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Direct Conversion of 1-(2-Bromobenzoyl)isoquinolines to Dibenzo[*de,g*]quinolin-7-ones via Reductive Photocyclization

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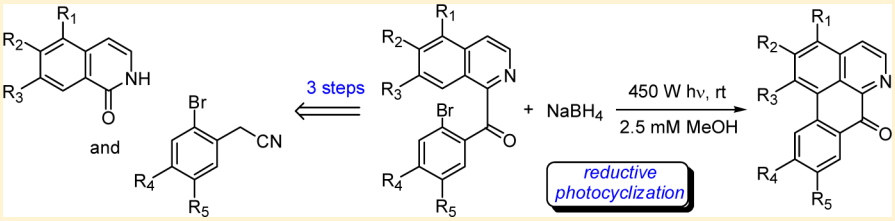
Supporting Information

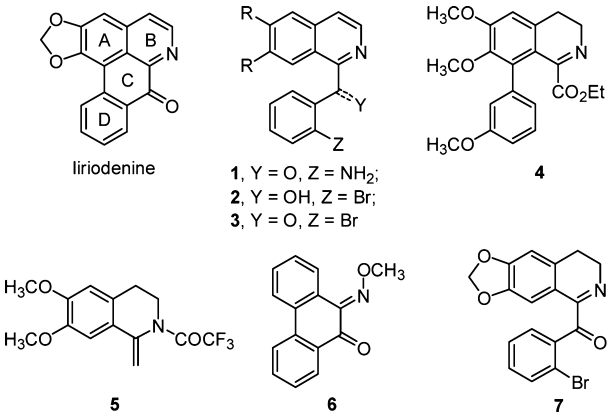


ABSTRACT: A series of A/D-ring substituted dibenzo[*de,g*]quinolin-7-ones was produced from the corresponding isoquinolinones and (2-bromophenyl)acetonitriles in four steps. This represents a convenient approach toward the synthesis of tetracyclic alkaloids. A direct conversion of 1-(2-bromobenzoyl)isoquinolines to dibenzo[*de,g*]quinolin-7-ones is the key step in the total synthesis. The yield of the reductive photocyclization depends on the position of the substituents at the isoquinolyl ring and the phenyl group. The mechanism of the reductive photocyclization is also discussed.

INTRODUCTION

Since the first isolation of liriodenine from *Atherosperma moschatum* Labill. in 1956,[1] dibenzo[*de,g*]quinolin-7-one alkaloids have been the focus of study in medicinal and synthetic chemistry. Some of the dibenzo[*de,g*]quinolin-7-one alkaloids have shown extensive pharmacological activities, such as antileishmanial,[2] antimicrobial,[3,4] antivirus,[5−7] antioxidative,[8] vasorelaxing,[8,9] antiplatelet aggregation,[10−12] antiflammatory,[13] and cytotoxic[13−19] activities. Moreover, previous structure−activity relationship (SAR) studies have indicated that removal of the oxo function sharply reduces the cytotoxic activities against human lung carcinoma A-549 and colon HCT-8 tumor cells.[20] This finding suggests that the oxo function may contribute to anticancer activity by extending the conjugation of the aporphine ring system.[20,21] However, dibenzo[*de,g*]-quinolin-7-one alkaloids are present in minor amounts in plants, even though they may be widely distributed in many plant families (e.g., Annonaceae, Magnoliaceae).[22−26] These tetracyclic alkaloids are most likely derived in the plants through the oxidation of the corresponding aporphines.[27,28]

The wide range of pharmacological properties exhibited by dibenzo[*de,g*]quinolin-7-one alkaloids has attracted the attention of chemists. Over the past several decades, the following methodologies have allowed access to dibenzo[*de,g*]quinolin-7-one alkaloids: (a) Coupling of rings A/D: using the Pschorr cyclization of 1-(2-amionbenzoyl)isoquinoline **1**, the first total synthesis of dibenzo[*de,g*]quinolin-7-ones was disclosed by Taylor in 1961,[29] and other methods are photocyclization[30] or Bu_3SnH-induced aryl radical cyclization[31] of the bromides **2** or **3**. (b) Ring closure between rings B and D: intramolecular Friedel−Crafts acylation of 8-phenyl-3,4-dihydroisoquinolines **4** in polyphosphoric acid has been utilized.[32] (c) A convergent



method involving the intermolecular [4 + 2] cycloaddition of protected 1-methylene-isoquinoline **5** with benzyne[33] or 10-(methoxyimino)phenanthren-9-one **6** with dimethyl acetylene-dicaboxylate (DMAD)[34] to provide the tetracyclic skeleton. However, there are some inherent limitations in the above methodologies. For example, the symmetrical species benzyne and DMAD were used. Moreover, the precursors of the Pschorr and radical cyclizations, obtained via alkylation of Reissert compounds, resulted in 1-cyanoisoquinoline byproducts that were difficult to separate from the products.[35] Furthermore, an attempt to prepare the aporphine skeleton by photocyclization of the bromo ketone **7**, as reported by Kessar et al.,[36] was unsuccessful. In this paper, we disclose a convenient one-pot methodology to produce a variety of A/D-ring substituted dibenzo[*de,g*]quinolin-7-ones **8** via photocyclization of 1-(2-

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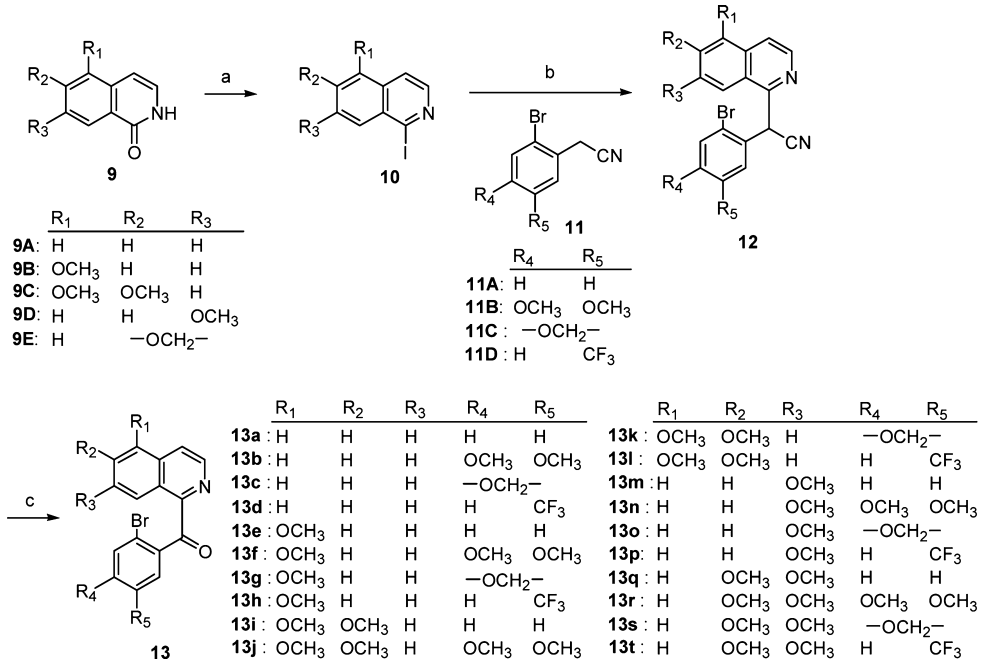
Scheme 1. Synthesis of 1-(2-Bromobenzoyl)isoquinolines 13[a]



[a]Reagents and conditions: (a) (i) Tf_2O, py, CH_3CN, rt, 2 h; (ii) NaI, TfOH, rt, overnight; (b) $NaNH_2$, THF, reflux, overnight; (c) NaH, O_2, THF, rt, 3 h.

Table 1. Formation of 12 and 13 from 1-Iodoisoquinolines 10 and (2-Bromophenyl)acetonitriles 11

			products (%)[a]	
entry	1-iodoisoquinoline (**10**), R =	(2-bromophenyl)acetonitrile (**11**), R =	**12**	**13**
1	**10A**, R = H	**11A**, R = H	**12a** (97)	**13a** (95)
2	**10A**, R = H	**11B**, R = 4,5-dimethoxy	**12b** (72)	**13b** (96)
3	**10A**, R = H	**11C**, R = 4,5-methylenedioxy	**12c** (76)	**13c** (81)
4	**10A**, R = H	**11D**, R = 5-trifluoromethyl	**12d** (89)	**13d** (59)[b]
5	**10B**, R = 5-methoxy	**11A**, R = H	**12e** (76)	**13e** (94)
6	**10B**, R = 5-methoxy	**11B**, R = 4,5-dimethoxy	**12f** (85)	**13f** (84)
7	**10B**, R = 5-methoxy	**11C**, R = 4,5-methylenedioxy	**12g** (95)	**13g** (67)
8	**10B**, R = 5-methoxy	**11D**, R = 5-trifluoromethyl	**12h** (75)	**13h** (55)[b]
9	**10C**, R = 5,6-dimethoxy	**11A**, R = H	**12i** (91)	**13i** (89)
10	**10C**, R = 5,6-dimethoxy	**11B**, R = 4,5-dimethoxy	**12j** (100)	**13j** (91)
11	**10C**, R = 5,6-dimethoxy	**11C**, R = 4,5-methylenedioxy	**12k** (97)	**13k** (94)
12	**10C**, R = 5,6-dimethoxy	**11D**, R = 5-trifluoromethyl	**12l** (93)	**13l** (65)[b]
13	**10D**, R =7-methoxy	**11A**, R = H	**12m** (74)	**13m** (88)
14	**10D**, R = 7-methoxy	**11B**, R = 4,5-dimethoxy	**12n** (100)	**13n** (96)
15	**10D**, R = 7-methoxy	**11C**, R = 4,5-methylenedioxy	**12o** (84)	**13o** (88)
16	**10D**, R = 7-methoxy	**11D**, R = 5-trifluoromethyl	**12p** (80)	**13p** (74)[b]
17	**10E**, R = 6,7-methylenedioxy	**11A**, R = H	**12q** (92)	**13q** (92)
18	**10E**, R = 6,7-methylenedioxy	**11B**, R = 4,5-dimethoxy	**12r** (87)	**13r** (79)
19	**10E**, R = 6,7-methylenedioxy	**11C**, R = 4,5-methylenedioxy	**12s** (97)	**13s** (94)
20	**10E**, R = 6,7-methylenedioxy	**11D**, R = 5-trifluoromethyl	**12t** (91)	**13t** (53)[b]

[a]Isolated yields. [b]Recovered starting materials **12d**, **12h**, **12l**, **12p**, and **12t** in 24%, 25%, 30%, 12%, and 30% yields, respectively.

bromobenzoyl)isoquinolines **13** in the presence of sodium borohydride ($NaBH_4$). In addition, a systematic investigation of substituent effects on the reductive photocyclization is also discussed.

RESULTS AND DISCUSSION

The strategy for the preparation of 1-(2-bromobenzoyl)-isoquinolines **13**, the photocyclization precursors, is shown in Scheme 1. First, a series of isoquinolinones **9** was obtained via thermal cyclization of the corresponding styryl isocyanates, as previously reported.[37] Subsequently, the reaction of compounds **9** with trifluoromethanesulfonic anhydride (Tf_2O) in the presence of pyridine led to the isoquinolyl triflates. Treatment of the intermediate triflates with sodium iodide and TfOH at room temperature in acetonitrile produced the desired iodides **10**. The one-pot iodination of isoquinolinones **9** gave the 1-iodoisoquinolines **10** in high yields.

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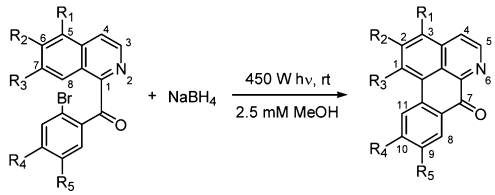
We originally planned to synthesize the photocyclization precursor **13a** via the Cu(I)-catalyzed acylation of 1-isoquinolylzinc iodide generated from the direct insertion of zinc into iodoisoquinoline **10a** in the presence of LiCl using 2-bromobenzoyl chloride.[38] Unfortunately, only the hydrolysis product isoquinoline was obtained despite the use of flame-dried glass vessels and standard Schlenk techniques. Therefore, we developed a two-step approach to synthesize the intermediates **13** via (2-bromophenyl)isoquinolin-1-ylacetonitriles **12**. The 1-iodoisoquinolines **10** reacted with commercially available (2-bromophenyl)acetonitriles **11** to give the adducts **12** in yields ranging from 72 to 100% (Table 1).[39] Then, the key photocyclization precursors **13** were readily produced in moderate to excellent yields (53 to 96%, Table 1) through oxidative decyanation of the corresponding nitriles **12** with oxygen in the presence of sodium hydride.[40] It should be mentioned here that some of the starting materials (**12d**, **12h**, **12l**, **12p**, and **12t**) were recovered from the oxidative decyanation reaction (Table 1, entries 4, 8, 12, 16, and 20). However, the conversion could not be completed by extending the reaction time to 6 h, most likely because the α-carbanions of the acetonitriles **12** were stabilized by the inductive effect of the electron-withdrawing substituent $-CF_3$.

