29}H_{20}F_3N_2O$ $[M+H]^+$ 469.1522, found 469.1527.

*4.3.20. 6-(6-bromopyridin-2-yl)-7-((6-bromopyridin-2-yl)methyl)benzo[4,5]imidazo[1,2-a]quinolin-5(7H)-one (**2t**)*

Following the general procedure B, compound **2t** was obtained as a white solid in 55% yield (61.4 mg), mp: 214-217 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.61 (dd, *J* = 8.0, 1.5 Hz, 1H), 8.45 (d, *J* = 8.5 Hz, 1H), 8.27 (d, *J* = 8.1 Hz, 1H), 7.84 – 7.79 (m, 1H), 7.58 (d, *J* = 7.5 Hz, 1H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 1H), 7.44 (t, *J* = 7.7 Hz, 1H), 7.42 – 7.39 (m, 1H), 7.38 – 7.32 (m, 3H), 7.13 (d, *J* = 7.7 Hz, 1H), 6.96 (d, *J* = 7.6 Hz, 1H), 5.06 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.59, 155.74, 154.04, 146.90, 141.79, 141.03, 139.40, 137.96, 135.52, 134.54, 131.66, 129.03, 128.01, 127.50, 127.15, 126.19, 125.89, 125.15, 124.95, 123.39, 119.67, 115.51, 113.49, 109.94, 100.95, 50.43. FTIR (neat): 3054, 3034, 2972, 1737, 1626, 1600, 1537, 1495, 1467, 1404, 1352, 1298, 1213, 1116, 1078, 960, 846, 732, 694

cm^{-1}. HRMS (ESI): m/z calcd for $C_{26}H_{17}Br_2N_4O$ $[M+H]^+$ 558.9764, found 558.9762, 560.9748, 562.9726.

*4.3.21. 3-(4-fluorobenzyl)-4-(4-fluorophenyl)imidazo[1,2-a]quinolin-5(3H)-one (**2u**)*

Following the general procedure B, compound **2u** was obtained as a slight yellow oil in 50% yield (38.6 mg), mp: 238-241 ˚C. ^{1}H NMR (500 MHz, $CO(CD_3)_2$) δ 8.41 (dd, *J* = 8.0, 1.2 Hz, 1H), 8.17 (d, *J* = 2.6 Hz, 1H), 8.08 (d, *J* = 8.3 Hz, 1H), 7.72 (ddd, *J* = 8.5, 7.1, 1.5 Hz, 1H), 7.50 – 7.44 (m, 1H), 7.33 (d, *J* = 2.6 Hz, 1H), 7.25 – 7.19 (m, 2H), 7.03 – 6.96 (m, 4H), 6.83 (dd, *J* = 8.8, 5.3 Hz, 2H), 4.83 (s, 2H). ^{13}C NMR (175 MHz, $CO(CD_3)_2$) δ 171.48, 162.72 (d, J_{FC} = 243.25 Hz), 162.27 (d, J_{FC} = 243.25 Hz), 143.99, 134.88 (d, J_{FC} = 8.75 Hz), 133.61, 133.28, 131.69, 130.94, 128.79 (d, J_{FC} = 8.75 Hz), 127.72, 126.16, 124.92, 122.58, 115.73 (d, J_{FC} = 22.75 Hz) , 115.44, 114.68 (d, J_{FC} = 21 Hz), 109.62, 100.53, 50.98. FTIR (neat): 2957, 2922, 2851, 1722, 1599, 1510, 1463, 1418, 1219, 1116, 817, 758, 700 cm^{-1}. HRMS (ESI): m/z calcd for $C_{24}H_{17}F_2N_2O$ $[M+H]^+$ 387.1303, found 387.1311.

*4.4 Synthesis of compound **3***

General procedure C: To a 10 mL sealed tube, compound **1** (1.0 equiv., 0.2 mmol) and benzyl bromides (4.0 equiv., 0.8 mmol) in toluene (0.5 mL) were added, and the reaction was heated at 130 ˚C for 15 h. Upon the completion of the starting materials, toluene was removed under the reduced pressure. After the remaining solid was totally dissolved in methanol (2.0 mL), DBU (2.0 equiv., 0.4 mmol, 60.0 μL) was added and the reaction was stirred at room temperature for 4 h. Then methanol was removed, and the residue was dissolved in DCM (50 mL), washed with H_2O (20 mL × 3), and dried over anhydrous Na_2SO_4. The solvent was removed and the crude was purified by using silica gel column chromatography (PE/EA = 20:1-5:1 as the eluents) to afford the target compound **3**.

