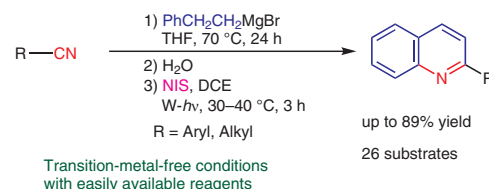


Preparation of 2-Arylquinolines from 2-Arylethyl Bromides and Aromatic Nitriles with Magnesium and *N*-Iodosuccinimide

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Abstract Treatment of 2-arylethylmagnesium bromides, prepared from 2-arylethyl bromides and magnesium, with aromatic nitriles, followed by reaction with water and then with *N*-iodosuccinimide under irradiation with a tungsten lamp, gave the corresponding 2-arylquinolines in good to moderate yields under transition-metal-free conditions. 2-Alkylquinolines could be also obtained in moderate yields by the same procedure with 2-arylethyl bromides, magnesium, aliphatic nitriles bearing a secondary alkyl group, and *N*-iodosuccinimide.

Key words quinolines, 2-arylethyl bromides, aromatic nitriles, Grignard reaction, *N*-iodosuccinimide

Quinolines are one of the most important nitrogen-containing heteroaromatics, because of their potent biological activities, such as antimalarial, antibacterial, anti-inflammatory, and anticancer activities.¹ As typical examples (Figure 1), quinine (natural product) and chloroquine (synthesized product) are antimalarials.²

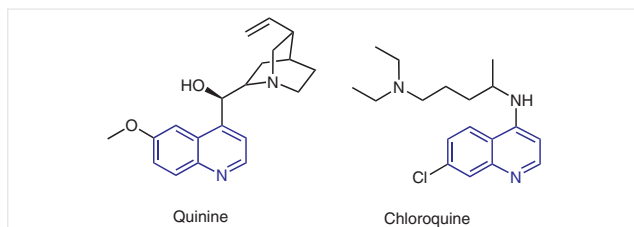


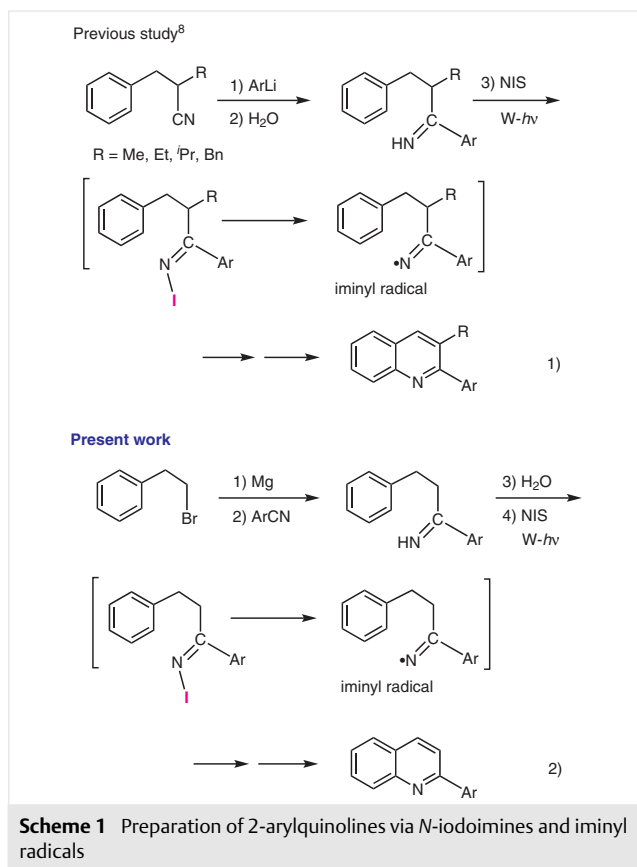
Figure 1 Typical quinolines possessing antimalarial activity

Synthetic studies of the quinoline core have been actively carried out.³ Conventionally, the quinoline core has been prepared by named reactions, such as the Skraup synthesis, the Friedländer synthesis, the Combes synthesis, and the Conrad–Limpach synthesis, among others.⁴ Recent reports

of the preparation of the quinoline core are as follows:⁵ the preparation of 2-aryl-4-methylquinolines with hydrazones of *o*-aminoacetophenone and ethynylarenes in the presence of $[\text{RhCp}^*\text{Cl}_2]_2$;^{5a} the preparation of 2-arylquinolines with anilines and aromatic aldehydes in the presence of FeCl_3 in nitroethane;^{5b} the preparation of 2-aryl-3-[(trifluoromethyl)sulfanyl]quinolines with *o*-alkynylbenzyl azides, $\text{Na}_2\text{S}_2\text{O}_8$, and AgSCF_3 ;^{5c} the preparation of 2-amino-3-arylquinolines with *o*-aminobenzyl alcohols and α -arylacetonitriles in the presence of Mn(I)-NNS complex;^{5d} the preparation of 4-amino-2-(difluoromethyl)-3-(methoxycarbonyl)quinolines with *o*-aminobenzonitriles and methyl 4,4-difluorobut-2-ynoate;^{5e} the preparation of 4-phenylquinolines with anilines, α -alkynyl esters, and phenylacetylene in the presence of AgOTf ;^{5f} the preparation of 2-aryl-3,4-diarylquinolines with α -(*N*-arylamino)acetophenones, 1,1-diarylethenes, and di-*tert*-butyl peroxide in the presence of $\text{Cu}(\text{OTf})_2$;^{5g} the preparation of 4-(acylmethyl)-2-aminoquinolines with β -(*o*-aminophenyl)- α,β -ynones and ynamides in the presence of Au(I) ;^{5h} the preparation of 2-aminoquinolines with *N*-acyl-*o*-alkynylanilines and isocyanides in the presence of $\text{Pd}(\text{OAc})_2$;⁵ⁱ the preparation of 2-aryl-3-tosylquinolines with anthranils and *N*-tosylhydrazones in the presence of $\text{Cu}(\text{OAc})_2$ and AgOTf ;^{5j} the preparation of 6-(aryldiazenyl)-3-iodoquinolines with (*o*-aminoaryl)propargyl alcohols, aryldiazonium salts, and I_2 ;^{5k} the preparation of 3-aryl-2-(arylsulfonyl)quinolines with *o*-alkynylisocyanobenzenes and *p*-TsNa;^{5l} and the preparation of 2,4-diarylquinolines with *o*-aminobenzyl alcohols and alcohols in the presence of Mn(I)-PNP complex.^{5m}