With the series of 1-(2-bromobenzoyl)isoquinolines **13** in hand, the key cyclization reaction was investigated. The unsubstituted dibenzo[*de*,*g*]quinolin-7-one **8a** was chosen as our initial target because its simplicity would allow us to test the feasibility of the cyclization. First, the bromo ketone **13a** was subjected to Bu_3SnH-induced aryl radical cyclization according to the method of Orito et al.[31] and a somewhat modified version of this method to give the cyclization adduct **8a** in a low yield. Additionally, we attempted to synthesize dibenzo[*de*,*g*]-quinolin-7-one **8a** by photocyclization of bromo ketone **13a** in MeOH, which resulted in a complicated reaction mixture. This result is similar to Kessar's observation that the photoinduced cyclization of bromo ketone **7** in dilute aqueous HCl solution was unsuccessful.[36] Intriguingly, we found that dibenzo[*de*,*g*]-quinolin-7-one **8a** could be obtained in 55% yield by irradiation of a solution of the bromo ketone **13a** and 1.5 equiv of $NaBH_4$ in MeOH (eq 1). Thus, the direct conversion of 1-(2-bromobenzoyl)isoquinolines to dibenzo[*de*,*g*]quinolin-7-ones using one-pot reductive photocyclization was accomplished.



(1)

13 **8**

	R_1	R_2	R_3	R_4	R_5
8a	H	H	H	H	H
8b	H	H	H	OCH_3	OCH_3
8c	H	H	H	$-OCH_2-$	
8d	H	H	H	H	CF_3
8e	OCH_3	H	H	H	H
8f	OCH_3	H	H	OCH_3	OCH_3
8g	OCH_3	H	H	$-OCH_2-$	
8h	OCH_3	H	H	H	CF_3
8i	OCH_3	OCH_3	H	H	H
8j	OCH_3	OCH_3	H	OCH_3	OCH_3
8k	OCH_3	OCH_3	H	$-OCH_2-$	
8l	OCH_3	OCH_3	H	H	CF_3
8m	H	H	OCH_3	H	H
8n	H	H	OCH_3	OCH_3	OCH_3
8o	H	H	OCH_3	$-OCH_2-$	
8p	H	H	OCH_3	H	CF_3
8q	H	OCH_3	OCH_3	H	H
8r	H	OCH_3	OCH_3	OCH_3	OCH_3
8s	H	OCH_3	OCH_3	$-OCH_2-$	
8t	H	OCH_3	OCH_3	H	CF_3

Based on the results of the model study, we anticipated that a series of dibenzo[*de*,*g*]quinolin-7-ones **8b**–**t** would be readily produced using the reductive photocyclization method (eq 1). The substituent effects on the reaction time and the yields from the reductive photocyclization of 1-(2-bromobenzoyl)-isoquinolines **13a**–**t** are shown in Table 2. First, with the bromo ketones **13b** and **13c**, which have vicinal dimethoxy or methylenedioxy groups at the 4,5-positions of the benzoyl group, the yields of dibenzo[*de*,*g*]quinolin-7-ones **8b** and **8c** slightly increased (compare entry 1 with entries 2 and 3). However, the photocyclization of bromo ketone **13d**, which has a strong electron-withdrawing group ($-CF_3$) at the 5-position of the phenyl group, was complete after a short period of time (9 h) and led to the production of the corresponding dibenzo[*de*,*g*]quinolin-7-one **8d** in 33% yield along with several complicated inseparable products (entry 4). We hypothesized that a shorter reaction time was needed because the photoinduced electron transfer from isoquinolyl ring to phenyl ring could be enhanced by the electron-withdrawing substituent $-CF_3$ on the phenyl ring. Second, bromo ketones **13e**, **13f**, **13g**, and **13h** bearing the electron-donating group 5-OCH_3 on the isoquinolyl ring produced the corresponding dibenzo[*de*,*g*]-quinolin-7-ones **8e**, **8f**, **8g**, and **8h** in higher yields (86%, 95%, 80%, and 99%, respectively). Similarly, when bromo ketones **13m**, **13n**, **13o**, and **13p**, which have a methoxy group at the 7-positions of the isoquinolyl ring, were utilized the photocyclizations provided higher yields of dibenzo[*de*,*g*]quinolin-7-ones **8m**, **8n**, **8o**, and **8p** (63%, 95%, 81%, and 80%, respectively). The results revealed that the reactivity of the photocyclization of 1-(2-bromobenzoyl)isoquinolines could be increased by the presence of 5-OCH_3 and 7-OCH_3 substituents (compare entry 1 with entries 5 and 13, entry 2 with entries 6 and 14, entry 3 with entries 7 and 15, and entry 4 with entries 8 and 16). Third, when the bromo ketones **13i**, **13j**, **13k**, and **13l**, which have vicinal 5,6-dimethoxy groups on the isoquinolyl ring, were subjected to the same conditions, formation of the dibenzo[*de*,*g*]quinolin-7-ones was disfavored (compare entry 5 with entry 9, entry 6 with entry 10, entry 7 with entry 11, and entry 8 with entry 12). The lower yields were also observed when the bromo ketones **13q**, **13r**, **13s**, and **13t**, which have a 6,7-methylenedioxy group on the isoquinolyl ring, were used (compare entry 13 with entry 17, entry 14 with entry 18, entry 15 with entry 19, and entry 16 with entry 20). We hypothesized that the yields of dibenzo[*de*,*g*]quinolin-7-ones decreased because the photoinduced electron transfer from isoquinolyl ring to phenyl ring could be retarded by the inductive effect of the oxygen atom at the 6-position of the isoquinolyl ring. Clearly, the reductive photocyclization was promoted by methoxy groups at the 5- or 7-positions of the isoquinolyl ring or the trifluoromethyl group at the 5-position of the phenyl group. In contrast, the reactivity of the reductive photocyclization was decreased by a methoxy group on the 6-position of the isoquinolyl ring.

Mechanistic study. On the basis of the above results, a complete mechanistic route for the formation of dibenzo[*de*,*g*]-quinolin-7-ones **8** through a reductive photocyclization of 1-(2-bromobenzoyl)isoquinolines **13** with $NaBH_4$ is proposed and depicted in Scheme 2. First, $NaBH_4$ apparently plays a role in reducing bromo ketones **13** into the corresponding α-hydroxy-(2-bromobenzyl)isoquinolines **14** prior to photocyclization because irradiation of bromo ketone **13a** in MeOH in the absence of $NaBH_4$ led to a complicated reaction mixture. Subsequently, the photoreaction of intermediates **14** might be initiated by photoinduced electron transfer, and gave diradical-ions **15** with a radical-cation on the isoquinolyl ring and a radical-anion on the phenyl ring.[41] The carbocation of the intermediates **15** could be stabilized by the resonance effect of

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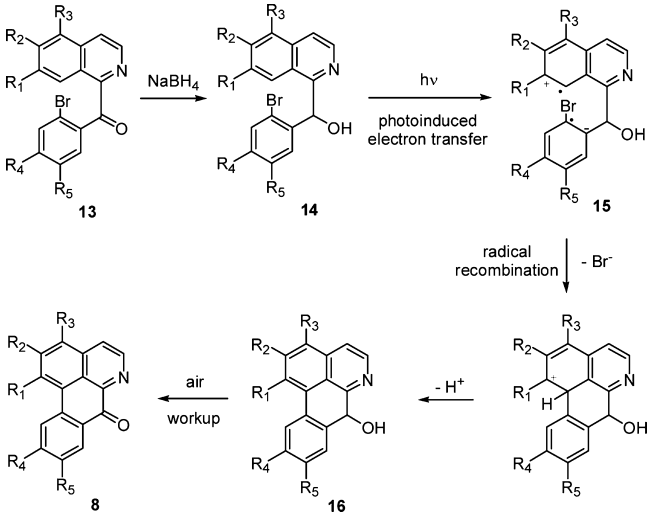
Table 2. Reductive Photocyclization of Bromo Ketone Precursors 13a–t with $NaBH_4$ (1.5 equiv) in MeOH (2.5 mM) To Provide Dibenzo[*de*,*g*]quinolin-7-ones 8a–t

			substituent					
entry	reactant	time (h)	R_1	R_2	R_3	R_4	R_5	product **8** (%)
1	**13a**	15	H	H	H	H	H	**8a** (55)
2	**13b**	24	H	H	H	OCH_3	OCH_3	**8b** (77)
3	**13c**	15	H	H	H	$-OCH_2O-$		**8c** (69)
4	**13d**	9	H	H	H	H	CF_3	**8d** (33)
5	**13e**	15	OCH_3	H	H	H	H	**8e** (86)
6	**13f**	20	OCH_3	H	H	OCH_3	OCH_3	**8f** (95)
7	**13g**	15	OCH_3	H	H	$-OCH_2O-$		**8g** (80)
8	**13h**	10	OCH_3	H	H	H	CF_3	**8h** (99)
9	**13i**	48	OCH_3	OCH_3	H	H	H	**8i** (61)
10	**13j**	24	OCH_3	OCH_3	H	OCH_3	OCH_3	**8j** (70)
11	**13k**	24	OCH_3	OCH_3	H	$-OCH_2O-$		**8k** (78)
12	**13l**	24	OCH_3	OCH_3	H	H	CF_3	**8l** (80)
13	**13m**	15	H	H	OCH_3	H	H	**8m** (63)
14	**13n**	20	H	H	OCH_3	OCH_3	OCH_3	**8n** (95)
15	**13o**	15	H	H	OCH_3	$-OCH_2O-$		**8o** (81)
16	**13p**	10	H	H	OCH_3	H	CF_3	**8p** (80)
17	**13q**	13	H	$-OCH_2O-$		H	H	**8q** (45)
18	**13r**	18	H	$-OCH_2O-$		OCH_3	OCH_3	**8r** (81)
19	**13s**	18	H	$-OCH_2O-$		$-OCH_2O-$		**8s** (53)
20	**13t**	5	H	$-OCH_2O-$		H	CF_3	**8t** (72)

Scheme 2. Mechanism of the Reductive Photocyclization of 1-(2-Bromobenzoyl)isoquinolines 13 with $NaBH_4$



the methoxy groups at the 5- or 7-positions of the isoquinolyl ring, and the carbanion of the intermediates **15** could also be stabilized by the inductive effect of the trifluoromethyl group on the phenyl ring. Hence, the reductive photocyclization of (2-bromo-5-trifluoromethylphenyl)-(5-methoxyisoquinolin-1-yl)-methanone (**13h**) was obtained in the highest yield. In contrast, the reductive photocyclization of bromo ketones with a methoxy group at the 6-position of the isoquinolyl ring was retarded because the inductive effect of oxygen made the carbocation on the isoquinolyl ring less stable. The facts supported the existence of the diradical-ions **15**. After elimination of the bromide as well as radical recombination, a loss of proton from the isoquinolyl ring would lead to the formation of 7-hydroxyaporphines **16**. No further oxidation occurred before workup due to the presence of $NaBH_4$, and this is supported by the obvious color change (from orange to yellow) observed during the workup. The auto-oxidation of intermediates **16** with air resulted in the formation of the desired dibenzo[*de*,*g*]quinolin-7-ones **8** after thorough removal of the reducing reagent during the workup procedure.[42]

■ CONCLUSION

To our knowledge, this paper is the first to describe the reductive photocyclization of 1-(2-bromobenzoyl)isoquinolines **13** to give dibenzo[*de*,*g*]quinolin-7-ones **8** using $NaBH_4$ as a reducing agent. A series of substituted dibenzo[*de*,*g*]quinolin-7-ones **8** was synthesized from the corresponding bromo ketones **13** in a one-pot reaction. The substituent effects on the subsequent reductive photocyclization are shown. When $-OCH_3$ is at the 5- or 7-positions of the isoquinolyl ring or $-CF_3$ at the 5-position of the phenyl group, the photocyclization can be enhanced. Hence, 9-trifluoromethyl-3-methoxy-dibenzo[*de*,*g*]quinolin-7-one (**8h**) could be obtained in the highest yield.

■ EXPERIMENTAL SECTION

General Methods. All reagents were purchased and used without further purification. Column chromatography was carried out using a 230–400 mesh silica gel. Nuclear magnetic resonance spectra were recorded on 500 and 600 MHz FT-NMR spectrometers; all chemical shifts were reported in ppm from tetramethylsilane as an internal standard. Melting points are uncorrected. FT-IR, MS, and elemental analysis were measured with conventional spectrometers. High-resolution electron ionization mass spectra (HREI-MS) were recorded on a high-resolution E/B mass spectrometer using a double-focusing magnetic-sector mass analyzer and orbitrap mass analyzer used for HRESI-MS measurements.