*4.4.1. 1-(2-(benzylamino)-4,5-dimethylphenyl)-3-phenylquinolin-4(1H)-one (**3a**)*

Following the general procedure C, compound **3a** was obtained as a white solid in 91% yield (78.3 mg), mp: 168-171 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.57 (d, *J* = 7.9 Hz, 1H), 7.84 (s, 1H), 7.74 (d, *J* = 7.5 Hz, 2H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.47 – 7.38 (m, 3H), 7.37 – 7.32 (m, 1H), 7.30 (d, *J* = 7.3 Hz, 2H), 7.26 (dd, *J* = 11.5, 7.2 Hz, 3H), 7.10 (d, *J* = 8.5 Hz, 1H), 7.02 (s, 1H), 6.71 (s, 1H), 4.47 – 4.32 (m, 2H), 4.23 – 4.06 (m, 1H), 2.32 (s, 3H), 2.25 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.90, 142.34, 141.54, 140.13, 139.42, 138.79, 135.08, 131.80, 129.13, 128.48, 128.07, 127.08, 127.03, 126.94, 126.81, 125.84, 123.95, 123.87, 122.54, 117.04, 113.96, 47.34, 20.08, 18.47. FTIR (neat): 3369, 2922, 1680, 1620, 1587, 1516, 1465, 1334, 762, 696 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{27}N_2O$ $[M+H]^+$ 431.2118, found 431.2114.

*4.4.2. 1-(4,5-dimethyl-2-((4-(trifluoromethyl)benzyl)amino)phenyl)-3-(4-(trifluoromethyl)phenyl)quinolin-4(1H)-one (**3b**)*

Following the general procedure C, compound **3b** was obtained as a white solid in 80% yield (90.6 mg), mp: 195-197 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.49 (d, *J* = 8.0 Hz, 1H), 7.81 (s, 1H), 7.80 (d, *J* = 8.2 Hz, 2H), 7.62 (d, *J* = 8.1 Hz, 2H), 7.58 – 7.50 (m, 3H), 7.39 (t, *J* = 7.5 Hz, 1H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.03 (d, *J* = 8.5 Hz, 1H), 7.00 (s, 1H), 6.56 (s, 1H), 4.41 (s, 2H), 2.26 (s, 3H), 2.20 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.76, 143.36, 142.84, 141.27, 140.21, 139.88, 138.75, 132.16, 129.50 (q, J_{FC} = 32.5 Hz), 129.30, 128.86 (q, J_{FC} = 32.5 Hz), 128.45, 127.05, 126.98, 126.37, 125.57 (q, J_{FC} = 2.5 Hz), 125.01 (q, J_{FC} = 3.75 Hz), 124.51, 124.26 (q, J_{FC} = 270.0 Hz), 124.08 (q, J_{FC} = 271.25 Hz), 123.81, 120.95, 117.18, 113.92, 46.87, 20.20, 18.55. ^{19}F NMR (470 MHz, $CDCl_3$) δ -62.37, -62.40. FTIR (neat): 3331, 2924, 1680, 1608, 1576, 1518, 1464, 1323, 1109, 1064, 843, 762 cm^{-1}. HRMS (ESI): m/z calcd for $C_{32}H_{25}F_6N_2O$ $[M+H]^+$ 567.1866, found 567.1864.

*4.4.3. 1-(4,5-dimethyl-2-((3-nitrobenzyl)amino)phenyl)-3-(3-nitrophenyl)quinolin-4(1H)-one (**3c**)*

Following the general procedure C, compound **3c** was obtained as a white solid in 73% yield (75.9 mg), mp: 222-223 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.49 (s, 1H), 8.35 (d, *J* = 7.9 Hz, 1H), 8.13 (s, 1H), 8.09 (dd, *J* = 15.6, 7.5 Hz, 3H), 7.95 (s, 1H), 7.66 – 7.61 (m, 2H), 7.50 (t, *J* = 7.8 Hz, 2H), 7.33 (t, *J* = 7.4 Hz, 1H), 7.11 (d, *J* = 8.5 Hz, 1H), 7.01 (s, 1H), 6.50 (s, 1H), 4.61 – 4.47 (m, 2H), 2.24 (s, 3H), 2.20 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.66, 148.65, 147.85, 143.09, 141.96, 140.98, 140.18, 140.00, 136.68, 134.05, 132.99, 132.57, 129.61, 129.40, 128.85, 126.84, 126.60, 126.30, 124.87, 123.69, 122.93, 122.25, 121.58, 121.50, 119.49, 117.33, 113.67, 46.27, 20.22, 18.54. FTIR (neat): 3311, 2922, 1710, 1607, 1521, 1342, 1281, 732 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{25}N_4O_5$ $[M+H]^+$ 521.1819, found 521.1815.