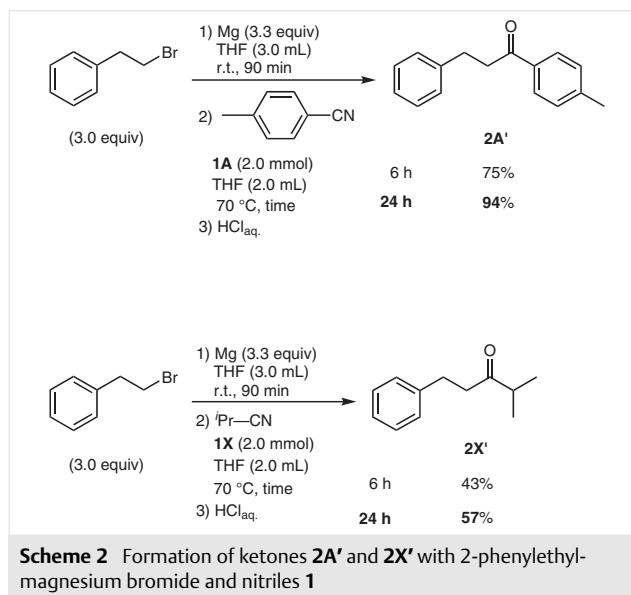
On the other hand, recently, synthetic uses of the iminyl radical (nitrogen-centered radicals) have become popular, particularly in the preparation of nitrogen-containing heterocyclic compounds such as dihydropyrroles and phenanthridines.⁶ As synthetic uses of iminyl radicals formed from ketimines and molecular iodine, we reported a one-pot

preparation of 6-arylphenanthridines by the treatment of *o*-cyanobiaryls with aryllithiums, followed by reaction with water and then with molecular iodine at 60 °C,⁷ and of 2-arylquinolines by the treatment of 3-arylpropionitriles with aryllithiums, followed by reaction with water and then with *N*-iodosuccinimide (NIS) under irradiation with a tungsten lamp (Scheme 1, eq 1).⁸ The latter method is suitable for the preparation of 2-arylquinolines bearing an alkyl group, such as methyl, ethyl, or isopropyl, at the 3-position. However, it cannot be practically used for the preparation of 2-arylquinolines due to the occurrence of α -proton abstraction of 3-arylpropionitriles by aryllithiums in the 1st reaction step. Herein, we report the transformation of 2-arylethyl bromides into 2-arylquinolines by the treatment with magnesium and then with aromatic nitriles, followed by reaction with water and then with NIS under irradiation with a tungsten lamp (Scheme 1, eq 2).



First, to understand the reactivity of 2-arylethylmagnesium bromides toward aromatic nitriles and secondary aliphatic nitriles, the reactions of 2-phenylethylmagnesium bromide with *p*-tolunitrile (**1A**) and with isobutyronitrile (**1X**) at 70 °C for 6 and 24 hours, followed by aqueous HCl hydrolysis to form the corresponding ketones **2A'** and **2X'**, respectively, were carried out (Scheme 2, eq 1 and 2). The results suggest that warming treatment at 70 °C for 24

hours is better, and the maximum yields of ketones **2A'** and **2X'** with *p*-tolunitrile (**1A**) and isobutyronitrile (**1X**) were 94% and 57%, respectively, due to the partial occurrence of α -proton abstraction from isobutyronitrile by 2-phenylethylmagnesium bromide. An excess amount of 2-phenylethylmagnesium bromide was used as the reactivity of 2-phenylethylmagnesium bromide toward *p*-tolunitrile and toward isobutyronitrile was not sufficiently high and warming conditions at 70 °C for 24 hours were required.

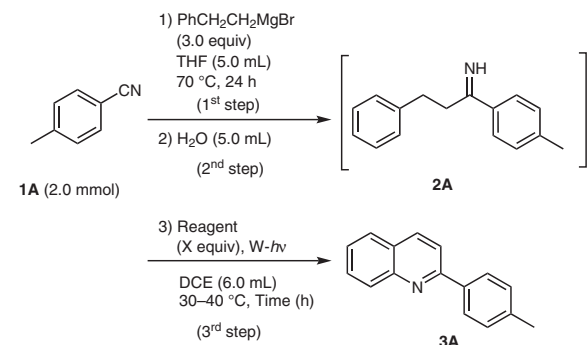


Then, treatment of 2-phenylethylmagnesium bromide, prepared from 2-phenylethyl bromide (3.0 equiv) and magnesium (3.3 equiv) in THF (5.0 mL), and *p*-tolunitrile (**1A**, 2.0 mmol) at 70 °C for 24 hours (1st step), followed by the addition of water (5.0 mL, 2nd step), gave *p*-methylphenyl 2-phenylethyl ketimine (**2A**). After rapid extraction of ketimine **2A** with chloroform and removal of the solvent, ketimine **2A** was treated with NIS (3.0 equiv) in 1,2-dichloroethane (DCE, 6.0 mL) under irradiation with a tungsten lamp (300 W) for 3 hours in the temperature range of 30–40 °C (3rd step) to give 2-(4-methylphenyl)quinoline (**3A**) in 73% yield, as shown in Table 1, entry 1. After the same reactions in the 1st reaction step, treatment of the reaction mixture with methanol (3.0 mL) and then DCE (6.0 mL), followed by reaction with NIS (3.0 equiv) under irradiation with a tungsten lamp, gave **3A** in only 21% yield (entry 2). Thus, the one-pot preparation of 2-(4-methylphenyl)quinoline (**3A**) from 2-phenylethylmagnesium bromide and *p*-tolunitrile (**1A**) was not effective because NIS was consumed by remaining magnesium and methanol. Under the same procedure and conditions as those of entry 1 (1st and 2nd steps), treatment of ketimine **2A** with NIS (3.5 equiv) in DCE under irradiation with a tungsten lamp for 3 and 6 hours generated quinoline **3A** in 82% and 81% yield, respectively (entries 3 and 4), although the same treatment with