General Procedure for the Preparation of 1-Iodoisoquinoline 10. Trifluoromethanesulfonic anhydride (11.0 mmol) was slowly added to a mixture of the isoquinolinones **9**[37] (10.0 mmol) and pyridine (11.5 mmol) in acetonitrile (20 mL) cooled in an ice bath. The reaction mixture was stirred for 2 h at room temperature under N_2. Without purification, sodium iodide (50.0 mmol) was added in one portion at room temperature, and trifluoromethanesulfonic acid (11.0 mmol) was then added dropwise via syringe. The reaction

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mixture was stirred at room temperature overnight. After the reaction was complete, the resulting solution was diluted with water (35 mL) and toluene (45 mL). Then, the mixture was quenched with 10 M sodium hydroxide to reach a pH of ca. 10 while being cooled in an ice bath. The organic layer was separated and washed with 5% sodium thiosulfate (2 × 10 mL), 1 M sodium hydroxide (10 mL), and water (3 × 10 mL). The organic extract was dried with anhydrous $MgSO_4$, filtered, and evaporated under reduced pressure. The residue was purified by column chromatography over silica gel eluting with hexane−EtOAc (10:1) to give the pure 1-iodoisoquinolines **10**. The full spectral data of **10A−E** are described as follows.

*1-Iodoisoquinoline (**10A**):* yield 90% (2.30 g, 9.0 mmol); white crystal; mp 70.5−71 °C (hexane−EtOAc) (lit.[43] mp 72−74 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58 (1H, d, J = 5.6 Hz), 7.67−7.76 (3H, m), 8.12 (1H, d, J = 8.7 Hz), 8.26 (1H, d, J = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 121.3, 127.3, 127.5, 129.0, 131.1, 132.0, 132.9, 136.2, 143.1; IR (KBr) 1612, 1578, 1541 cm^{-1}; EIMS m/z (rel int) 128 (100), 255 (64, M$^+$). Anal. Calcd for C_9H_6IN: C, 42.38; H, 2.37; N, 5.49. Found: C, 42.65; H, 2.37; N, 5.34.

*1-Iodo-5-methoxyisoquinoline (**10B**):* yield 88% (2.51 g, 8.8 mmol); white needle; mp 115.5−116 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.02 (3H, s), 7.05 (1H, d, J = 8.2 Hz), 7.57 (1H, t, J = 8.2 Hz), 7.68 (1H, d, J = 8.2 Hz), 7.98 (1H, d, J = 5.6 Hz), 8.24 (1H, d, J = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.9, 108.2, 110.0, 115.7, 124.5, 126.6, 128.7, 132.6, 142.6, 154.5; IR (KBr) 1578, 1483 cm^{-1}; EIMS m/z (rel int) 285 (100, M$^+$). Anal. Calcd for $C_{10}H_8INO$: C, 42.13; H, 2.83; N, 4.91. Found: C, 41.77; H, 3.05; N, 4.53.

*1-Iodo-5,6-dimethoxyisoquinoline (**10C**):* yield 87% (2.74 g, 8.7 mmol); white needle; mp 91−91.5 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.98 (3H, s), 4.04 (3H, s), 7.42 (1H, d, J = 9.3 Hz), 7.82 (1H, d, J = 5.8 Hz), 7.88 (1H, d, J = 9.3 Hz), 8.15 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.5, 61.3, 115.0, 116.3, 126.9, 127.4, 129.8, 131.9, 141.3, 142.6, 151.9; IR (KBr) 1614, 1580, 1551, 1476 cm^{-1}; EIMS m/z (rel int) 315 (100, M$^+$). Anal. Calcd for $C_{11}H_{10}INO_2$: C, 41.93; H, 3.20; N, 4.45. Found: C, 42.05; H, 3.60; N, 4.36.

*1-Iodo-7-methoxyisoquinoline (**10D**):* yield 84% (2.39 g, 8.4 mmol); white needle; mp 86.5−87 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.00 (3H, s), 7.35−7.37 (2H, m), 7.51 (1H, d, J = 5.4 Hz), 7.65 (1H, d, J = 8.8 Hz), 8.16 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 110.5, 121.1, 124.1, 125.8, 128.9, 131.7, 133.3, 141.3, 159.8; IR (KBr) 1622, 1580, 1547, 1499 cm^{-1}; EIMS m/z (rel int) 158 (100), 285 (31, M$^+$); HREIMS m/z calcd for $C_{10}H_8INO$ 284.9651, found 284.9641 [M]$^+$.

*1-Iodo-6,7-(methylenedioxy)isoquinoline (**10E**):* yield 75% (2.24 g, 7.5 mmol); white needle; mp 181−182 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.14 (2H, s), 6.99 (1H, s), 7.41 (1H, d, J = 5.5 Hz), 7.46 (1H, s), 8.10 (1H, d, J = 5.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 102.1, 102.8, 109.1, 120.8, 124.7, 129.6, 134.5, 142.1, 149.7, 151.4; IR (KBr) 1576, 1458, 1404 cm^{-1}; EIMS m/z (rel int) 172 (100), 299 (80, M$^+$). Anal. Calcd for $C_{10}H_6INO_2$: C, 40.16; H, 2.02; N, 4.68. Found: C, 40.28; H, 2.14; N, 4.62.

General Procedure for the Preparation of (2-Bromophenyl)-isoquinolin-1-yl-acetonitrile 12. Sodium amide (43.8 mmol) was added to a mixture of the 1-iodoisoquinolines **10** (7.0 mmol) and (2-bromophenyl)acetonitriles **11** (8.8 mmol) in tetrahydrofuran (100 mL) while being stirred and cooled in an ice bath. The reaction mixture was then refluxed overnight under N_2. After cooling, the resulting solution was quenched with water (50 mL) and extracted with EtOAc (3 × 100 mL). The combined extracts were washed with water, dried with anhydrous $MgSO_4$, filtered, and evaporated under reduced pressure. The residue was purified by column chromatography over silica gel eluting with hexane−EtOAc (5:1) to give the pure (2-bromophenyl)isoquinolin-1-yl-acetonitriles **12**. The full spectral data of **12a−t** are described as follows.

*(2-Bromophenyl)isoquinolin-1-ylacetonitrile (**12a**):* Yield 97% (2.19 g, 6.8 mmol); white needle; mp 160−161 °C (hexane−EtOAc) (lit.[44] mp 152.5 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.52 (1H, s), 7.21 (1H, td, J = 7.8, 1.7 Hz), 7.27 (1H, td, J = 7.8, 1.7 Hz), 7.41 (1H, dd, J = 7.8, 1.7 Hz), 7.60−7.63 (1H, m), 7.65 (1H, dd, J = 7.8, 1.7 Hz), 7.69−7.72 (2H, m), 7.89 (1H, d, J = 8.2 Hz), 7.97 (1H, d, J = 8.2 Hz), 8.61 (1H, d, J = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.2, 177.7, 121.5, 123.4, 123.7, 125.5, 127.7, 128.2, 128.3, 130.2, 130.3, 130.4, 133.1, 134.2, 136.6, 141.9, 153.0; IR (KBr) 2249 cm^{-1}; ESIMS m/z (rel int) 323 (100, [M + 1]$^+$), 323 (100, [M + 3]$^+$). Anal. Calcd for $C_{17}H_{11}BrN_2$: C, 63.18; H, 3.43; N, 8.67. Found: C, 63.17; H, 3.20; N, 8.51.

*(2-Bromo-4,5-dimethoxyphenyl)isoquinolin-1-yl-acetonitrile (**12b**):* yield 72% (1.93 g, 5.0 mmol); white granule; mp 146−147 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.69 (3H, s), 3.86 (3H, s), 6.45 (1H, s), 6.91 (1H, s), 7.07 (1H, s), 7.62 (1H, t, J = 8.3 Hz), 7.69−7.72 (2H, m), 7.88 (1H, d, J = 8.3 Hz), 8.02 (1H, d, J = 8.3 Hz), 8.63 (1H, d, J = 8.3 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 41.8, 55.9, 56.1, 112.4, 113.5, 115.3, 118.1, 121.5, 123.9, 125.6, 126.0, 127.7, 128.3, 130.5, 136.7, 141.9, 149.1, 149.9, 153.5; IR (KBr) 2243 cm^{-1}; ESIMS m/z (rel int) 383 (100, [M + 1]$^+$), 385 (97, [M + 3]$^+$). Anal. Calcd for $C_{19}H_{15}BrN_2O_2$: C, 59.55; H, 3.95; N, 7.31. Found: C, 59.64; H, 4.07; N, 7.07.

*(2-Bromo-4,5-methylenedioxyphenyl)isoquinolin-1-ylacetonitrile (**12c**):* yield 76% (1.95 g, 5.3 mmol); white granule; mp168−169 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 5.89 (1H, s), 5.95 (1H, s), 6.43 (1H, s), 6.81 (1H, s), 7.06 (1H, s), 7.60 (1H, t, J = 8.2 Hz), 7.68−7.71 (2H, m), 7.87 (1H, d, J = 8.2 Hz), 7.93 (1H, d, J = 8.2 Hz), 8.62 (1H, d, J = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.2, 102.2, 109.8, 112.8, 114.2, 117.9, 121.6, 123.8, 125.6, 127.3, 127.8, 128.4, 130.5, 136.8, 142.0, 148.1, 148.8, 153.3; IR (KBr) 2251 cm^{-1}; ESIMS m/z (rel int) 367 (100, [M + 1]$^+$), 369 (98, [M + 3]$^+$) ; HRESIMS m/z calcd for $C_{18}H_{12}BrN_2O_2$ 367.0077, found 367.0079 [M + 1]$^+$.

*(2-Bromo-5-trifluoromethylphenyl)isoquinolin-1-ylacetonitrile (**12d**):* yield 89% (2.44 g, 6.2 mmol); pale yellow needle; mp 147−148 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.54 (1H, s), 7.48 (1H, dd, J = 8.3, 1.9 Hz), 7.67 (1H, t, J = 8.3 Hz), 7.71−7.81 (4H, m), 7.92 (1H, d, J = 8.3 Hz), 8.03 (1H, d, J = 8.3 Hz), 8.58 (1H, d, J = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 41.7, 117.3, 121.9, 123.2 (q, J = 271 Hz), 123.4, 125.7, 126.9 (q, J = 4 Hz), 127.4, 127.5 (q, J = 4 Hz), 128.0, 128.6, 130.7, 130.8 (q, J = 33 Hz), 133.8, 135.4, 136.8, 142.1, 152.0; IR (KBr) 2245 cm^{-1}; ESIMS m/z (rel int) 391 (100, [M + 1]$^+$), 393 (97, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{10}BrF_3N_2$: C, 55.27; H, 2.58; N, 7.16. Found: C, 55.21; H, 2.66; N, 7.19.

*(2-Bromophenyl)(5-methoxyisoquinolin-1-yl)acetonitrile (**12e**):* yield 76% (1.88 g, 5.3 mmol); white granule; mp 146−147 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.00 (3H, s), 6.46 (1H, s), 6.99 (1H, t, J = 7.8 Hz), 7.19 (1H, t, J = 7.8 Hz), 7.25 (1H, t, J = 7.8 Hz), 7.37 (1H, d, J = 7.8 Hz), 7.49−7.50 (2H, m), 7.63 (1H, d, J = 7.8 Hz), 8.09 (1H, d, J = 5.8 Hz), 8.59 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 55.7, 107.7, 115.4, 115.9, 117.8, 123.6, 126.5, 128.2, 128.5, 129.5, 130.2, 130.4, 133.2, 134.4, 141.6, 152.4, 155.2; IR (KBr) 2245 cm^{-1}; ESIMS m/z (rel int) 353 (100, [M + 1]$^+$), 355 (93, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{13}BrN_2O$: C, 61.21; H, 3.71; N, 7.93. Found: C, 61.40; H, 3.98; N, 8.04.

*(2-Bromo-4,5-dimethoxyphenyl)(5-methoxyisoquinolin-1-yl)-acetonitrile (**12f**):* yield 85% (2.46 g, 6.0 mmol); white needle; mp 144−145 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.67 (3H, s), 3.85 (3H, s), 4.01 (3H, s), 6.40 (1H, s), 6.88 (1H, s), 7.00 (1H, d, J = 7.4 Hz), 7.06 (1H, s), 7.49−7.55 (2H, m), 8.09 (1H, d, J = 5.8 Hz), 8.62 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.1, 55.7, 56.0, 56.2, 107.7, 112.4, 113.6, 115.4, 115.5, 115.9, 118.2, 126.2, 126.4, 128.5, 129.5, 141.5, 149.1, 149.9, 152.9, 155.2; IR (KBr) 2245 cm^{-1}; ESIMS m/z (rel int) 413 (100, [M + 1]$^+$), 415 (92, [M + 3]$^+$). Anal. Calcd for $C_{20}H_{17}BrN_2O_3$: C, 58.13; H, 4.15; N, 6.78. Found: C, 58.12; H, 4.16; N, 6.90.