*4.4.4. 1-(2-((4-(tert-butyl)benzyl)amino)-4,5-dimethylphenyl)-3-(4-(tert-butyl)phenyl)quinolin-4(1H)-one (**3d**)*

Following the general procedure C, compound **3d** was obtained as a white solid in 37% yield (40.1 mg), mp: 153-154 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.58 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.79 (s, 1H), 7.66 (d, *J* = 8.4 Hz, 2H), 7.56 – 7.51 (m, 1H), 7.44 (d, *J* = 8.4 Hz, 2H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.28 (d, *J* = 8.2 Hz, 2H), 7.10 (d, *J* = 8.1 Hz, 2H), 7.04 (d, *J* = 8.5 Hz, 1H), 6.98 (s, 1H), 6.70 (s, 1H), 4.36 – 4.22 (m, 2H), 3.77 (s, 1H), 2.30 (s, 3H), 2.21 (s, 3H), 1.36 (s, 9H), 1.29 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 176.17, 150.23, 149.97, 142.19, 141.73, 140.19, 139.48, 135.55, 132.20, 131.86, 129.23, 128.23, 127.20, 127.00, 126.73, 125.94, 125.54, 125.20, 124.00, 123.94, 122.69, 117.08, 113.94, 47.26, 34.49, 34.41, 31.32, 31.27, 20.16, 18.55. FTIR (neat): 3358, 2960, 1712, 1622, 1514, 1477, 1328, 835, 758 cm^{-1}. HRMS (ESI): m/z calcd for $C_{38}H_{43}N_2O$ $[M+H]^+$ 543.3370, found 543.3375.

*4.4.5. 1-(2-((3-bromobenzyl)amino)-4,5-dimethylphenyl)-3-(3-bromophenyl)quinolin-4(1H)-one (**3e**)*

Following the general procedure C, compound **3e** was obtained as a white solid in 77% yield (90.2 mg), mp: 164-166 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.50 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.83 (s, 1H), 7.78 (s, 1H), 7.67 (d, *J* = 7.8 Hz, 1H), 7.61 – 7.56 (m, 1H), 7.45 – 7.37 (m, 2H), 7.37 – 7.32 (m, 2H), 7.25 (t, *J* = 7.8 Hz, 2H), 7.19 – 7.11 (m, 2H), 7.03 (d, *J* = 8.5 Hz, 1H), 6.99 (s, 1H), 6.57 (s, 1H), 4.38 – 4.26 (m, 2H), 2.26 (s, 3H), 2.20 (s, 3H). ^{13}C NMR (175 MHz, $CDCl_3$) δ 175.72, 142.58, 141.62, 141.19, 140.11, 139.73, 137.16, 132.25, 131.08, 130.25, 130.17, 129.94, 129.79, 129.63, 129.26, 127.07, 127.02, 126.93, 126.17, 125.45, 124.41, 123.82, 122.82, 122.18, 120.96, 117.15, 113.84, 46.58, 20.20, 18.55. FTIR (neat): 3319, 2922, 1681, 1608, 1516, 1323, 1255, 1068, 837, 738, 665 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{25}Br_2N_2O$ $[M+H]^+$ 587.0328, found 587.0310, 589.0303, 591.0292.

*4.4.6. 1-(2-((3,4-difluorobenzyl)amino)-4,5-dimethylphenyl)-3-(3,4-difluorophenyl)quinolin-4(1H)-one (**3f**)*

Following the general procedure C, compound **3f** was obtained as a white solid in 85% yield (85.3 mg), mp: 171-173 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.39 (d, *J* = 7.9 Hz, 1H), 7.75 (s, 1H), 7.61 – 7.50 (m, 2H), 7.37 – 7.29 (m, 2H), 7.16 – 6.92 (m, 6H), 6.55 (s, 1H), 4.41 – 4.26 (m, 2H), 2.26 (s, 3H), 2.19 (s, 3H). ^{13}C NMR (175 MHz, $CDCl_3$) δ 175.69, 150.48 (dd, J_{FC} = 246.25, 12.25 Hz), 149.87 (dd, J_{FC} = 246.25, 12.25 Hz), 149.42 (dd, J_{FC} = 246.25, 12.25 Hz), 149.40 (dd, J_{FC} = 245.88, 17.5 Hz), 142.41, 141.18, 140.12, 139.81, 136.35, 132.15, 131.97, 129.28, 126.86, 126.29, 124.42, 124.02 (d, J_{FC} = 3.5 Hz), 123.80, 122.61 (d, J_{FC} = 3.5 Hz), 120.25, 117.51, 117.40, 117.32 (d, J_{FC} = 17.5 Hz), 117.15, 116.70 (d, J_{FC} = 15.75 Hz), 115.66 (d, J_{FC} = 17.5 Hz), 113.90, 46.27, 20.19, 18.53. FTIR (neat): 3321, 2922, 1680, 1610, 1574, 1512, 1338, 1271, 1109, 812, 758 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{23}F_4N_2O$ $[M+H]^+$ 503.1741, found 503.1736.