NIS (4.0 equiv) slightly reduced the yield of **3A** (entry 5). Under the same procedure and conditions as those of entry 3, a solution of ketimine **2A** and NIS was irradiated with an LED lamp (13.6 W) and a 40 W tungsten lamp, instead of a 300 W tungsten lamp, in the 3rd reaction step to give **3A** in 71% and 67% yield, respectively (entries 6 and 7). Moreover, room light instead of irradiation with a 300 W tungsten lamp was not effective at all (entry 8). On the other hand, warming treatment of the mixture under dark conditions in the 3rd reaction step gave 2-(4-methylphenyl)quinoline (**3A**) in 66% yield (entry 9). Thus, entry 3 showed the best result. When 1,3-diiodo-5,5-dimethylhydantoin (DIH, 1.75 equiv) was used instead of NIS under the same procedure and conditions as those of entry 3, **3A** was obtained in 82% yield again (entry 10). On the other hand, warming treatment of a solution of ketimine **2A** with I₂ in the presence of K₂CO₃ at 70 °C for 3 hours, and also irradiation treatment of ketimine **2A** with *N*-bromosuccinimide (NBS) or *N*-chlorosuccinimide (NCS) with a tungsten lamp for 3 hours at 30–40 °C, did not generate **3A** at all (entries 11–13), and *p*-methylphenyl 2-phenylethyl ketone (**2A'**), a hydrolyzed compound of ketimine **2A** by quenching the reaction mixture with aqueous Na₂SO₃, was obtained in more than 80% yield. Thus, NIS and DIH were effective for the present 3rd reaction step. When the 3rd reaction step was carried out in the presence of 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO, 1.5 equiv) or 2,6-di-*tert*-butyl-*p*-cresol (BHT, 1.5 equiv), **3A** was not obtained at all (entries 14 and 15).

Based on those results, 2-phenylethylmagnesium bromide prepared from 2-phenylethyl bromide (3.0 equiv) and magnesium (3.3 equiv) in THF (5.0 mL) was treated with aromatic nitriles **1B–1O** (2.0 mmol), bearing a *o*-methylphenyl (**B**), *m*-methylphenyl (**C**), phenyl (**D**), *p*-*tert*-butylphenyl (**E**), 3,5-dimethylphenyl (**F**), *p*-methoxyphenyl (**G**), *p*-fluorophenyl (**H**), *p*-chlorophenyl (**I**), *m*-bromophenyl (**J**), *p*-bromophenyl (**K**), *p*-(trifluoromethyl)phenyl (**L**), β-naphthyl (**M**), *p*-biphenyl (**N**), or *p*-phenoxyphenyl (**O**) group, at 70 °C for 24 hours (1st step), and then with water (5.0 mL, 2nd step) to give aryl 2-phenylethyl ketimines **2**. After extraction of ketimines **2** with chloroform and removal of the solvent, ketimines **2** were treated with NIS (3.5 equiv) in DCE (6.0 mL) under irradiation with a tungsten lamp (300 W) for 3 hours in the temperature range of 30–40 °C (3rd step) to form 2-arylquinolines **3B–3O** in good to moderate yields, except **3B** in 35% yield (Scheme 3). As a gram-scale experiment, when 2-phenylethylmagnesium bromide was treated with benzonitrile (**1D**, 10 mmol) under the same procedure and conditions, 2-phenylquinoline (**3D**) was obtained in 71% yield (Scheme 3). Treatment of 2-phenylethylmagnesium bromide with aromatic nitriles **1P** and **1Q** bearing an acetal and MOM group under the same procedure and conditions generated the corresponding 2-arylquinolines **3P** and **3Q** in a moderate and good yield, respectively.

Table 1 Optimization of the Reaction Conditions for Compound **3A**



Entry	Reagent	X (equiv)	Time (h)	Yield (%)
1	NIS	3.0	3	73
2 ^a	NIS	3.0	3	21
3	NIS	3.5	3	82
4	NIS	3.5	6	81
5	NIS	4.0	3	78
6 ^b	NIS	3.5	3	71
7 ^c	NIS	3.5	3	67
8 ^d	NIS	3.5	3	5
9 ^e	NIS	3.5	3	66
10	DIH	1.75	3	82
11 ^f	I ₂	3.5	3	0
12	NBS	3.5	3	0
13	NCS	3.5	3	0
14 ^g	NIS	3.5	3	0
15 ^h	NIS	3.5	3	0

^a MeOH (3.0 mL) was used instead of H₂O, and the obtained mixture was directly treated with NIS under irradiation with a tungsten lamp.

^b A white LED lamp (13.6 W) was used, instead of a 300 W tungsten lamp.

^c A 40 W tungsten lamp was used, instead of a 300 W tungsten lamp.

^d Room light (fluorescent lighting, 32 W) was used, instead of a 300 W tungsten lamp.