*(2-Bromo-4,5-methylenedioxyphenyl)(5-methoxyisoquinolin-1-yl)acetonitrile (**12g**):* yield 95% (2.64 g, 6.7 mmol); white crystal; mp 170−171 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.01 (3H, s), 5.90 (1H, d, J = 1.3 Hz), 5.95 (1H, d, J = 1.3 Hz), 6.39 (1H, s), 6.80 (1H, s), 7.00 (1H, d, J = 6.7 Hz), 7.06 (1H, s), 7.46−7.52 (2H, m), 8.09 (1H, d, J = 5.8 Hz), 8.61 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 55.8, 102.2, 107.7, 109.8, 112.8, 114.3, 115.4,

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116.0, 117.9, 126.4, 127.5, 128.5, 129.6, 141.6, 148.1, 148.8, 152.6, 155.3; IR (KBr) 2249 cm^{-1}; ESIMS *m/z* (rel int) 397 (100, $[M + 1]^+$), 399 (94, $[M + 3]^+$). Anal. Calcd for $C_{19}H_{13}BrN_2O_3$: C, 57.45; H, 3.30; N, 7.05. Found: C, 57.71; H, 3.33; N, 7.03.

*(2-Bromo-5-trifluoromethylphenyl)(5-methoxyisoquinolin-1-yl)-acetonitrile (**12h**):* yield 75% (2.21 g, 5.3 mmol); white needle; mp 145−146 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 4.01 (3H, s), 6.48 (1H, s), 7.02 (1H, dd, *J* = 6.6, 1.8 Hz), 7.46 (1H, dd, *J* = 8.4, 1.6 Hz), 7.52−7.56 (2H, m), 7.75−7.77 (2H, m), 8.11 (1H, d, *J* = 5.8 Hz), 8.56 (1H, d, *J* = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.0, 55.8, 107.9, 115.0, 116.3, 117.3, 123.3 (q, *J* = 271 Hz), 126.5, 126.9 (q, *J* = 3 Hz), 127.4, 127.5 (q, *J* = 3 Hz), 128.8, 129.7, 130.8 (q, *J* = 33 Hz), 133.8, 135.5, 141.7, 151.4, 155.4; IR (KBr) 2247 cm^{-1}; ESIMS *m/z* (rel int) 421 (100, $[M + 1]^+$), 423 (93, $[M + 3]^+$). Anal. Calcd for $C_{19}H_{12}BrF_3N_2O$: C, 54.18; H, 2.87; N, 6.65. Found: C, 54.36; H, 2.92; N, 6.78.

*(2-Bromophenyl)(5,6-dimethoxyisoquinolin-1-yl)acetonitrile (**12i**):* yield 91% (2.44 g, 6.4 mmol); white granule; mp 196−197 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.99 (3H, s), 4.00 (3H, s), 6.44 (1H, s), 7.19 (1H, td, *J* = 7.9, 1.6 Hz), 7.26 (1H, td, *J* = 7.9, 1.1 Hz), 7.36 (1H, d, *J* = 9.3 Hz), 7.40 (1H, dd, *J* = 7.9, 1.6 Hz), 7.64 (1H, dd, *J* = 7.9, 1.1 Hz), 7.73 (1H, d, *J* = 9.3 Hz), 7.94 (1H, d, *J* = 6.0 Hz), 8.52 (1H, d, *J* = 6.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.4, 56.5, 61.3, 115.3, 116.3, 117.8, 120.7, 121.5, 123.5, 128.3, 130.2, 130.5, 133.0, 133.2, 134.4, 141.9, 142.2, 151.4, 152.9; IR (KBr) 2245 cm^{-1}; ESIMS *m/z* (rel int) 383 (100, $[M + 1]^+$), 385 (97, $[M + 3]^+$). Anal. Calcd for $C_{19}H_{15}BrN_2O_2$: C, 59.55; H, 3.95; N, 7.31. Found: C, 59.60; H, 3.90; N, 7.39.

*(2-Bromo-4,5-dimethoxyphenyl)(5,6-dimethoxyisoquinolin-1-yl)-acetonitrile (**12j**):* yield 100% (3.10 g, 7.0 mmol); white needle; mp 122−123 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.69 (3H, s), 3.85 (3H, s), 3.99 (3H, s), 4.01 (3H, s), 6.38 (1H, s), 6.91 (1H, s), 7.06 (1H, s), 7.37 (1H, d, *J* = 9.3 Hz), 7.79 (1H, d, *J* = 9.3 Hz), 7.95 (1H, d, *J* = 5.9 Hz), 8.54 (1H, d, *J* = 5.9 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.0, 56.0, 56.2, 56.4, 61.3, 112.3, 113.4, 115.3 (2 × C), 116.3, 118.2, 120.8, 121.4, 126.2, 132.9, 141.8, 142.1, 149.1, 149.9, 151.4, 153.3; IR (KBr) 2245 cm^{-1}; ESIMS *m/z* (rel int) 443 (100, $[M + 1]^+$), 445 (100, $[M + 3]^+$). Anal. Calcd for $C_{21}H_{19}BrN_2O_4$: C, 56.90; H, 4.32; N, 6.32. Found: C, 56.70; H, 3.98; N, 6.02.

*(2-Bromo-4,5-methylenedioxyphenyl)(5,6-dimethoxyisoquinolin-1-yl)acetonitrile (**12k**):* yield 97% (2.90 g, 6.8 mmol); white granule; mp 147−148 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.99 (3H, s), 4.00 (3H, s), 5.90 (1H, s), 5.95 (1H, s), 6.37 (1H, s), 6.82 (1H, s), 7.06 (1H, s), 7.36 (1H, d, *J* = 9.3 Hz), 7.70 (1H, d, *J* = 9.3 Hz), 7.94 (1H, d, *J* = 5.9 Hz), 8.53 (1H, d, *J* = 5.9 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.3, 56.4, 61.2, 102.2, 109.7, 112.7, 114.1, 115.3, 116.3, 117.9, 120.7, 121.3, 127.4, 132.9, 141.8, 142.1, 148.1, 148.8, 151.4, 153.0; IR (KBr) 2239 cm^{-1}; ESIMS *m/z* (rel int) 427 (100, $[M + 1]^+$), 429 (96, $[M + 3]^+$). Anal. Calcd for $C_{20}H_{15}BrN_2O_4$: C, 56.22; H, 3.54; N, 6.56. Found: C, 56.47; H, 3.50; N, 6.55.

*(2-Bromo-5-trifluoromethylphenyl)(5,6-dimethoxyisoquinolin-1-yl)acetonitrile (**12l**):* yield 93% (2.94 g, 6.5 mmol); pale yellow needle; mp 161−162 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 4.01 (3H, s), 4.03 (3H, s), 6.46 (1H, s), 7.42 (1H, d, *J* = 9.3 Hz), 7.47 (1H, d, *J* = 8.4 Hz), 7.76−7.81 (3H, m), 7.97 (1H, d, *J* = 5.9 Hz), 8.47 (1H, d, *J* = 5.9 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 41.8, 56.5, 61.3, 115.6, 116.6, 117.3, 120.2, 121.6, 123.2 (q, *J* = 271 Hz), 126.9 (q, *J* = 3 Hz), 127.4, 127.6 (q, *J* = 4 Hz), 130.9 (q, *J* = 33 Hz), 133.1, 133.8, 135.4, 142.0, 142.3, 151.5, 151.8; IR (KBr) 2245 cm^{-1}; ESIMS *m/z* (rel int) 451 (100, $[M + 1]^+$), 453 (96, $[M + 3]^+$). Anal. Calcd for $C_{20}H_{14}BrF_3N_2O_2$: C, 53.23; H, 3.13; N, 6.21. Found: C, 52.90; H, 2.99; N, 6.20.

*(2-Bromophenyl)(7-methoxyisoquinolin-1-yl)acetonitrile (**12m**):* yield 74% (1.83 g, 5.2 mmol); white granule; mp 156−157 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.87 (3H, s), 6.45 (1H, s), 7.10 (1H, s), 7.19 (1H, t, *J* = 7.9 Hz), 7.24 (1H, t, *J* = 7.9 Hz), 7.32 (1H, d, *J* = 9.0 Hz), 7.41 (1H, d, *J* = 7.9 Hz), 7.61 (1H, d, *J* = 5.6 Hz), 7.65 (1H, d, *J* = 7.9 Hz), 7.75 (1H, d, *J* = 9.0 Hz), 8.52 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 55.7, 101.6, 117.9, 121.3, 123.5, 123.7, 126.8, 128.6, 129.3, 130.3, 130.5, 132.4, 133.1, 134.5, 140.3, 151.6, 159.0; IR (KBr) 2249 cm^{-1}; ESIMS *m/z* (rel int) 353 (100, $[M + 1]^+$), 355 (97, $[M + 3]^+$). Anal. Calcd for $C_{18}H_{13}BrN_2O$: C, 61.21; H, 3.71; N, 7.93. Found: C, 61.25; H, 4.03; N, 8.06.

*(2-Bromo-4,5-dimethoxyphenyl)(7-methoxyisoquinolin-1-yl)-acetonitrile (**12n**):* yield 100% (2.89 g, 7.0 mmol); white granule; mp 148−149 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.67 (3H, s), 3.86 (3H, s), 3.91 (3H, s), 6.39 (1H, s), 6.90 (1H, s), 7.06 (1H, s), 7.18 (1H, s), 7.33 (1H, d, *J* = 9.0 Hz), 7.62 (1H, d, *J* = 5.6 Hz), 7.76 (1H, d, *J* = 9.0 Hz), 8.54 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.1, 55.7, 55.9, 56.1, 101.5, 112.1, 113.4, 115.1, 118.1, 121.2, 123.7, 126.1, 126.7, 129.2, 132.3, 140.1, 149.3, 150.0, 151.9, 159.0; IR (KBr) 2245 cm^{-1}; ESIMS *m/z* (rel int) 413 (100, $[M + 1]^+$), 415 (97, $[M + 3]^+$). Anal. Calcd for $C_{20}H_{17}BrN_2O_3$: C, 58.13; H, 4.15; N, 6.78. Found: C, 58.08; H, 4.19; N, 6.69.

*(2-Bromo-4,5-methylenedioxyphenyl)(7-methoxyisoquinolin-1-yl)acetonitrile (**12o**):* yield 84% (2.33 g, 5.9 mmol); white crystal; mp 205−207 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.89 (3H, s), 5.90 (1H, d, *J* = 1.1 Hz), 5.96 (1H, d, *J* = 1.1 Hz), 6.38 (1H, s), 6.83 (1H, s), 7.07 (1H, s), 7.10 (1H, d, *J* = 2.2 Hz), 7.32 (1H, dd, *J* = 9.0, 2.2 Hz), 7.62 (1H, d, *J* = 5.6 Hz), 7.76 (1H, d, *J* = 9.0 Hz), 8.53 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 55.8, 101.5, 102.3, 109.7, 112.5, 114.1, 117.9, 121.3, 123.8, 126.7, 127.5, 129.3, 132.4, 140.3, 148.3, 149.0, 151.8, 159.1; IR (KBr) 2249 cm^{-1}; ESIMS *m/z* (rel int) 397 (100, $[M + 1]^+$), 399 (90, $[M + 3]^+$). Anal. Calcd for $C_{19}H_{13}BrN_2O_3$: C, 57.45; H, 3.30; N, 7.05. Found: C, 57.66; H, 3.58; N, 7.02.

*(2-Bromo-5-trifluoromethylphenyl)(7-methoxyisoquinolin-1-yl)-acetonitrile (**12p**):* yield 80% (2.36 g, 5.6 mmol); white needle; mp 164−165 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.92 (3H, s), 6.46 (1H, s), 7.16 (1H, s), 7.37 (1H, d, *J* = 9.0 Hz), 7.47 (1H, d, *J* = 8.4 Hz), 7.64 (1H, d, *J* = 5.5 Hz), 7.78−7.80 (2H, m), 7.82 (1H, s), 8.50 (1H, d, *J* = 5.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.0, 55.7, 101.2, 117.3, 121.6, 123.2 (q, *J* = 271 Hz), 123.8, 126.9, 127.0 (q, *J* = 3 Hz), 127.4, 127.6 (q, *J* = 4 Hz), 129.6, 131.1 (q, *J* = 33 Hz), 132.5, 133.8, 135.6, 140.5, 150.5, 159.3; IR (KBr) 2249 cm^{-1}; ESIMS *m/z* (rel int) 421 (100, $[M + 1]^+$), 423 (93, $[M + 3]^+$). Anal. Calcd for $C_{19}H_{12}BrF_3N_2O$: C, 54.18; H, 2.87; N, 6.65. Found: C, 54.17; H, 3.16; N, 6.85.