*4.4.7. 3-(6-bromopyridin-2-yl)-1-(2-(((6-bromopyridin-2-yl)methyl)amino)-4,5-dimethylphenyl)quinolin-4(1H)-one (**3g**)*

Following the general procedure C, compound **3g** was obtained as a white solid in 94% yield (110.5 mg), mp: 217-218 °C. ^{1}H NMR (500 MHz, DMSO) δ 8.90 (d, *J* = 7.8 Hz, 1H), 8.67 (s, 1H), 8.41 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.80 (t, *J* = 7.8 Hz, 1H), 7.74 – 7.61 (m, 2H), 7.51 – 7.44 (m, 3H), 7.22 (d, *J* = 7.6 Hz, 1H), 7.13 (s, 1H), 7.03 (d, *J* = 8.4 Hz, 1H), 6.57 (s, 1H), 6.05 (t, *J* = 6.3 Hz, 1H), 4.32 (d, *J* = 6.2 Hz, 2H), 2.17 (s, 3H), 2.12 (s, 3H). ^{13}C NMR (125 MHz, DMSO) δ 175.10, 161.74, 154.38, 145.66, 141.36, 140.63, 140.34, 140.04, 139.98, 139.92, 139.19, 132.36, 129.27, 127.60, 126.15, 126.07, 125.53, 124.69, 124.43, 123.34, 121.47, 119.96, 117.77, 116.11, 113.36, 47.04, 19.73, 17.99. FTIR (neat): 3344, 2920, 1618, 1578, 1521, 1421, 1317, 1121, 779 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{23}Br_2N_4O$ $[M+H]^+$ 589.0233, found 589.0235, 591.0221, 593.0199.

*4.4.8. 1-(4,5-dimethyl-2-((thiophen-3-ylmethyl)amino)phenyl)-3-(thiophen-3-yl)quinolin-4(1H)-one (**3h**)*

Following the general procedure C, compound **3h** was obtained as a white solid in 94% yield (37 mg), mp: 216-217 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.49 (d, *J* = 7.2 Hz, 1H), 8.49 (d, *J* = 7.2 Hz, 1H), 8.19 (d, *J* = 2.0 Hz, 1H), 7.95 (s, 1H), 7.52 – 7.46 (m, 1H), 7.40 (d, *J* = 4.4 Hz, 1H), 7.34 (t, *J* = 7.5 Hz, 1H), 7.30 (dd, *J* = 5.0, 3.1 Hz, 1H), 7.22 (dd, *J* = 4.9, 3.0 Hz, 1H), 7.03 – 6.95 (m, 3H), 6.86 (d, *J* = 4.8 Hz, 1H), 6.72 (s, 1H), 4.33 (s, 2H), 2.31 (s, 3H), 2.21 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.76, 141.54, 141.40, 139.90, 139.75, 139.64, 134.76, 131.80, 129.29, 127.06, 126.82, 126.55, 126.32, 126.17, 125.91, 124.61, 124.13, 124.06, 122.93, 121.36, 117.80, 117.04, 114.08, 43.13, 20.20, 18.58. FTIR (neat): 3342, 2914, 2856, 1620, 1608, 1573, 1520, 1479, 1381, 1289, 754, 678 cm^{-1}. HRMS (ESI): m/z calcd for $C_{26}H_{23}N_2OS_2$ $[M+H]^+$ 443.1246, found 443.1256.