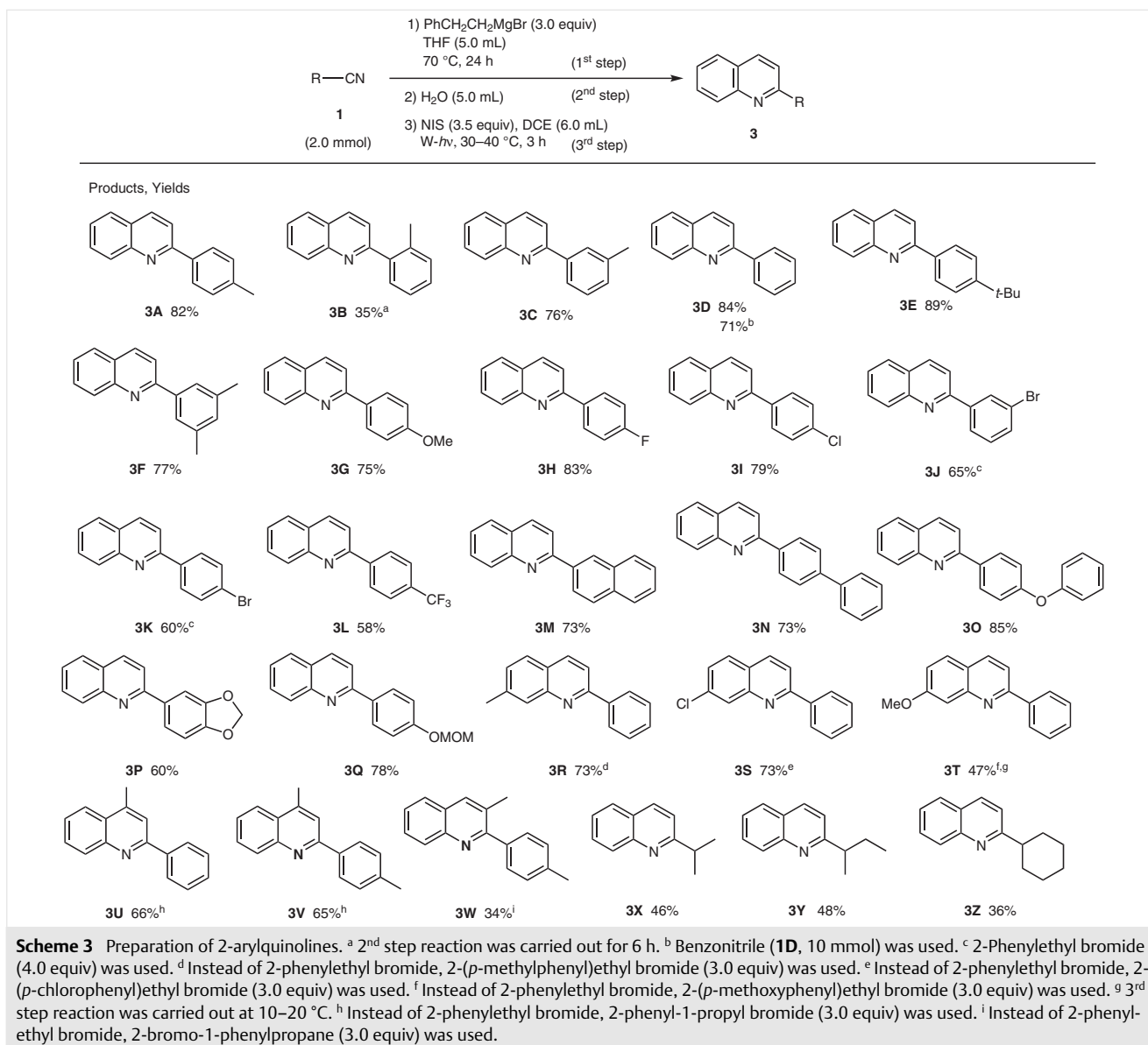
^e The 3rd step reaction was carried out at 70 °C under dark conditions.

^f In the 3rd step reaction, K₂CO₃ (1.5 equiv) was added.

^g In the 3rd step reaction, TEMPO (1.5 equiv) was added.

^h In the 3rd step reaction, BHT (1.5 equiv) was added.

When 2-(*p*-methylphenyl)ethylmagnesium bromide, 2-(*p*-chlorophenyl)ethylmagnesium bromide, and 2-(*p*-methoxyphenyl)ethylmagnesium bromide were used instead of 2-phenylethylmagnesium bromide in the reaction with benzonitrile (**1D**) under the same procedure and conditions, 7-methyl-2-phenylquinoline (**3R**), 7-chloro-2-phenylquinoline (**3S**), and 7-methoxy-2-phenylquinoline (**3T**) were obtained in good to moderate yields (Scheme 3). Treatment of 2-phenyl-1-propylmagnesium bromide with benzonitrile and *p*-tolunitrile under the same procedure and conditions generated 4-methyl-2-phenylquinoline (**3U**) and 4-methyl-2-(4-methylphenyl)quinoline (**3V**), respectively, in moderate yields. On the other hand, treatment of



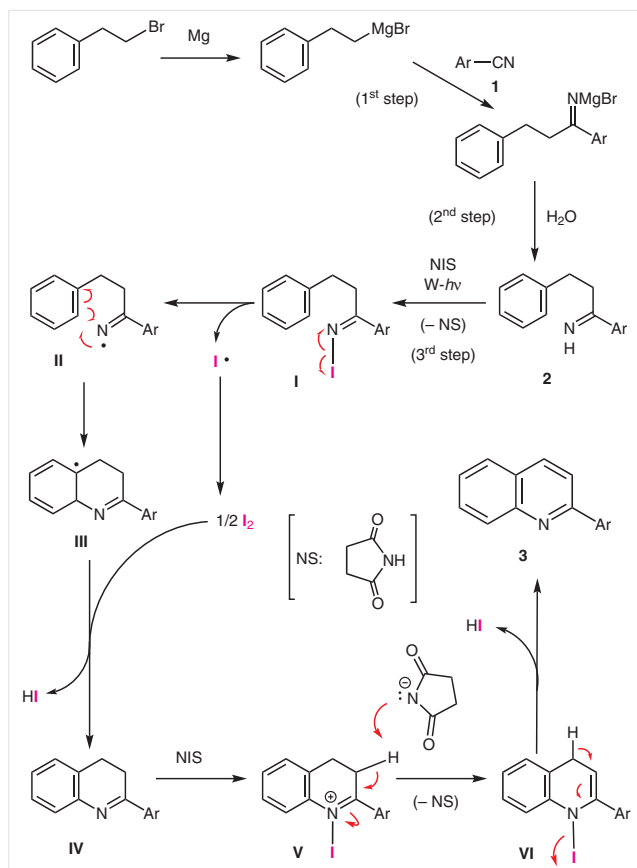
1-phenyl-2-propylmagnesium bromide, derived from 2-bromo-1-phenylpropane and magnesium, with *p*-toluonitrile under the same procedure and conditions gave 3-methyl-2-(4-methylphenyl)quinoline (**3W**) in low yield, as addition of the Grignard reagent to *p*-toluonitrile in the 1st reaction step does not proceed effectively due to steric hindrance.