*(2-Bromophenyl)(6,7-methylenedioxyisoquinolin-1-yl)acetonitrile (**12q**):* yield 92% (2.36 g, 6.4 mmol); white granule; mp 229−230 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 6.07 (1H, s), 6.11 (1H, s), 6.28 (1H, s), 7.10 (1H, s), 7.18 (1H, s), 7.20 (1H, t, *J* = 7.9 Hz), 7.25−7.28 (1H, m), 7.40 (1H, d, *J* = 7.9 Hz), 7.51 (1H, d, *J* = 5.6 Hz), 7.64 (1H, d, *J* = 7.9 Hz), 8.45 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 99.9, 101.9, 103.5, 117.8, 121.0, 123.1, 123.6, 128.3, 130.2, 130.5, 133.2, 134.3, 135.5, 141.4, 149.3, 150.9, 151.1; IR (KBr) 2241 cm^{-1}; ESIMS *m/z* (rel int) 367 (100, $[M + 1]^+$), 369 (95, $[M + 3]^+$). Anal. Calcd for $C_{18}H_{11}BrN_2O_2$: C, 58.88; H, 3.02; N, 7.63. Found: C, 58.60; H, 3.14; N, 7.42.

*(2-Bromo-4,5-dimethoxyphenyl)(6,7-methylenedioxyisoquinolin-1-yl)acetonitrile (**12r**):* yield 87% (2.60 g, 6.1 mmol); white needle; mp 192−193 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 3.68 (3H, s), 3.86 (3H, s), 6.07 (1H, s), 6.11 (1H, s), 6.21 (1H, s), 6.88 (1H, s), 7.06 (1H, s), 7.09 (1H, s), 7.21 (1H, s), 7.50 (1H, d, *J* = 5.6 Hz), 8.47 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.1, 56.0, 56.2, 100.0, 101.9, 103.4, 112.3, 113.6, 115.4, 118.2, 121.0, 122.9, 126.1, 135.5, 141.3, 149.1, 149.3, 150.0, 150.9, 151.5; IR (KBr) 2245 cm^{-1}; ESIMS *m/z* (rel int) 427 (100, $[M + 1]^+$), 429 (94, $[M + 3]^+$). Anal. Calcd for $C_{20}H_{15}BrN_2O_4$: C, 56.22; H, 3.54; N, 6.56. Found: C, 56.43; H, 3.66; N, 6.31.

*(2-Bromo-4,5-methylenedioxyphenyl)(6,7-methylenedioxyisoquinolin-1-yl)acetonitrile (**12s**):* yield 97% (2.79 g, 6.8 mmol); white granule; mp 233−235 °C (hexane−EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 5.91 (1H, d, *J* = 1.2 Hz), 5.96 (1H, d, *J* = 1.2 Hz), 6.08 (1H, d, *J* = 0.7 Hz), 6.11 (1H, d, *J* = 0.7 Hz), 6.20 (1H, s), 6.80 (1H, s), 7.06 (1H, s), 7.10 (1H, s), 7.14 (1H, s), 7.51 (1H, d, *J* = 5.6 Hz), 8.46 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.5, 99.9, 101.9, 102.2, 103.5, 109.7, 112.8, 114.2, 117.9, 121.1, 122.9, 127.3, 135.5, 141.4, 148.1, 148.9, 149.3, 150.9, 151.3; IR (KBr) 2245 cm^{-1}; ESIMS

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m/*z* (rel int) 411 (100, [M + 1]$^+$), 413 (93, [M + 3]$^+$); HRESIMS *m*/*z* calcd for $C_{19}H_{12}BrN_2O_4$ 410.9975, found 410.9977 [M + 1]$^+$.

(2-Bromo-5-trifluoromethylphenyl)(6,7-methylenedioxyisoquinolin-1-yl)acetonitrile ***(12t)****:* yield 91% (2.77 g, 6.4 mmol); white granule; mp 226−228 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.10 (1H, s), 6.13 (1H, s), 6.29 (1H, s), 7.13 (1H, s), 7.22 (1H, s), 7.47 (1H, dd, *J* = 8.4, 1.5 Hz), 7.52 (1H, d, *J* = 5.6 Hz), 7.76−7.78 (2H, m), 8.41 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 42.0, 99.5, 102.1, 103.7, 117.3, 121.4, 123.1, 123.3 (q, *J* = 271 Hz), 126.9 (q, *J* = 4 Hz), 127.4, 127.5 (q, *J* = 4 Hz), 130.9 (q, *J* = 33 Hz), 133.8, 135.5, 135.6, 141.6, 149.6, 150.0, 151.1; IR (KBr) 2243 cm^{-1}; ESIMS *m*/*z* (rel int) 435 (100, [M + 1]$^+$), 437 (96, [M + 3]$^+$). Anal. Calcd for $C_{19}H_{10}BrF_3N_2O_2$: C, 52.44; H, 2.32; N, 6.44. Found: C, 52.23; H, 2.27; N, 6.66.

General Procedure for the Preparation of (2-Bromophenyl)-isoquinolin-1-ylmethanone 13. A solution of nitriles **12** (2.00 mmol) in tetrahydrofuran (30 mL) was added to sodium hydride (60% dispersion in oil, 120 mg, 3.00 mmol), which had been washed with hexane, and the mixture was stirred at room temperature for 1 h. Then, a slow stream of oxygen gas was passed through the mixture for 3 h. The resulting solution was quenched with water (30 mL) and extracted with EtOAc (3 × 60 mL). The combined extracts were washed with water, dried with anhydrous $MgSO_4$, filtered, and evaporated under reduced pressure. The residue was purified by column chromatography over silica gel eluting with hexane−EtOAc (5:1) to give the pure (2-bromophenyl)isoquinolin-1-ylmethanones **13**. The full spectral data of **13a**−**t** are described as follows.

(2-Bromophenyl)isoquinolin-1-ylmethanone ***(13a)****:* yield 95% (593 mg, 1.90 mmol); pale yellow crystal; mp 103−104 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.37 (1H, t, *J* = 7.8 Hz), 7.46 (1H, t, *J* = 7.8 Hz), 7.59 (1H, d, *J* = 7.8 Hz), 7.66 (1H, d, *J* = 7.8 Hz), 7.72−7.78 (2H, m), 7.81 (1H, d, *J* = 5.5 Hz), 7.91 (1H, d, *J* = 8.2 Hz), 8.53 (1H, d, *J* = 5.5 Hz), 8.79 (1H, d, *J* = 8.2 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 120.6, 124.0, 126.5, 126.8, 127.1, 127.3, 129.0, 130.6, 131.0, 132.1, 133.2, 137.0, 141.3, 141.4, 154.0, 196.7; IR (KBr) 1667 cm^{-1}; ESIMS *m*/*z* (rel int) 312 (100, [M + 1]$^+$), 314 (94, [M + 3]$^+$); HRESIMS *m*/*z* calcd for $C_{16}H_{11}BrNO$ 312.00185, found 312.00183 [M + 1]$^+$.

(2-Bromo-4,5-dimethoxyphenyl)isoquinolin-1-ylmethanone ***(13b)****:* yield 96% (714 mg, 1.92 mmol); pale yellow crystal; mp 109.5−110 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.92 (3H, s), 3.93 (3H, s), 7.02 (1H, s), 7.34 (1H, s), 7.71 (1H, t, *J* = 8.2 Hz), 7.76 (1H, t, *J* = 8.2 Hz), 7.80 (1H, d, *J* = 5.6 Hz), 7.91 (1H, d, *J* = 8.2 Hz), 8.54 (1H, d, *J* = 5.6 Hz), 8.55 (1H, d, *J* = 8.2 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.1, 56.3, 113.6, 114.0, 115.9, 123.4, 126.4, 126.7, 127.0, 128.7, 130.5, 132.4, 136.8, 141.3, 148.4, 152.2, 155.4, 195.5; IR (KBr) 1680 cm^{-1}; ESIMS *m*/*z* (rel int) 372 (100, [M + 1]$^+$), 374 (95, [M + 3]$^+$); HRESIMS *m*/*z* calcd for $C_{18}H_{15}BrNO_3$ 372.0230, found 372.0240 [M + 1]$^+$.

(2-Bromo-4,5-methylenedioxyphenyl)isoquinolin-1-ylmethanone ***(13c)****:* yield 81% (577 mg, 1.62 mmol); white granule; mp 131−132 °C (hexane−EtOAc) (lit.[45] mp 150 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.02 (2H, s), 7.00 (1H, s), 7.17 (1H, s), 7.68 (1H, t, *J* = 8.1 Hz), 7.72 (1H, t, *J* = 8.1 Hz), 7.60 (1H, d, *J* = 5.6 Hz), 7.88 (1H, d, *J* = 8.1 Hz), 8.51 (1H, d, *J* = 5.6 Hz), 8.61 (1H, d, *J* = 8.1 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 102.4, 111.1, 113.4, 113.8, 123.5, 126.3, 126.6, 127.0, 128.7, 130.5, 133.9, 136.8, 141.2, 147.4, 150.8, 154.8, 195.2; IR (KBr) 1665 cm^{-1}; ESIMS *m*/*z* (rel int) 356 (100, [M + 1]$^+$), 358 (92, [M + 3]$^+$). Anal. Calcd for $C_{17}H_{10}BrNO_3$: C, 57.33; H, 2.83; N, 3.93. Found: C, 57.03; H, 2.90; N, 3.61.

(2-Bromo-5-trifluoromethylphenyl)isoquinolin-1-ylmethanone ***(13d)****:* yield 59% (448 mg, 1.18 mmol); white needle; mp 125−126 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.61 (1H, d, *J* = 8.3 Hz), 7.73 (1H, d, *J* = 8.3 Hz), 7.77−7.91 (2H, m), 7.85−7.87 (2H, m), 7.94−7.95 (1H, m), 8.53 (1H, d, *J* = 5.5 Hz), 8.90−8.92 (1H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 123.6 (q, *J* = 271 Hz), 124.3, 124.7, 126.3, 126.8, 127.2, 127.5 (q, *J* = 3 Hz), 128.1 (q, *J* = 3 Hz), 129.5, 130.0 (q, *J* = 33 Hz), 130.7, 133.7, 137.0, 141.3, 142.4, 152.4, 195.5; IR (KBr) 1682 cm^{-1}; ESIMS *m*/*z* (rel int) 380 (100, [M + 1]$^+$), 382 (99, [M + 3]$^+$); HREIMS *m*/*z* calcd for $C_{17}H_{10}BrF_3NO$ 379.9892, found 379.9883 [M + 1]$^+$.

(2-Bromophenyl)(5-methoxyisoquinolin-1-yl)methanone ***(13e)****:* yield 94% (643 mg, 1.88 mmol); pale yellow granule; mp 141−142 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.04 (3H, s), 7.06 (1H, d, *J* = 8.0 Hz), 7.36 (1H, td, *J* = 8.0, 1.7 Hz), 7.45 (1H, td, *J* = 8.0, 1.0 Hz), 7.58 (1H, dd, *J* = 8.0, 1.0 Hz), 7.63 (1H, t, *J* = 8.0 Hz), 7.65 (1H, dd, *J* = 8.0, 1.7 Hz), 8.22 (1H, d, *J* = 5.7 Hz), 8.33 (1H, d, *J* = 8.0 Hz), 8.52 (1H, d, *J* = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 107.6, 117.9, 118.4, 120.5, 127.2, 127.4, 129.1, 129.7, 130.9, 131.9, 133.0, 140.8, 141.3, 153.2, 154.5, 196.6; IR (KBr) 1682 cm^{-1}; ESIMS *m*/*z* (rel int) 342 (100, [M + 1]$^+$), 344 (90, [M + 3]$^+$). Anal. Calcd for $C_{17}H_{12}BrNO_2$: C, 59.67; H, 3.53; N, 4.09. Found: C, 59.35; H, 3.28; N, 3.75.

(2-Bromo-4,5-dimethoxyphenyl)(5-methoxyisoquinolin-1-yl)-methanone ***(13f)****:* yield 84% (675 mg, 1.68 mmol); pale yellow crystal; mp 153−154 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.92 (6H, s), 4.04 (3H, s), 7.01 (1H, s), 7.05 (1H, d, *J* = 8.2 Hz), 7.33 (1H, s), 7.59 (1H, t, *J* = 8.2 Hz), 8.09 (1H, d, *J* = 8.2 Hz), 8.20 (1H, d, *J* = 5.7 Hz), 8.53 (1H, d, *J* = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.7, 56.1, 56.3, 107.7, 113.6, 114.1, 116.0, 117.8, 118.0, 127.4, 128.8, 129.7, 132.5, 141.0, 148.4, 152.2, 154.6, 154.8, 195.6; IR (KBr) 1678 cm^{-1}; ESIMS *m*/*z* (rel int) 424 (100, [M + 1]$^+$), 426 (99, [M + 3]$^+$); HRESIMS *m*/*z* calcd for $C_{19}H_{16}BrNO_4Na$ 424.0160, found 424.0163 [M + Na]$^+$.