*4.4.9. 1-(2-(benzylamino)phenyl)-3-phenylquinolin-4(1H)-one (**3i**)*

Following the general procedure C, compound **3i** was obtained as a white solid in 85% yield (68.3 mg), mp: 189-191 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.54 (d, *J* = 8.1 Hz, 1H), 7.80 (s, 1H), 7.68 (d, *J* = 7.9 Hz, 2H), 7.54 (t, *J* = 7.7 Hz, 1H), 7.40 (t, *J* = 7.1 Hz, 3H), 7.36 (d, *J* = 8.8 Hz, 1H), 7.34 – 7.31 (m, 1H), 7.30 – 7.25 (m, 2H), 7.24 (d, *J* = 7.5 Hz, 1H), 7.22 – 7.18 (m, 3H), 7.01 (d, *J* = 8.5 Hz, 1H), 6.84 (dd, *J* = 16.8, 8.1 Hz, 2H), 4.41 – 4.31 (m, 2H), 4.26 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 176.06, 143.81, 142.03, 140.04, 138.39, 135.00, 132.04, 130.95, 128.66, 128.63, 128.61, 128.21, 127.31, 127.22, 127.15, 127.03, 126.81, 126.14, 124.19, 122.93, 117.64, 116.88, 112.59, 47.19. FTIR (neat): 3337, 2922, 1736, 1620, 1607, 1577, 1520, 1323, 1244, 756, 696 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{23}N_2O$ $[M+H]^+$ 403.1805, found 403.1816.

*4.4.10. 1-(2-((3-chlorobenzyl)amino)phenyl)-3-(3-chlorophenyl)quinolin-4(1H)-one (**3j**)*

Following the general procedure C, compound **3j** was obtained as a white solid in 83% yield (78.0 mg), mp: 151-152 °C. ^{1}H NMR (500 MHz, $CO(CD_3)_2$) δ 8.42 (d, *J* = 8.0 Hz, 1H), 8.12 (s, 1H), 7.97 (t, *J* = 1.7 Hz, 1H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.65 (ddd, *J* = 8.5, 7.1, 1.5 Hz, 1H), 7.46 – 7.41 (m, 1H), 7.39 (d, *J* = 7.9 Hz, 1H), 7.37 – 7.34 (m, 3H), 7.34 – 7.29 (m, 3H), 7.26 – 7.20 (m, 1H), 6.99 (d, *J* = 8.4 Hz, 1H), 6.87 – 6.80 (m, 2H), 5.95 (t, *J* = 5.8 Hz, 1H), 4.44 (d, *J* = 6.3 Hz, 2H). ^{13}C NMR (125 MHz, $CO(CD_3)_2$) δ 175.88, 144.87, 143.68, 143.30, 141.31, 138.71, 134.59, 133.91, 132.73, 131.50, 130.71, 130.16, 129.80, 129.14, 128.16, 127.51, 127.42, 127.27, 127.16, 127.01, 126.20, 124.57, 120.96, 118.00, 117.75, 113.04, 46.21. FTIR (neat): 3325, 2922, 1681, 1620, 1575, 1516, 1477, 1323, 748, 680 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{21}Cl_2N_2O$ $[M+H]^+$ 471.1025, found 471.1019.

*4.4.11. 1-(2-((3-bromobenzyl)amino)phenyl)-3-(3-bromophenyl)quinolin-4(1H)-one (**3k**)*

Following the general procedure C, compound **3k** was obtained as a white solid in 74% yield (82.6 mg), mp: 140-141 °C. ^{1}H NMR (500 MHz, $CO(CD_3)_2$) δ 8.43 (dd, *J* = 8.1, 1.3 Hz, 1H), 8.15 – 8.09 (m, 2H), 7.83 – 7.79 (m, 1H), 7.67 (ddd, *J* = 8.6, 7.0, 1.6 Hz, 1H), 7.50 (s, 1H), 7.49 – 7.41 (m, 2H), 7.41 – 7.31 (m, 5H), 7.24 (t, *J* = 7.8 Hz, 1H), 6.99 (d, *J* = 8.5 Hz, 1H), 6.83 (dd, *J* = 11.1, 4.5 Hz, 2H), 5.95 (t, *J* = 6.2 Hz, 1H), 4.44 (d, *J* = 6.3 Hz, 2H). ^{13}C NMR (125 MHz, $CO(CD_3)_2$) δ 175.85, 144.82, 143.66, 143.53, 141.31, 139.00, 132.77, 132.02, 131.50, 130.99, 130.46, 130.43, 130.11, 129.79, 128.15, 127.86, 127.26, 127.00, 126.62, 124.55, 122.85, 122.16, 120.90, 117.98, 117.75, 113.02, 110.69, 46.12. FTIR (neat): 3346, 2922, 1712, 1608, 1577, 1521, 1479, 1317, 759, 740, 682 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{21}Br_2N_2O$ $[M+H]^+$ 559.0015, found 558.9992, 560.9987, 562.9977.