When 2-phenylethylmagnesium bromide was treated with isobutyronitrile (**1X**), α -methylbutyronitrile (**1Y**), and cyclohexanecarbonitrile (**1Z**), which are aliphatic nitriles bearing a secondary alkyl group, under the same procedure and conditions, 2-isopropylquinoline (**3X**), 2-*sec*-butylquinoline (**3Y**), and 2-cyclohexylquinoline (**3Z**), respectively, were obtained in moderate yields (Scheme 3). However,

treatment of 2-phenylethylmagnesium bromide with propionitrile, an aliphatic nitrile bearing a primary alkyl group, under the same procedure and conditions generated 2-ethylquinoline in low yield (~20%), due to α -proton abstraction from propionitrile by the Grignard reagent in the 1st reaction step. Moreover, treatment of 2-phenylethylmagnesium bromide with pivalonitrile, an aliphatic nitrile bearing a tertiary alkyl group, under the same procedure and conditions did not generate 2-*tert*-butylquinoline at all and, instead, 3-phenylpropionitrile was obtained in 50% yield through the radical β -elimination of the formed imino-nitrogen-centered radical. Thus, the present method is limited to the preparation of 2-arylquinolines mainly and 2-alkylquinolines bearing a secondary alkyl group.

An opposite approach for the preparation of 2-arylquinolines with β -arylpropionitriles and arylmagnesium bromides to form ketimines **2**, then the same reaction with NIS, could be proposed. However, treatment of β -phenylpropionitrile and *p*-methylphenylmagnesium bromide at 70 °C for 24 hours did not generate *p*-methylphenyl 2-phenylethyl ketimine (**2A**) effectively due to α -proton abstraction from β -phenylpropionitrile by *p*-methylphenylmagnesium bromide. Thus, the opposite approach (reaction of β -arylpropionitriles and ArMgBr, followed by reaction with NIS under irradiation with a tungsten lamp) is not practical to obtain 2-arylquinolines **3**.

A possible reaction pathway is shown in Scheme 4. Ketimine **2** formed from the reaction of 2-phenylethylmagnesium bromide and aromatic nitrile **1** (1st and 2nd steps) reacts with NIS to produce *N*-iodoimine **I** together with the generation of succinimide (NS). Once *N*-iodoimine **I** is formed, smooth homolytic bond cleavage of its N–I bond occurs to form imino-nitrogen-centered radical **II** and an iodine atom. Imino-nitrogen-centered radical **II** cyclizes onto the aromatic ring to form intermediate **III**, which is further oxidized to 3,4-dihydroquinoline **IV** by molecular iodine. Oxidation of 3,4-dihydroquinoline **IV** by NIS gives 2-arylquinoline **3** via the formation of *N*-iodonium compound **V** and HI elimination from compound **VI**.



Scheme 4 Plausible reaction mechanism

In conclusion, 2-arylquinolines could be obtained smoothly and efficiently by the treatment of aryl 2-arylethyl ketimines, prepared from the reaction of 2-arylethylmagnesium bromides and aromatic nitriles, with NIS under irradiation with a tungsten lamp, through the formation of *N*-iodoimines and imino-nitrogen-centered radicals, and radical cyclization onto the aromatic ring. This is a new approach for the preparation of 2-arylquinolines from commercially available 2-arylethyl bromides, aromatic nitriles, magnesium, and NIS under transition-metal-free conditions.

¹H NMR spectra were measured on 400 MHz spectrometers. Data are reported as follows: chemical shift in ppm from internal tetramethylsilane on the δ scale, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, sex = sextet, sep = septet, m = multiplet), coupling constant (Hz), integration. ¹³C NMR spectra were measured at 100 MHz on 400 MHz spectrometers. Chemical shifts are reported in ppm from the solvent resonance employed as the internal standard (CDCl₃ at 77.0 ppm). Characteristic peaks in the IR spectra are reported in wavenumbers, cm⁻¹. High-resolution mass spectra were recorded with Thermo Fisher Scientific Exactive Orbitrap mass spectrometers. Melting points are uncorrected. TLC was performed using 0.25 mm silica gel plates (60 F254). The products were purified by column chromatography on neutral silica gel 60N (63–200 mesh).

1-(4-Methylphenyl)-3-phenylpropan-1-one (2A')

Yield: 422.1 mg (94%); yellow oil.

IR (neat): 2959, 1676 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 2.41 (s, 3 H), 3.06 (t, *J* = 7.3 Hz, 2 H), 3.27 (t, *J* = 7.0 Hz, 2 H), 7.18–7.31 (m, 7 H), 7.85 (d, *J* = 8.2 Hz, 2 H).

¹³C NMR (100 MHz, CDCl₃): δ = 21.5, 30.1, 40.2, 126.0, 128.0, 128.3, 128.4, 129.2, 134.2, 141.3, 143.7, 198.7.

HRMS (APCI): *m/z* [M + H]⁺ calcd for C₁₆H₁₇O: 225.1274; found: 225.1270.

4-Methyl-1-phenylpentan-3-one (2X')

Yield: 200.9 mg (57%); yellow oil.

IR (neat): 2968, 1705 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 1.07 (d, *J* = 6.8 Hz, 6 H), 2.57 (quintet, *J* = 7.0 Hz, 1 H), 2.77 (t, *J* = 7.7 Hz, 2 H), 2.89 (t, *J* = 7.7 Hz, 2 H), 7.17–7.20 (m, 3 H), 7.29 (d, *J* = 7.7 Hz, 2 H).

¹³C NMR (100 MHz, CDCl₃): δ = 18.0, 29.7, 40.8, 41.8, 125.9, 128.2, 128.3, 141.2, 213.5.

HRMS (APCI): *m/z* [M + H]⁺ calcd for C₁₂H₁₇O: 177.1274; found: 177.1277.