(2-Bromo-4,5-methylenedioxyphenyl)(5-methoxyisoquinolin-1-yl)methanone ***(13g)****:* yield 67% (517 mg, 1.34 mmol); pale yellow crystal, mp 153−154 °C (hexane−EtOAc). ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.03 (3H, s), 6.05 (2H, s), 7.01 (1H, s), 7.04 (1H, d, *J* = 8.4 Hz), 7.17 (1H, s), 7.59 (1H, t, *J* = 8.4 Hz), 8.15 (1H, d, *J* = 8.4 Hz), 8.20 (1H, d, *J* = 5.7 Hz), 8.52 (1H, d, *J* = 5.7 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.7, 102.4, 107.7, 111.3, 113.5, 113.9, 118.0, 118.1, 127.5, 128.9, 129.8, 134.1, 141.0, 147.5, 150.9, 154.3, 154.6, 195.4; IR (KBr) 1668 cm^{-1}; ESIMS *m*/*z* (rel int) 386 (100, [M + 1]$^+$), 388 (97, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{12}BrNO_4$: C, 55.98; H, 3.13; N, 3.63. Found: C, 56.28; H, 3.52; N, 3.76.

(2-Bromo-5-trifluoromethylphenyl)(5-methoxyisoquinolin-1-yl)-methanone ***(13h)****:* yield 55% (410 mg, 1.10 mmol); pale yellow crystal; mp 137−138 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.05 (3H, s), 7.08 (1H, d, *J* = 8.3 Hz), 7.59 (1H, dd, *J* = 8.3, 1.7 Hz), 7.76 (1H, t, *J* = 8.3 Hz), 7.71 (1H, d, *J* = 8.3 Hz), 7.87 (1H, d, *J* = 1.7 Hz), 8.27 (1H, d, *J* = 5.6 Hz), 8.44 (1H, d, *J* = 8.3 Hz), 8.52 (1H, d, *J* = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.8, 107.8, 117.8, 119.2, 123.7 (q, *J* = 271 Hz), 124.3, 127.5 (q, *J* = 4 Hz), 127.6, 128.1 (q, *J* = 3 Hz), 129.7, 129.9 (q, *J* = 33 Hz), 130.0, 133.7, 141.0, 142.6, 151.8, 154.7, 195.6; IR (KBr) 1682 cm^{-1}; ESIMS *m*/*z* (rel int) 410 (100, [M + 1]$^+$), 412 (96, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{11}BrF_3NO_2$: C, 52.71; H, 2.70; N, 3.41. Found: C, 52.70; H, 2.90; N, 3.40.

(2-Bromophenyl)(5,6-dimethoxyisoquinolin-1-yl)methanone ***(13i)****:* yield 89% (662 mg, 1.78 mmol); pale yellow crystal; mp 125−126 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.03 (3H, s), 4.07 (3H, s), 7.37 (1H, td, *J* = 7.9, 1.6 Hz), 7.46 (1H, td, *J* = 7.9, 1.0 Hz), 7.51 (1H, d, *J* = 9.4 Hz), 7.59 (1H, dd, *J* = 7.9, 1.0 Hz), 7.64 (1H, dd, *J* = 7.9, 1.6 Hz), 8.08 (1H, d, *J* = 5.9 Hz), 8.46 (1H, d, *J* = 5.9 Hz), 8.58 (1H, d, *J* = 9.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.5, 61.3, 117.2, 117.7, 120.6, 122.5, 123.5, 127.3, 131.0, 132.0, 133.1, 133.2, 141.2, 141.3, 141.4, 151.3, 153.6, 196.9; IR (KBr) 1682 cm^{-1}; ESIMS *m*/*z* (rel int) 372 (100, [M + 1]$^+$), 374 (100, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{14}BrNO_3$: C, 58.08; H, 3.79; N, 3.76. Found: C, 58.20; H, 4.06; N, 3.77.

(2-Bromo-4,5-dimethoxyphenyl)(5,6-dimethoxyisoquinolin-1-yl)-methanone ***(13j)****:* yield 91% (786 mg, 1.82 mmol); pale yellow granule; mp 161−162 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.92 (3H, s), 3.93 (3H, s), 4.03 (3H, s), 4.06 (3H, s) 7.02 (1H, s), 7.32 (1H, s), 7.48 (1H, d, *J* = 9.4 Hz), 8.06 (1H, d, *J* = 5.8 Hz), 8.35 (1H, d, *J* = 9.4 Hz), 8.47 (1H, d, *J* = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.1, 56.3, 56.5, 61.3, 113.5, 114.0, 116.0, 116.9, 117.1, 122.4, 123.4, 132.4, 133.1, 141.4, 141.5, 148.4, 151.4, 152.2, 155.0, 195.7; IR (KBr) 1667 cm^{-1}; ESIMS *m*/*z* (rel int) 432 (100, [M

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+ 1]$^+$), 434 (95, [M + 3]$^+$); HRESIMS m/z calcd for $C_{20}H_{19}BrNO_5$ 432.0441, found 432.0442 [M + 1]$^+$.

*(2-Bromo-4,5-methylenedioxyphenyl)(5,6-dimethoxyisoquinolin-1-yl)methanone (**13k**):* yield 94% (782 mg, 1.88 mmol); pale yellow granule; mp 190−191 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.02 (3H, s), 4.05 (3H, s), 6.05 (2H, s), 7.02 (1H, s), 7.16 (1H, s), 7.47 (1H, d, J = 9.4 Hz), 8.06 (1H, d, J = 5.8 Hz), 8.41 (1H, d, J = 9.4 Hz), 8.46 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.5, 61.3, 102.4, 111.2, 113.4, 113.8, 117.0, 117.3, 122.4, 123.4, 133.1, 134.0, 141.3, 141.4, 147.4, 150.8, 151.3, 154.5, 195.5; IR (KBr) 1682 cm^{-1}; ESIMS m/z (rel int) 416 (100, [M + 1]$^+$), 418 (100, [M + 3]$^+$); HRESIMS m/z calcd for $C_{19}H_{15}BrNO_5$ 416.0128, found 416.0130 [M + 1]$^+$.

*(2-Bromo-5-trifluoromethylphenyl)(5,6-dimethoxyisoquinolin-1-yl)methanone (**13l**):* yield 65% (572 mg, 1.30 mmol); pale yellow crystal; mp 163−164 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.03 (3H, s), 4.08 (3H, s), 7.54 (1H, d, J = 9.4 Hz), 7.60 (1H, dd, J = 8.4, 1.8 Hz), 7.72 (1H, d, J = 8.4 Hz), 7.86 (1H, d, J = 1.8 Hz), 8.12 (1H, d, J = 5.8 Hz), 8.46 (1H, d, J = 5.8 Hz), 8.70 (1H, d, J = 9.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.5, 61.3, 117.6, 118.4, 122.5, 123.3, 123.5 (q, J = 271 Hz), 124.3, 127.4 (q, J = 4 Hz), 128.1 (q, J = 3 Hz), 129.9 (q, J = 33 Hz), 133.3, 133.6, 141.3, 141.5, 142.4, 151.4, 152.1, 195.7; IR (KBr) 1690 cm^{-1}; ESIMS m/z (rel int) 440 (100, [M + 1]$^+$), 442 (98, [M + 3]$^+$); HRESIMS m/z calcd for $C_{19}H_{14}BrF_3NO_3$ 440.0104, found 440.0098 [M + 1]$^+$.

*(2-Bromophenyl)(7-methoxyisoquinolin-1-yl)methanone (**13m**):* yield 88% (602 mg, 1.76 mmol); pale yellow granule; mp 104−105 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.00 (3H, s), 7.36 (1H, t, J = 7.9 Hz), 7.42 (1H, d, J = 9.0 Hz), 7.45 (1H, t, J = 7.9 Hz), 7.59−7.61 (2H, m), 7.75 (1H, d, J = 5.4 Hz), 7.81 (1H, d, J = 9.0 Hz), 8.26 (1H, s), 8.44 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 103.5, 120.5, 124.1, 124.2, 127.2, 128.5, 128.6, 130.6, 131.7, 132.9, 133.1, 139.7, 141.8, 151.3, 160.1, 197.4; IR (KBr) 1668 cm^{-1}; ESIMS m/z (rel int) 342 (100, [M + 1]$^+$), 344 (97, [M + 3]$^+$). Anal. Calcd for $C_{17}H_{12}BrNO_2$: C, 59.67; H, 3.53; N, 4.09. Found: C, 59.66; H, 3.85; N, 3.85.

*(2-Bromo-4,5-dimethoxyphenyl)(7-methoxyisoquinolin-1-yl)-methanone (**13n**):* yield 96% (772 mg, 1.92 mmol); white granule; mp 158−159 °C (hexane−EtOAc). ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.92 (3H, s), 3.93 (3H, s), 3.97 (3H, s), 7.03 (1H, s), 7.28 (1H, s), 7.41 (1H, d, J = 9.0 Hz), 7.73 (1H, d, J = 5.3 Hz), 7.81 (1H, d, J = 9.0 Hz), 7.99 (1H, s), 8.45 (1H, d, J = 5.3 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.5, 56.1, 56.3, 103.5, 113.3, 113.8, 115.9, 123.5, 124.1, 128.3, 128.5, 132.8, 132.9, 139.6, 148.3, 151.9, 152.8, 159.7, 196.2; IR (KBr) 1667 cm^{-1}; ESIMS m/z (rel int) 402 (100, [M + 1]$^+$), 404 (95, [M + 3]$^+$); HRESIMS m/z calcd for $C_{19}H_{17}BrNO_4$ 402.03355, found 402.03348 [M + 1]$^+$.

*(2-Bromo-4,5-methylenedioxyphenyl)(7-methoxyisoquinolin-1-yl)methanone (**13o**):* yield 88% (679 mg, 1.76 mmol); pale yellow crystal; mp146−147 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.97 (3H, s), 6.05 (2H, s), 7.03 (1H, s), 7.12 (1H, s), 7.40 (1H, d, J = 9.0, 2.4 Hz), 7.73 (1H, d, J = 5.4 Hz), 7.80 (1H, d, J = 9.0 Hz), 8.07 (1H, d, J = 2.4 Hz), 8.44 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 102.4, 103.5, 111.0, 113.4, 113.6, 123.7, 124.1, 128.4, 128.6, 132.8, 134.5, 139.6, 147.4, 150.6, 152.2, 159.9, 196.0; IR (KBr) 1668 cm^{-1}; ESIMS m/z (rel int) 386 (100, [M + 1]$^+$), 388 (95, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{12}BrNO_4$: C, 55.98; H, 3.13; N, 3.63. Found: C, 56.07; H, 3.22; N, 3.44.

*(2-Bromo-5-trifluoromethylphenyl)(7-methoxyisoquinolin-1-yl)-methanone (**13p**):* yield 74% (607 mg, 1.48 mmol); pale yellow granule; mp 121−122 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.02 (3H, s), 7.44 (1H, dd, J = 9.1, 2.0 Hz), 7.59 (1H, dd, J = 8.4, 2.0 Hz), 7.73 (1H, d, J = 8.4 Hz), 7.78 (1H, d, J = 5.3 Hz), 7.81 (1H, d, J = 2.0 Hz), 7.83 (1H, d, J = 9.1 Hz), 8.39 (1H, d, J = 2.0 Hz), 8.44 (1H, d, J = 5.3 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.6, 103.4, 123.6 (q, J = 271 Hz), 124.2, 124.3, 124.8, 127.1 (q, J = 4 Hz), 127.8 (q, J = 3 Hz), 128.7, 128.8, 129.8 (q, J = 33 Hz), 133.0, 133.6, 139.7, 143.0, 149.7, 160.6, 196.2; IR (KBr) 1680 cm^{-1}; ESIMS m/z (rel int) 410 (100, [M + 1]$^+$), 412 (93, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{11}BrF_3NO_2$: C, 52.71; H, 2.70; N, 3.41. Found: C, 52.92; H, 2.79; N, 3.67.