*4.4.12. 1-(2-((3,4-dichlorobenzyl)amino)phenyl)-3-(3,4-dichlorophenyl)quinolin-4(1H)-one (**3l**)*

Following the general procedure C, compound **3l** was obtained as a white solid in 75% yield (80.7 mg), mp: 148-150 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.30 (d, *J* = 7.8 Hz, 1H), 7.79 (s, 1H), 7.75 (s, 1H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.47 (d, *J* = 8.0 Hz, 1H), 7.42 – 7.34 (m, 4H), 7.31 (t, *J* = 7.5 Hz, 1H), 7.23 – 7.17 (m, 1H), 7.11 (d, *J* = 8.1 Hz, 1H), 6.97 (d, *J* = 8.5 Hz, 1H), 6.87 (t, *J* = 7.3 Hz, 1H), 6.72 (d, *J* = 8.2 Hz, 1H), 4.90 (s, 1H), 4.49 – 4.33 (m, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.64, 143.54, 142.42, 139.88, 139.74, 139.69, 134.82, 132.74, 132.24, 131.89, 131.19, 130.98, 130.68, 130.57, 129.80, 129.64, 128.71, 127.08, 126.73, 126.57, 126.32, 125.88, 124.59, 119.54, 117.50, 117.03, 112.36, 45.78. FTIR (neat): 3323, 2922, 1681, 1607, 1575, 1519, 1471, 1319, 1028, 821, 740 cm^{-1}. HRMS (ESI): m/z calcd for $C_{28}H_{19}Cl_4N_2O$ $[M+H]^+$ 539.0246, found 539.0190.

*4.4.13. 1-(2-((4-(trifluoromethyl)benzyl)amino)phenyl)-3-(4-(trifluoromethyl)phenyl)quinolin-4(1H)-one (**3m**)*

Following the general procedure C, compound **3m** was obtained as a white solid in 70% yield (75.3 mg), mp: 197-200 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, *J* = 7.8 Hz, 1H), 7.82 (s, 1H), 7.69 (d, *J* = 8.2 Hz, 2H), 7.53 (dt, *J* = 14.5, 7.4 Hz, 5H), 7.39 (d, *J* = 7.9 Hz, 2H), 7.35 (t, *J* = 7.8 Hz, 1H), 7.26 (t, *J* = 7.5 Hz, 1H), 7.21 (d, *J* = 7.7 Hz, 1H), 7.00 (d, *J* = 8.5 Hz, 1H), 6.86 (t, *J* = 7.5 Hz, 1H), 6.74 (d, *J* = 8.3 Hz, 1H), 5.08 (t, *J* = 5.9 Hz, 1H), 4.59 – 4.45 (m, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.81,

143.63, 143.08, 142.58, 140.03, 138.59, 132.22, 131.21, 129.60 (q, J_{FC} = 32.5 Hz), 128.88 (q, J_{FC} = 32.5 Hz), 128.75, 128.39, 127.04, 127.01, 126.92, 126.00, 125.60 (q, J_{FC} = 3.75 Hz), 125.00 (q, J_{FC} = 3.75 Hz), 124.62, 124.23 (q, J_{FC} = 270.13 Hz), 124.05 (q, J_{FC} = 270.38 Hz), 121.03, 117.83, 116.97, 112.50, 46.64. FTIR (neat): 3365, 2924, 1712, 1682, 1608, 1579, 1521, 1321, 1107, 1064, 756, 740 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{21}F_6N_2O$ $[M+H]^+$ 539.1553, found 539.1564.

*4.4.14. 1-(2-(benzylamino)-4,5-dimethylphenyl)-5-chloro-3-phenylquinolin-4(1H)-one (**3n**)*

Following the general procedure C, compound **3n** was obtained as a white solid in 63% yield (58.5 mg), mp: 224-226 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.66 (s, 1H), 7.66 – 7.63 (m, 2H), 7.37 (t, *J* = 7.5 Hz, 2H), 7.35 – 7.29 (m, 3H), 7.29 – 7.20 (m, 4H), 7.17 (d, *J* = 7.1 Hz, 2H), 6.95 (s, 1H), 6.92 (dd, *J* = 7.7, 2.0 Hz, 1H), 6.64 (s, 1H), 4.39 – 4.22 (m, 2H), 3.89 (s, 1H), 2.26 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.59, 142.80, 141.47, 141.23, 139.73, 138.69, 135.20, 134.75, 131.11, 129.13, 128.86, 128.67, 128.12, 127.35, 127.28, 126.94, 126.31, 124.59, 124.30, 123.45, 116.29, 114.19, 47.56, 20.17, 18.57. FTIR (neat): 3354, 2920, 1712, 1614, 1573, 1519, 1462, 1304, 808, 731, 692 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{26}ClN_2O$ $[M+H]^+$ 465.1728, found 465.1736.