2-(4-Methylphenyl)quinoline (3A); Typical Procedure for the Preparation of 2-Arylquinolines 3 from 2-Arylethyl Bromides and Aromatic Nitriles 1

To a solution of Mg (160.4 mg, 6.6 mmol) in THF (3.0 mL) was added 2-phenylethyl bromide (1110.0 mg, 6.0 mmol) at room temperature under argon atmosphere. After 90 min, the obtained Grignard reagent solution was added to a solution of *p*-tolunitrile (**1A**; 234.3 mg, 2.0 mmol) in THF (2.0 mL) at room temperature. The obtained mixture was stirred for 24 h at 70 °C under argon atmosphere. Then, H₂O (5.0

mL) was added to the mixture, and the obtained mixture was filtered through Celite. Then, the product was extracted from the filtrates with CHCl_3 (3×15.0 mL). The organic layer was dried over Na_2SO_4 . After filtration and removal of the solvent under reduced pressure, 1,2-dichloroethane (6.0 mL) and NIS (1.575 g, 7.0 mmol) were added to the residue at room temperature, and the obtained mixture was stirred for 3 h at 30–40 °C under irradiation with a tungsten lamp (300 W). Sat. aq. Na_2SO_3 solution (15.0 mL) was added to the reaction mixture and the product was extracted with CHCl_3 (3×15.0 mL). The organic layer was dried over Na_2SO_4 . After filtration and removal of the solvent, the residue was purified by silica gel column chromatography (*n*-hexane–EtOAc, 9:1) to give **3A**.

Yield: 361.0 mg (82%); white solid; mp 77–78 °C.

IR (neat): 3025, 1594, 1550 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.44 (s, 3 H), 7.34 (d, J = 7.9 Hz, 2 H), 7.51 (td, J = 7.6, 1.1 Hz, 1 H), 7.72 (td, J = 7.7, 1.4 Hz, 1 H), 7.82 (d, J = 8.2 Hz, 1 H), 7.87 (d, J = 8.6 Hz, 1 H), 8.08 (d, J = 8.4 Hz, 2 H), 8.16 (d, J = 9.1 Hz, 1 H), 8.21 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 21.3, 118.8 (2 C), 126.1, 127.1, 127.4, 129.6 (3 C), 136.6, 136.8, 139.4, 148.3, 157.3.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{N}$: 220.1121; found: 220.1116.

2-(2-Methylphenyl)quinoline (3B)

Yield: 154.4 mg (35%); white solid; mp 76–78 °C.

IR (neat): 3056, 1593, 1501 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.42 (s, 3 H), 7.32–7.35 (m, 3 H), 7.49–7.51 (m, 1 H), 7.55 (d, J = 8.5 Hz, 1 H), 7.57 (dt, J = 7.6, 1.1 Hz, 1 H), 7.74 (td, J = 7.8, 1.6 Hz, 1 H), 7.87 (d, J = 8.2 Hz, 1 H), 8.16 (d, J = 8.4 Hz, 1 H), 8.22 (d, J = 8.4 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 20.3, 122.3, 126.0 (2 C), 126.4, 126.7, 127.5, 128.5, 129.6, 130.8, 135.9, 136.0 (2 C), 140.7, 147.9, 160.3.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{N}$: 220.1121; found: 220.1121.

2-(3-Methylphenyl)quinoline (3C)

Yield: 335.0 mg (76%); yellow oil.

IR (neat): 3057, 1618, 1556 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.49 (s, 3 H), 7.28 (d, J = 7.5 Hz, 1 H), 7.42 (t, J = 7.7 Hz, 1 H), 7.53 (td, J = 7.6, 1.1 Hz, 1 H), 7.73 (td, J = 7.7, 1.4 Hz, 1 H), 7.83 (d, J = 8.2 Hz, 1 H), 7.87 (d, J = 8.6 Hz, 1 H), 7.92 (d, J = 7.7 Hz, 1 H), 8.01 (s, 1 H), 8.18 (d, J = 8.4 Hz, 1 H), 8.22 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 21.5, 119.1, 124.6, 126.1, 127.1, 127.4, 128.2, 128.7, 129.6 (2 C), 130.1, 136.6, 138.5, 139.6, 148.2, 157.5.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{N}$: 220.1121; found: 220.1117.

2-Phenylquinoline (3D)

Yield: 346.0 mg (84%); white solid; mp 83–85 °C.

IR (neat): 3057, 1597, 1556 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 7.47 (tt, J = 7.2, 2.1 Hz, 1 H), 7.53 (d, J = 6.4 Hz, 1 H), 7.54 (t, J = 6.9 Hz, 2 H), 7.74 (td, J = 7.8, 1.5 Hz, 1 H), 7.84 (d, J = 8.0 Hz, 1 H), 7.89 (d, J = 8.5 Hz, 1 H), 8.16–8.19 (m, 3 H), 8.24 (d, J = 8.5 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 119.0, 126.3, 127.1, 127.4, 127.5, 128.8, 129.3, 129.6, 129.7, 136.8, 139.7, 148.2, 157.4.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{15}\text{H}_{12}\text{N}$: 206.0964; found: 206.0959.

2-(4-tert-Butylphenyl)quinoline (3E)

Yield: 466.3 mg (89%); white solid; mp 77 °C.

IR (neat): 2967, 1597, 1550 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 1.38 (s, 9 H), 7.51 (td, J = 7.6, 1.1 Hz, 1 H), 7.55 (d, J = 8.4 Hz, 2 H), 7.72 (td, J = 7.7, 1.4 Hz, 1 H), 7.82 (d, J = 8.2 Hz, 1 H), 7.87 (d, J = 8.6 Hz, 1 H), 8.09 (dt, J = 8.6, 2.0 Hz, 2 H), 8.16 (d, J = 9.1 Hz, 1 H), 8.21 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 21.3, 34.7, 118.9, 125.8, 126.0, 127.0, 127.2, 127.4, 129.5, 129.7, 136.6, 136.9, 148.3, 152.5, 157.5.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{19}\text{H}_{20}\text{N}$: 262.1590; found: 262.1586.

2-(3,5-Dimethylphenyl)quinoline (3F)

Yield: 360.2 mg (77%); yellow oil.

IR (neat): 3007, 1595, 1557 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.44 (s, 6 H), 7.11 (s, 1 H), 7.52 (t, J = 6.9 Hz, 1 H), 7.73 (td, J = 7.0, 1.6 Hz, 1 H), 7.77 (s, 2 H), 7.83 (d, J = 8.2 Hz, 1 H), 7.87 (d, J = 8.6 Hz, 1 H), 8.18 (d, J = 9.1 Hz, 1 H), 8.21 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 21.4, 119.2, 125.4, 126.1, 127.1, 127.4, 129.5, 129.6, 131.0, 136.6, 138.3, 140.0, 148.2, 157.7.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{17}\text{H}_{16}\text{N}$: 234.1277; found: 234.1272.