*(2-Bromophenyl)(6,7-methylenedioxyisoquinolin-1-yl)-methanone (**13q**):* yield 92% (655 mg, 1.84 mmol); pale yellow crystal; mp 182−183 °C (hexane−EtOAc) (lit.[46] mp 173−175 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.14 (2H, s), 7.14 (1H, s), 7.35 (1H, td, J = 7.7, 1.7 Hz), 7.44 (1H, t, J = 7.7 Hz), 7.58 (1H, d, J = 7.7 Hz), 7.60 (1H, dd, J = 7.7, 1.7 Hz), 7.62 (1H, d, J = 5.4 Hz), 8.21 (1H, s), 8.37 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 101.9, 102.5, 102.7, 120.4, 123.5, 124.7, 127.2, 130.6, 131.7, 133.0, 135.9, 140.7, 141.7, 150.3, 150.9, 151.5, 197.3; IR (KBr) 1680 cm^{-1}; ESIMS m/z (rel int) 356 (100, [M + 1]$^+$), 358 (96, [M + 3]$^+$). Anal. Calcd for $C_{17}H_{10}BrNO_3$: C, 57.33; H, 2.83; N, 3.93. Found: C, 57.55; H, 3.09; N, 3.67.

*(2-Bromo-4,5-dimethoxyphenyl)(6,7-methylenedioxyisoquinolin-1-yl)methanone (**13r**):* yield 79% (657 mg, 1.58 mmol); white granule; mp 169−170 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.92 (6H, s), 6.14 (2H, s), 7.01 (1H, s), 7.14 (1H, s), 7.28 (1H, s), 7.61 (1H, d, J = 5.5 Hz), 7.94 (1H, s), 8.38 (1H, d, J = 5.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.1, 56.3, 101.8, 102.4, 102.7, 113.2, 113.9, 115.9, 123.0, 124.5, 132.8, 135.7, 140.7, 148.4, 149.9, 151.0, 151.9, 153.0, 196.1; IR (KBr) 1674 cm^{-1}; ESIMS m/z (rel int) 416 (100, [M + 1]$^+$), 418 (93, [M + 3]$^+$); HRESIMS m/z calcd for $C_{19}H_{15}BrNO_5$ 416.0128, found 416.0124 [M + 1]$^+$.

*(2-Bromo-4,5-methylenedioxyphenyl)(6,7-methylenedioxyisoquinolin-1-yl)methanone (**13s**):* yield 94% (752 mg, 1.88 mmol); pale yellow needle; mp 220−222 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.05 (2H, s), 6.13 (2H, s), 7.01 (1H, s), 7.12 (1H, s), 7.13 (1H, s), 7.61 (1H, d, J = 5.5 Hz), 8.02 (1H, s), 8.37 (1H, d, J = 5.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 101.9, 102.4, 102.5, 102.7, 111.0, 113.3, 113.5, 123.2, 124.6, 134.4, 135.8, 140.7, 147.4, 150.1, 150.6, 151.0, 152.4, 195.9; IR (KBr) 1667 cm^{-1}; ESIMS m/z (rel int) 400 (100, [M + 1]$^+$), 402 (94, [M + 3]$^+$). Anal. Calcd for $C_{18}H_{10}BrNO_5$: C, 54.02; H, 2.52; N, 3.50. Found: C, 53.90; H, 2.70; N, 3.41.

*(2-Bromo-5-trifluoromethylphenyl)(6,7-methylenedioxyisoquinolin-1-yl)methanone (**13t**):* yield 53% (449 mg, 1.06 mmol); pale yellow granule; mp 175−176 °C (hexane−EtOAc); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.16 (2H, s), 7.15 (1H, s), 7.58 (1H, dd, J = 8.4, 2.1 Hz), 7.65 (1H, d, J = 5.4 Hz), 7.71 (1H, d, J = 8.4 Hz), 7.82 (1H, d, J = 2.1 Hz), 8.33 (1H, s), 8.36 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 102.0, 102.3, 102.8, 123.6, 124.1, 124.2, 124.9, 127.1 (q, J = 4 Hz), 127.9 (q, J = 3 Hz), 129.9 (q, J = 33 Hz), 133.5, 136.1, 140.7, 142.9, 150.0, 150.7, 151.1, 196.0; IR (KBr) 1682 cm^{-1}; ESIMS m/z (rel int) 424 (89, [M + 1]$^+$), 426 (89, [M + 3]$^+$). Anal. Calcd for $C_{18}H_9BrF_3NO_3$: C, 50.97; H, 2.14; N, 3.30. Found: C, 51.17; H, 2.07; N, 3.22.

General Procedure for the Reductive Photocyclization of 1-(2-Bromobenzoyl)isoquinolines 13. $NaBH_4$ (0.750 mmol) was carefully added to a stirred solution of the bromo ketones **13** (0.500 mmol) in hot methanol (200 mL). After cooling, the resulting solution was irradiated in a quartz reactor equipped with a medium pressure mercury lamp (450 W) at room temperature. The reactions were monitored using TLC. Water (5 mL) was added until TLC showed the reaction to be complete. The solution was then evaporated, and the residue was dissolved in $CHCl_3$ (400 mL). The solution was washed with water (3 × 50 mL). The organic phase was dried with anhydrous $MgSO_4$, filtered, and evaporated under reduced pressure. The residue was purified by column chromatography over silica gel and eluted with $CHCl_3$−MeOH (20:1) to yield the pure dibenzo[*de,g*]quinolin-7-ones **8**. The full spectral data of dibenzo[*de,g*]-quinolin-7-ones **8a−t** are described as follows.

*Dibenzo[de,g]quinolin-7-one (**8a**):* yield 55% (63.5 mg, 0.275 mmol); yellow solid; mp 222−224 °C (lit.[47] mp 222−222.5 °C); ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.60 (1H, t, J = 7.8 Hz), 7.78 (1H, td, J = 7.8, 1.2 Hz), 7.87 (1H, t, J = 7.8 Hz), 7.98−8.00 (2H, m), 8.30 (1H, d, J = 7.8 Hz), 8.45 (1H, d, J = 7.8 Hz), 8.56 (1H, dd, J = 7.8, 1.2 Hz), 9.06 (1H, d, J = 5.4 Hz); ^{13}C NMR (150 MHz, $CDCl_3$) δ 123.1, 124.5, 124.6, 125.1, 128.6, 128.7, 129.1, 129.2, 131.0, 131.6, 134.1, 134.9, 136.9, 145.5, 146.7, 182.7; IR (KBr) 1665 cm^{-1}; EIMS m/z (rel int)

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231 (100, M^+); HREIMS m/z calcd for $C_{16}H_9NO$ 231.0684, found 231.0686 $[M]^+$.

9,10-Dimethoxydibenzo[de,g]quinolin-7-one (**8b**): yield 77% (112.0 mg, 0.385 mmol); orange granule; mp 257−259 °C (lit.[47] mp 255−256 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.06 (3H, s), 4.12 (3H, s), 7.56 (1H, s), 7.77 (1H, t, J = 7.8 Hz), 7.87−7.92 (3H, m), 8.22 (1H, d, J = 7.8 Hz), 9.02 (1H, d, J = 5.3 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.2, 56.3, 104.4, 109.6, 123.8, 123.9, 124.6, 125.8, 127.8, 128.5, 129.6, 130.7, 136.5, 145.1, 146.7, 150.1, 154.0, 181.3; IR (KBr) 1651 cm^{-1}; EIMS m/z (rel int) 291 (100, M^+); HREIMS m/z calcd for $C_{18}H_{13}NO_3$ 291.0895, found 291.0905 $[M]^+$.

9,10-(Methylenedioxy)dibenzo[de,g]quinolin-7-one (**8c**): yield 69% (94.9 mg, 0.345 mmol); orange granule; mp 300 °C dec; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.15 (2H, s), 7.62 (1H, s), 7.81 (1H, t, J = 7.2 Hz), 7.91−7.95 (3H, m), 8.21 (1H, d, J = 7.2 Hz), 9.03 (1H, d, J = 5.4 Hz); ^{13}C NMR (150 MHz, $CDCl_3$) δ 102.3, 102.4, 107.7, 123.9, 124.3, 124.8, 127.8, 128.2, 128.7, 130.9, 132.0, 136.7, 145.5, 146.7, 149.1, 153.2, 181.2; IR (KBr) 1659 cm^{-1}; EIMS m/z (rel int) 275 (100, M^+); HREIMS m/z calcd for $C_{17}H_9NO_3$ 275.0582, found 275.0586 $[M]^+$.

9-Trifluoromethyldibenzo[de,g]quinolin-7-one (**8d**): yield 33% (49.3 mg, 0.165 mmol); pale yellow solid; mp 238−243 °C (sublimation); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.85 (1H, t, J = 8.0 Hz), 7.89 (1H, d, J = 8.0 Hz), 7.95 (1H, d, J = 5.3 Hz), 7.99 (1H, d, J = 8.0 Hz), 8.27 (1H, d, J = 8.0 Hz), 8.38 (1H, d, J = 8.0 Hz), 8.69 (1H, s), 9.03 (1H, d, J = 5.3 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 123.5 (q, J = 271 Hz), 123.8, 124.5, 125.3, 125.7, 126.0 (q, J = 4 Hz), 126.9, 129.8, 129.9 (q, J = 3 Hz), 130.9, 131.0 (q, J = 33 Hz), 131.4, 136.7, 137.4, 145.7, 146.0, 181.2; IR (KBr) 1672 cm^{-1}; EIMS m/z (rel int) 299 (100, M^+); HREIMS m/z calcd for $C_{17}H_8F_3NO$ 299.0558, found 299.0560 $[M]^+$.

3-Methoxydibenzo[de,g]quinolin-7-one (**8e**): yield 86% (112.2 mg, 0.430 mmol); orange needle; mp 201−203 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.06 (3H, s), 6.97 (1H, d, J = 8.0 Hz), 7.47 (1H, t, J = 8.0 Hz), 7.66 (1H, t, J = 8.0 Hz), 8.03 (1H, d, J = 8.0 Hz), 8.15 (1H, d, J = 8.0 Hz), 8.23 (1H, d, J = 5.1 Hz), 8.46 (1H, d, J = 8.0 Hz), 8.99 (1H, d, J = 5.1 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.0, 107.7, 119.7, 120.5, 122.3, 125.0, 125.7, 127.8, 128.8, 129.9, 130.7, 133.8, 135.2, 145.0, 146.2, 156.5, 182.7; IR (KBr) 1657 cm^{-1}; EIMS m/z (rel int) 261 (100, M^+); HREIMS m/z calcd for $C_{17}H_{11}NO_2$ 261.0790, found 261.0798 $[M]^+$.

3,9,10-Trimethoxydibenzo[de,g]quinolin-7-one (**8f**): yield 95% (152.0 mg, 0.475 mmol); orange solid; mp 268−270 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.02 (3H, s), 4.03 (3H, s), 4.04 (3H, s), 6.78 (1H, d, J = 7.9 Hz), 7.14 (1H, s), 7.71 (1H, s), 7.76 (1H, d, J = 7.9 Hz), 8.14 (1H, d, J = 5.4 Hz), 8.94 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.9, 56.1, 56.2, 103.5, 107.4, 109.2, 119.2, 120.3, 124.2, 124.8, 124.9, 129.6, 130.1, 144.6, 146.1, 149.2, 154.0, 155.9, 181.3; IR (KBr) 1645 cm^{-1}; EIMS m/z (rel int) 321 (100, M^+); HREIMS m/z calcd for $C_{19}H_{15}NO_4$ 321.1001, found 321.1008 $[M]^+$.

3-Methoxy-9,10-(methylenedioxy)dibenzo[de,g]quinolin-7-one (**8g**): yield 80% (122.0 mg, 0.400 mmol); dark red solid; mp 260−273 °C (sublimation); ^{1}H NMR (600 MHz, $CDCl_3$) δ 4.08 (3H, s), 6.10 (2H, s), 7.04 (1H, d, J = 8.4 Hz), 7.51 (1H, s), 7.89 (1H, s), 8.11 (1H, d, J = 8.4 Hz), 8.31 (1H, d, J = 5.4 Hz), 9.02 (1H, d, J = 5.4 Hz); ^{13}C NMR (150 MHz, $CDCl_3$) δ 56.0, 101.6, 102.1, 107.4, 107.6, 119.5, 120.7, 124.4, 125.5, 126.8, 129.9, 132.6, 145.2, 146.2, 148.2, 153.2, 156.4, 181.3; IR (KBr) 1647 cm^{-1}; EIMS m/z (rel int) 305 (100, M^+); HREIMS m/z calcd for $C_{18}H_{11}NO_4$ 305.0688, found 305.0684 $[M]^+$.

9-Trifluoromethyl-3-methoxydibenzo[de,g]quinolin-7-one (**8h**): yield 99% (162.9 mg, 0.495 mmol); yellow solid; mp 220 °C (sublimation); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.13 (3H, s), 7.09 (1H, d, J = 8.3 Hz), 7.88 (1H, d, J = 8.3 Hz), 8.18 (1H, d, J = 8.3 Hz), 8.30 (1H, d, J = 8.3 Hz), 8.33 (1H, d, J = 5.4 Hz), 8.74 (1H, s), 9.06 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.2, 107.7, 119.0, 120.1, 123.1, 123.7 (q, J = 271 Hz), 125.2, 126.1 (q, J = 4 Hz), 127.2, 129.8, 129.9 (q, J = 34 Hz), 130.1, 130.6, 138.0, 145.5, 145.7, 157.6, 181.7; IR (KBr) 1663 cm^{-1}; EIMS m/z (rel int) 329 (100, M^+); HREIMS m/z calcd for $C_{18}H_{10}F_3NO_2$ 329.0664, found 329.0672 $[M]^+$.