*4.4.15. 1-(2-((3,4-dichlorobenzyl)amino)-4,5-dimethylphenyl)-3-(3,4-dichlorophenyl)-7-methoxyquinolin-4(1H)-one (**3o**)*

Following the general procedure C, compound **3o** was obtained as a white solid in 90% yield (107.3 mg), mp: 259-260 ˚C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, *J* = 9.0 Hz, 1H), 7.75 (d, *J* = 2.0 Hz, 1H), 7.68 (s, 1H), 7.48 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.36 (t, *J* = 5.6 Hz, 3H), 7.10 (dd, *J* = 8.2, 1.6 Hz, 1H), 6.94 (s, 1H), 6.90 (dd, *J* = 9.0, 2.3 Hz, 1H), 6.51 (s, 1H), 6.33 (d, *J* = 2.3 Hz, 1H), 4.57 (d, *J* = 5.5 Hz, 1H), 4.43 – 4.30 (m, 2H), 3.76 (s, 3H), 2.25 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.17, 162.99, 142.20, 141.94, 140.94, 139.90, 139.68, 135.13, 132.78, 132.06, 131.11, 130.72, 130.62, 129.92, 129.23, 129.00, 128.65, 127.59, 126.51, 126.13, 123.82, 121.14, 119.87, 113.86, 113.15, 99.48, 55.59, 46.22, 20.27, 18.60. FTIR (neat): 3325, 2921, 1614, 1572, 1519, 1460, 1278, 1208, 833 cm^{-1}. HRMS (ESI): m/z calcd for $C_{31}H_{25}Cl_4N_2O_2$ $[M+H]^+$ 597.0665, found 597.0658.

*4.4.16. 1-(2-((2-bromo-5-fluorobenzyl)amino)phenyl)-3-(2-bromo-5-fluorophenyl)-7-(trifluoromethyl)quinolin-4(1H)-one (**3p**)*

Following the general procedure C, compound **3p** was obtained as a white solid in 34% yield (45.0 mg), mp: 247-248 ˚C. ^{1}H NMR (500 MHz, DMSO) δ 8.53 (d, *J* = 8.3 Hz, 1H), 8.21 (s, 1H), 7.81 – 7.73 (m, 2H), 7.65 (dd, *J* = 8.7, 5.3 Hz, 1H), 7.38 (t, *J* = 7.6 Hz, 2H), 7.31 (dd, *J* = 9.4, 3.1 Hz, 1H), 7.22 (td, *J* = 8.5, 3.1 Hz, 1H), 7.16 (s, 1H), 7.08 (td, *J* = 8.4, 3.1 Hz, 1H), 6.91 (dd, *J* = 9.6, 3.0 Hz, 1H), 6.84 (dd, *J* = 10.9, 4.1 Hz, 1H), 6.61 (d, *J* = 8.1 Hz, 1H), 6.33 (t, *J* = 5.8 Hz, 1H), 4.28 (qd, *J* = 17.2, 5.9 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.53, 162.18 (d, J_{FC} = 246.25 Hz), 161.66 (d, J_{FC} = 246.25 Hz), 144.79, 143.06, 140.16, 139.08 (d, J_{FC} = 6.25 Hz), 136.55 (d, J_{FC} = 7.5 Hz), 134.41, 134.18 (q, J_{FC} = 8.75 Hz), 131.82, 128.86, 128.73, 128.70, 125.19, 123.31 (q, J_{FC} = 270.0 Hz), 122.95, 120.67, 119.56 (d, J_{FC} = 22.5 Hz), 118.71, 118.47 (d, J_{FC} = 2.5 Hz), 116.78 (d, J_{FC} = 225 Hz) 116.73 (d, J_{FC} = 2.5 Hz), 116.19 (d, J_{FC} = 22.5 Hz), 115.72 (d, J_{FC} = 22.5 Hz), 114.63 (d, J_{FC} = 3.75 Hz), 112.85, 47.56. FTIR (neat): 3396, 2924, 1605, 1516, 1462, 1317, 1170, 1128, 1026, 808 cm^{-1}. HRMS (ESI): m/z calcd for $C_{29}H_{18}Br_2F_5N_2O$ $[M+H]^+$ 662.9701, found 662.9696, 664.9682, 666.9664.