2-(4-Methoxyphenyl)quinoline (3G)

Yield: 352.9 mg (75%); white solid; mp 118–120 °C.

IR (neat): 3012, 1595, 1550, 1028 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 3.89 (s, 3 H), 7.05 (d, J = 8.8 Hz, 2 H), 7.50 (t, J = 7.5 Hz, 1 H), 7.71 (t, J = 7.7 Hz, 1 H), 7.81 (d, J = 8.2 Hz, 1 H), 7.84 (d, J = 8.6 Hz, 1 H), 8.13–8.16 (m, 3 H), 8.19 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 55.4, 114.2, 118.5, 125.9, 126.9, 127.4, 128.9, 129.5 (2 C), 132.2, 136.6, 148.3, 156.9, 160.8.

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{ON}$: 236.1070; found: 236.1066.

2-(4-Fluorophenyl)quinoline (3H)

Yield: 371.9 mg (83%); white solid; mp 81 °C.

IR (neat): 3060, 1596, 1554 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 7.20 (d, J = 8.8 Hz, 1 H), 7.23 (d, J = 8.6 Hz, 1 H), 7.54 (t, J = 7.5 Hz, 1 H), 7.74 (td, J = 7.7, 1.4 Hz, 1 H), 7.82–7.85 (m, 2 H), 8.14–8.19 (m, 3 H), 8.23 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 115.8 (d, $J_{\text{C-F}}$ = 21.6 Hz), 118.6, 126.3, 127.1, 127.5, 129.4 (d, $J_{\text{C-F}}$ = 8.5 Hz), 129.6, 129.8, 135.8, 136.9, 148.2, 156.2, 163.8 (d, $J_{\text{C-F}}$ = 249.0 Hz).

HRMS (ESI): m/z [$\text{M} + \text{H}$] $^+$ calcd for $\text{C}_{15}\text{H}_{11}\text{NF}$: 224.0870; found: 224.0867.

2-(4-Chlorophenyl)quinoline (3I)

Yield: 378.7 mg (79%); white solid; mp 101–102 °C.

IR (neat): 3056, 1588, 1552 cm^{-1} .

¹H NMR (400 MHz, CDCl₃): δ = 7.50 (d, *J* = 8.5 Hz, 2 H), 7.54 (t, *J* = 8.1 Hz, 1 H), 7.74 (t, *J* = 7.7 Hz, 1 H), 7.84 (d, *J* = 7.9 Hz, 1 H), 7.85 (d, *J* = 8.6 Hz, 1 H), 8.12–8.17 (m, 3 H), 8.24 (d, *J* = 8.6 Hz, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.5, 126.5, 127.2, 127.5, 128.8, 129.0, 129.7, 129.8, 135.5, 136.9, 138.0, 148.2, 156.0.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₅H₁₁NCl: 240.0575; found: 240.0573.

2-(3-Bromophenyl)quinoline (3J)

Yield: 370.5 mg (65%); white solid; mp 66–67 °C.

IR (neat): 3061, 2987, 1594, 1550 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.40 (t, *J* = 7.9 Hz, 1 H), 7.55 (t, *J* = 7.0 Hz, 1 H), 7.59 (d, *J* = 8.8 Hz, 1 H), 7.75 (t, *J* = 7.0 Hz, 1 H), 7.84 (d, *J* = 8.4 Hz, 1 H), 7.85 (d, *J* = 8.5 Hz, 1 H), 8.08 (d, *J* = 7.7 Hz, 1 H), 8.17 (d, *J* = 8.6 Hz, 1 H), 8.25 (d, *J* = 8.6 Hz, 1 H), 8.35–8.36 (m, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.6, 123.1, 126.0, 126.6, 127.3, 127.4, 129.7, 129.8, 130.3, 130.6, 132.1, 136.9, 141.6, 148.1, 155.5.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₅H₁₁N⁷⁹Br: 284.0069; found: 284.0070.

2-(4-Bromophenyl)quinoline (3K)

Yield: 342.7 mg (60%); white solid; mp 109–110 °C.

IR (neat): 3057, 3034, 1594, 1550 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.54 (td, *J* = 7.6, 1.1 Hz, 1 H), 7.66 (d, *J* = 8.6 Hz, 2 H), 7.74 (td, *J* = 7.8, 1.6 Hz, 1 H), 7.84 (d, *J* = 8.2 Hz, 1 H), 7.85 (d, *J* = 8.6 Hz, 1 H), 8.06 (d, *J* = 8.6 Hz, 2 H), 8.16 (d, *J* = 8.6 Hz, 1 H), 8.24 (d, *J* = 8.6 Hz, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.5, 123.9, 126.5, 127.2, 127.5, 129.1, 129.7, 129.8, 131.9, 136.9, 138.5, 148.2, 156.0.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₅H₁₁N⁷⁹Br: 284.0069; found: 284.0067.

2-[4-(Trifluoromethyl)phenyl]quinoline (3L)

Yield: 318.6 mg (58%); white solid; mp 121–122 °C.

IR (neat): 3073, 2983, 1594, 1556 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.58 (t, *J* = 7.9 Hz, 1 H), 7.75–7.80 (m, 3 H), 7.86 (d, *J* = 8.2 Hz, 1 H), 7.90 (d, *J* = 8.6 Hz, 1 H), 8.19 (d, *J* = 8.4 Hz, 1 H), 8.27–8.30 (m, 3 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.7, 124.2 (q, *J*_{C-F} = 272.5 Hz), 125.7 (d, *J*_{C-F} = 3.8 Hz), 126.8, 127.4, 127.5, 127.7, 129.8, 129.9, 131.0 (q, *J*_{C-F} = 32.0 Hz), 137.6, 142.8, 148.2, 155.5.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₆H₁₁NF₃: 274.0838; found: 274.0835.

2-(β-Naphthyl)quinoline (3M)

Yield: 374.3 mg (73%); yellow solid; mp 145–147 °C.