2,3-Dimethoxydibenzo[de,g]quinolin-7-one (**8i**): yield 61% (88.8 mg, 0.305 mmol); orange solid; mp 179−180 °C (lit.[47] mp 190−191 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.12 (3H, s), 4.18(3H, s), 7.55 (1H, t, J = 7.9 Hz), 7.74 (1H, t, J = 7.9 Hz), 8.14−8.17 (2H, m), 8.22 (1H, d, J = 5.6 Hz), 8.51 (1H, d, J = 7.9 Hz), 8.97 (1H, d, J = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 57.1, 61.7, 113.9, 119.1, 120.8, 122.6, 125.3, 128.7, 129.0, 131.3, 133.2, 133.8, 134.5, 143.5, 145.2, 146.3, 151.2, 182.8; IR (KBr) 1667 cm^{-1}; EIMS m/z (rel int) 291 (100, M^+); HREIMS m/z calcd for $C_{18}H_{13}NO_3$ 291.0895, found 291.0888 $[M]^+$.

2,3,9,10-Tetramethoxydibenzo[de,g]quinolin-7-one (**8j**): yield 70% (122.9 mg, 0.350 mmol); dark red solid; mp 208−210 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.06 (3H, s), 4.09 (3H, s), 4.12 (3H, s), 4.17 (3H, s), 7.40 (1H, s), 7.87 (1H, s), 7.88 (1H, s), 8.17 (1H, d, J = 5.6 Hz), 8.94 (1H, d, J = 5.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.2, 56.3, 57.4, 61.7, 104.1, 109.8, 113.8, 118.8, 120.3, 125.4, 125.7, 129.4, 133.1, 143.3, 145.0, 146.4, 149.9, 151.1, 154.1, 181.7; IR (KBr) 1643 cm^{-1}; EIMS m/z (rel int) 351 (100, M^+); HREIMS m/z calcd for $C_{20}H_{17}NO_5$ 351.1107, found 351.1103 $[M]^+$.

2,3-Dimethoxy-9,10-(methylenedioxy)dibenzo[de,g]quinolin-7-one (**8k**): yield 78% (130.7 mg, 0.390 mmol); dark red solid; mp 264−266 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.09 (3H, s), 4.13 (3H, s), 6.08 (2H, s), 7.22 (1H, s), 7.65 (1H, s), 7.68 (1H, s), 8.10 (1H, d, J = 5.4 Hz), 8.88 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.9, 61.6, 101.7, 102.2, 107.1, 113.6, 118.7, 119.7, 124.9, 127.1, 131.4, 132.8, 143.0, 144.9, 146.0, 148.4, 151.0, 152.8, 181.1; IR (KBr) 1649 cm^{-1}; EIMS m/z (rel int) 335 (100, M^+); HREIMS m/z calcd for $C_{19}H_{13}NO_5$ 335.0794, found 335.0786 $[M]^+$.

9-Trifluoromethyl-2,3-dimethoxydibenzo[de,g]quinolin-7-one (**8l**): yield 80% (143.6 mg, 0.400 mmol); orange solid; mp 221−223 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.15 (3H, s), 4.19 (3H, s), 7.88 (1H, d, J = 8.4 Hz), 8.07 (1H, s), 8.16 (1H, d, J = 8.4 Hz), 8.20 (1H, d, J = 5.5 Hz), 8.69 (1H, s), 8.94 (1H, d, J = 5.5 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 57.2, 61.7, 115.2, 119.5, 120.9, 123.3, 123.4, 123.6 (q, J = 271 Hz), 126.2 (q, J = 4 Hz), 129.9 (q, J = 3 Hz), 130.6 (q, J = 33 Hz), 131.2, 133.1, 137.3, 144.6, 145.4, 145.7, 150.9, 181.6; IR (KBr) 1667 cm^{-1}; EIMS m/z (rel int) 359 (100, M^+); HREIMS m/z calcd for $C_{19}H_{12}F_3NO_3$ 359.0769, found 359.0760 $[M]^+$.

1-Methoxydibenzo[de,g]quinolin-7-one (**8m**): yield 63% (82.2 mg, 0.315 mmol); orange solid; mp 179−180 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.20 (3H, s), 7.52 (1H, t, J = 8.0 Hz), 7.62 (1H, d, J = 9.2 Hz), 7.71 (1H, t, J = 8.0 Hz), 7.86 (1H, d, J = 5.2 Hz), 7.93 (1H, d, J = 9.2 Hz), 8.60 (1H, d, J = 8.0 Hz), 8.94 (1H, d, J = 5.2 Hz), 9.08 (1H, d, J = 8.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.5, 112.9, 119.5, 124.7, 126.1, 127.7, 128.7, 128.9, 130.5, 131.6, 132.3, 133.8, 134.8, 143.3, 145.5, 158.6, 182.4; IR (KBr) 1645 cm^{-1}; EIMS m/z (rel int) 261 (100, M^+); HREIMS m/z calcd for $C_{17}H_{11}NO_2$ 261.0790, found 261.0792 $[M]^+$.

1,9,10-Trimethoxydibenzo[de,g]quinolin-7-one (**8n**): yield 95% (152.5 mg, 0.475 mmol); orange solid; mp 250−252 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.06 (3H, s), 4.08 (3H, s), 4.22 (3H, s), 7.62 (1H, d, J = 9.2 Hz), 7.86 (1H, d, J = 5.2 Hz), 7.91 (1H, d, J = 9.2 Hz), 8.04 (1H, s), 8.67 (1H, s), 8.95 (1H, d, J = 5.2 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.8, 56.2, 56.8, 109.8, 110.9, 113.5, 119.6, 124.4, 125.7, 126.5, 129.9, 130.0, 132.4, 143.4, 145.9, 148.8, 153.4, 157.8, 181.1; IR (KBr) 1634 cm^{-1}; EIMS m/z (rel int) 321 (100, M^+); HREIMS m/z calcd for $C_{19}H_{15}NO_4$ 321.1001, found 321.1004 $[M]^+$.

1-Methoxy-9,10-(methylenedioxy)dibenzo[de,g]quinolin-7-one (**8o**): yield 81% (123.5 mg, 0.405 mmol); dark red solid; mp 275−277 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.19 (3H, s), 6.12 (2H, s), 7.60 (1H, d, J = 9.1 Hz), 7.83 (1H, d, J = 4.6 Hz), 7.89 (1H, d, J = 9.1 Hz), 8.00 (1H, s), 8.55 (1H, s), 8.92 (1H, d, J = 4.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.6, 102.0, 107.6, 108.4, 113.3, 119.6, 124.5, 125.5, 128.2, 130.3, 131.7, 132.3, 143.5, 145.6, 147.6, 152.7, 158.2, 180.9; IR (KBr) 1643 cm^{-1}; EIMS m/z (rel int) 305 (100, M^+); HREIMS m/z calcd for $C_{18}H_{11}NO_4$ 305.0688, found 305.0682 $[M]^+$.

9-Trifluoromethyl-1-methoxydibenzo[de,g]quinolin-7-one (**8p**): yield 80% (131.6 mg, 0.400 mmol); yellow solid; mp 232−234 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.24 (3H, s), 7.62 (1H, d, J = 9.3 Hz), 7.80 (1H, d, J = 8.8 Hz), 7.83 (1H, d, J = 5.1 Hz), 7.95 (1H, d, J = 9.3 Hz), 8.77 (1H, s), 8.92 (1H, d, J = 5.1 Hz), 9.05 (1H, d, J = 8.8 Hz);

^{13}C NMR (125 MHz, $CDCl_3$) δ 56.6, 111.4, 119.4, 123.8 (q, J = 271 Hz), 125.1, 125.6 (q, J = 4 Hz), 126.3, 129.4 (q, J = 33 Hz), 129.5, 129.6 (q, J = 3 Hz), 131.5, 131.9, 132.2, 137.4, 143.8, 144.9, 159.5, 181.3; IR (KBr) 1659 cm^{-1}; EIMS m/z (rel int) 324 (100, M$^+$); HREIMS m/z calcd for $C_{18}H_{10}F_3NO_2$ 329.0664, found 329.0672 [M]$^+$.

*1,2-(Methylenedioxy)dibenzo[de,g]quinolin-7-one (**8q**):* yield 45% (61.9 mg, 0.225 mmol); yellow solid; mp 279−281 °C (lit.[48] mp 280−282 °C); ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.34 (2H, s), 7.14 (1H, s), 7.54 (1H, t, J = 7.2 Hz), 7.70 (1H, t, J = 7.2 Hz), 7.73 (1H, d, J = 5.4 Hz), 8.55 (1H, d, J = 7.2 Hz), 8.59 (1H, d, J = 7.2 Hz), 8.85 (1H, d, J = 5.4 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 102.4, 103.2, 108.1, 123.2, 124.2, 127.3, 128.6, 128.8, 131.3, 132.8, 133.9, 135.7, 144.9, 145.4, 147.9, 151.7, 182.4; IR (KBr) 1651 cm^{-1}; EIMS m/z (rel int) 275 (100, M$^+$); HREIMS m/z calcd for $C_{17}H_9NO_3$ 275.0582, found 275.0579 [M]$^+$.

*Dicentrinone (**8r**):* yield 81% (135.7 mg, 0.405 mmol); yellow solid; mp 300 °C dec (lit.[49] mp 300 °C dec); ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.95 (3H, s), 4.06 (3H, s), 6.34 (2H, s), 7.06 (1H, s), 7.70 (1H, d, J = 5.2 Hz), 7.86 (1H, s), 7.92 (1H, s), 8.86 (1H, d, J = 5.2 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 56.1, 56.2, 102.4, 102.7, 108.2, 108.8, 109.5, 122.6, 124.0, 125.9, 127.7, 135.5, 144.7, 145.4, 147.0, 149.5, 151.5, 153.8, 181.2; IR (KBr) 1643 cm^{-1}; EIMS m/z (rel int) 335 (100, M$^+$); HREIMS m/z calcd for $C_{19}H_{13}NO_5$ 335.0794, found 335.0790 [M]$^+$.

*Cassameridine (**8s**):* yield 53% (84.5 mg, 0.265 mmol); brown solid; mp 320 °C dec (lit.[50] mp 300 °C); ^{1}H NMR (500 MHz, $CDCl_3$ + CF_3CO_2D + D_2O) δ 6.22 (2H, s), 6.60 (2H, s), 7.41 (1H, s), 7.77 (1H, s), 8.06 (1H, s), 8.30 (1H, d, J = 5.8 Hz), 8.94 (1H, d, J = 5.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$ + CF_3CO_2D) δ 103.4, 103.5, 105.0, 107.5, 107.6, 108.6, 121.6, 124.7, 126.6, 130.1, 134.1, 135.1, 142.9, 150.0, 151.6, 155.9, 158.3, 174.4; IR (KBr) 1682 cm^{-1}; EIMS m/z (rel int) 319 (100, M$^+$); HREIMS m/z calcd for $C_{18}H_9NO_5$ 319.0481, found 319.0488 [M]$^+$.

*9-Trifluoromethyl-1,2-(methylenedioxy)dibenzo[de,g]quinolin-7-one (**8t**):* yield 72% (123.5 mg, 0.360 mmol); yellow solid; mp 350 °C dec; ^{1}H NMR (600 MHz, $CDCl_3$) δ 6.44 (2H, s), 7.25 (1H, s), 7.81 (1H, d, J = 5.4 Hz), 7.93 (1H, d, J = 8.4 Hz), 8.75 (1H, d, J = 8.4 Hz), 8.92 (1H, d, J = 5.4 Hz); ^{13}C NMR (150 MHz, $CDCl_3$) δ 102.9, 104.3, 106.7, 123.3, 123.6 (q, J = 270 Hz), 124.7, 125.9, 128.0, 129.9, 130.3 (q, J = 33 Hz), 131.2, 135.6, 135.7, 144.8, 145.3, 149.0, 151.8, 181.4; IR (KBr) 1667 cm^{-1}; EIMS m/z (rel int) 343 (100, M$^+$); HREIMS m/z calcd for $C_{18}H_8F_3NO_3$ 343.0456, found 343.0459 [M]$^+$.

■ ASSOCIATED CONTENT

Ⓢ Supporting Information

Copies of the ^{1}H and ^{13}C NMR spectra of compounds **8**, **10**, **12**, and **13**. This material is available free of charge via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

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