*4.5. Synthesis of intermediates **I** and **II**.*

*4.5.1. 10,10a-dibenzyl-7,8-dimethyl-10,10a-dihydro-11H-benzo[4,5]imidazo[1,2-a]indol-11-one (**I**)*

According to the general procedure B, after the reaction was running for two hours (we found a new weak red spot (compound **I**), together with product **2** and starting material **1**, on the TLC plate), it was terminated mandatorily by adding water, and the mixture was then extracted with AcOEt. The AcOEt layer was dried and removed, and the crude mixture was purified using silica gel column chromatography (PE/EA = 100:1 - 50:1) to afford compound **I** as a red solid, mp: 168-169 ˚C. ^{1}H NMR (500 MHz, DMSO) δ 7.64 – 7.60 (m, 1H), 7.51 (d, *J* = 9.1 Hz, 2H), 7.34 (s, 1H), 7.26 (t, *J* = 7.3 Hz, 2H), 7.20 (d, *J* = 7.2 Hz, 1H), 7.18 – 7.15 (m, 4H), 7.13 (t, *J* = 7.4 Hz, 2H), 7.07 (ddd, *J* = 10.9, 5.2, 2.7 Hz, 2H), 5.92 (s, 1H), 4.90 (d, *J* = 16.4 Hz, 1H), 4.46 (d, *J* = 16.4 Hz, 1H), 3.37 (d, *J* = 13.4 Hz, 1H), 3.14 (d, *J* = 13.3 Hz, 1H), 2.14 (s, 3H), 1.96 (s, 3H).^{13}C NMR (125 MHz, DMSO) δ 198.94, 161.83, 142.85, 138.30, 138.03, 133.70, 133.09, 132.01, 130.49, 128.40, 127.70, 126.87, 126.63, 126.53, 125.11, 124.25, 123.09, 117.92, 115.05, 107.69, 89.99, 45.81, 36.61, 19.52, 18.94. FTIR (neat): 2918, 1849, 1708, 1600, 1494, 1454, 1360, 1296, 1134, 841, 746, 696 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{27}N_2O$ $[M+H]^+$ 431.2118, found 431.2118.

*4.5.2. 10,11-dibenzyl-11-hydroxy-7,8-dimethyl-11H-benzo[4,5]imidazo[1,2-a]indol-10-ium bromide (**II**)*

The intermediate **II** was obtained from the first step according to the general procedure C. The crude product was dissolved in MeOH and purified using semi-preparative HPLC (column: ODS-AQ C_{18}, 250×10 mml.D.S-5 μm, 12 nm) with MeOH:H_2O = 63:37 as eluent, mp: 34-37 ˚C. ^{1}H NMR (500 MHz, MeOD) δ 8.03 (s, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.66 (dt, *J* = 7.1, 3.5 Hz, 2H), 7.60 – 7.53 (m, 2H), 7.50 (d, *J* = 7.0 Hz, 2H), 7.47 – 7.36 (m, 3H), 7.11 (t, *J* = 7.4 Hz, 1H), 7.03 (t, *J* = 7.5 Hz, 2H), 6.84 (d, *J* = 7.3 Hz, 2H), 5.93 (d, *J* = 15.5 Hz, 1H), 5.78 (d, *J* = 15.5 Hz, 1H), 3.79 (d, *J* = 13.5 Hz, 1H), 3.71 (d, *J* = 13.6 Hz, 1H), 2.48 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (125 MHz, MeOD) δ 158.15, 140.16, 139.69, 139.28, 137.04, 135.14, 134.55, 134.37, 132.19, 131.02, 130.35, 130.22, 129.37, 129.23, 129.09, 128.82, 126.81, 126.24, 115.65, 114.76, 114.67, 81.10, 50.90, 45.37, 20.60, 20.43. FTIR (neat): 3047, 2929, 1681, 1558, 1483, 1456, 1202, 1138, 979, 800, 725, 704 cm^{-1}. HRMS (ESI): m/z calcd for $C_{30}H_{27}N_2O$ $[M]^+$ 431.2118, found 431.2113.

Acknowledgments

We thank Prof. Liming Zhang (UC Santa Barbara) and Dr. Zhixun Wang (Yale University) for valuable discussions and suggestions. We also thank Dr. Zhihui Xiao, Dr. Chuanrong Li, and Dr. Xiaohong Zheng for the help on NMR analysis, and Ms. Aijun Sun, Ms. Yun Zhang, and Ms. Xuan Ma for the help on HRMS and X-ray analysis. This work was supported by the National Natural Science Foundation of China (21772210, 41476135) and Natural Science Foundation of Anhui Province (1608085MB38).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org

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