IR (neat): 3053, 2925, 1594, 1556 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.52–7.57 (m, 3 H), 7.76 (td, *J* = 7.7, 1.4 Hz, 1 H), 7.86 (d, *J* = 8.0 Hz, 1 H), 7.88–7.92 (m, 1 H), 7.99–8.02 (m, 2 H), 8.05 (d, *J* = 8.6 Hz, 1 H), 8.23 (d, *J* = 8.4 Hz, 1 H), 8.27 (d, *J* = 8.6 Hz, 1 H), 8.38 (dd, *J* = 8.7, 1.7 Hz, 1 H), 8.62 (s, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 119.1, 125.0, 126.3, 126.7, 127.1, 127.2 (2 C), 127.5, 127.7, 128.4, 128.6, 128.8, 129.7, 133.5, 133.8, 136.8, 136.9, 148.3, 157.1.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₉H₁₄N: 256.1121; found: 256.1118.

2-(*p*-Biphenyl)quinoline (3N)

Yield: 412.5 mg (73%); white solid; mp 173–174 °C.

IR (neat): 3053, 3035, 1595, 1569 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.31 (td, *J* = 7.4, 2.0 Hz, 1 H), 7.49 (t, *J* = 7.9 Hz, 2 H), 7.54 (td, *J* = 7.6, 1.1 Hz, 1 H), 7.69 (d, *J* = 7.0 Hz, 2 H), 7.75 (td, *J* = 7.7, 1.4 Hz, 1 H), 7.78 (d, *J* = 8.6 Hz, 2 H), 7.85 (d, *J* = 8.2 Hz, 1 H), 7.94 (d, *J* = 8.6 Hz, 1 H), 8.19 (d, *J* = 8.4 Hz, 1 H), 8.24–8.28 (m, 3 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.8, 126.3, 127.1, 127.2, 127.4, 127.5, 127.6, 127.9, 128.8, 129.7 (2 C), 136.8, 138.5, 140.5, 142.0, 148.3, 156.8.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₁H₁₆N: 282.1277; found: 282.1272.

2-(4-Phenoxyphenyl)quinoline (3O)

Yield: 507.3 mg (85%); white solid; mp 116–117 °C.

IR (neat): 3063, 3038, 1589 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 7.08 (dd, *J* = 8.6, 0.9 Hz, 2 H), 7.14–7.17 (m, 3 H), 7.38 (t, *J* = 7.9 Hz, 2 H), 7.52 (td, *J* = 7.6, 1.1 Hz, 1 H), 7.72 (td, *J* = 7.7, 1.4 Hz, 1 H), 7.81–7.86 (m, 2 H), 8.14–8.17 (m, 3 H), 8.21 (d, *J* = 8.6 Hz, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 118.7, 118.9, 119.2, 123.6, 126.1, 127.0, 127.4, 129.1, 129.6, 129.7, 129.8, 134.7, 136.8, 148.3, 156.7, 156.8, 158.6.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₁H₁₆ON: 298.1226; found: 298.1223.

2-(1,3-Benzodioxol-5-yl)quinoline (3P)

Yield: 299.6 mg (60%); white solid; mp 85–86 °C.

IR (neat): 2992, 2900, 1595, 1486, 1247, 1037 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 6.05 (s, 2 H), 6.95 (d, *J* = 8.2 Hz, 1 H), 7.51 (td, *J* = 7.6, 1.1 Hz, 1 H), 7.66 (dd, *J* = 8.2, 1.6 Hz, 1 H), 7.69–7.75 (m, 2 H), 7.79–7.82 (m, 2 H), 8.13 (d, *J* = 8.6 Hz, 1 H), 8.18 (d, *J* = 8.6 Hz, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 101.3, 107.9, 108.5, 118.6, 121.7, 126.0, 127.0, 127.4, 129.5, 129.6, 134.1, 136.7, 148.1, 148.4, 148.8, 156.6.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₆H₁₂O₂N: 250.0863; found: 250.0860.

2-[4-(Methoxymethoxy)phenyl]quinoline (3Q)

Yield: 415.5 mg (78%); white solid; mp 64–65 °C.

IR (neat): 2988, 1595, 1495, 1249 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ = 3.52 (s, 3 H), 5.26 (s, 2 H), 7.19 (d, *J* = 8.8 Hz, 2 H), 7.51 (t, *J* = 6.8 Hz, 1 H), 7.71 (t, *J* = 7.0 Hz, 1 H), 7.80–7.85 (m, 2 H), 8.12–8.15 (m, 3 H), 8.19 (d, *J* = 8.6 Hz, 1 H).

¹³C NMR (100 MHz, CDCl₃): δ = 56.1, 94.3, 116.4, 118.6, 126.0 (2 C), 126.9, 127.4, 128.8, 129.6, 133.4, 136.6, 148.2, 156.8, 158.3.

HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₇H₁₆O₂N: 266.1176; found: 266.1171.

7-Methyl-2-phenylquinoline (3R)

Yield: 321.5 mg (73%); white solid; mp 61–62 °C.

IR (neat): 2987, 2901, 1596, 1550 cm⁻¹.

^1H NMR (400 MHz, CDCl_3): δ = 2.55 (s, 3 H), 7.45 (tt, J = 7.3, 2.0 Hz, 1 H), 7.50–7.59 (m, 4 H), 7.84 (d, J = 8.6 Hz, 1 H), 8.07 (d, J = 8.6 Hz, 1 H), 8.13–8.16 (m, 3 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 21.6, 119.0, 126.3, 127.1, 127.4, 128.8, 129.1, 129.4, 131.9, 136.1 (2 C), 140.0, 146.8, 156.4.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{N}$: 220.1121; found: 220.1118.

7-Chloro-2-phenylquinoline (3S)

Yield: 350.4 mg (73%); white solid; mp 102–104 °C.

IR (neat): 2987, 2901, 1594, 1547 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 7.48 (tt, J = 7.3, 2.6 Hz, 1 H), 7.54 (t, J = 7.5 Hz, 2 H), 7.66 (dd, J = 9.0, 2.5 Hz, 1 H), 7.82 (s, 1 H), 7.91 (d, J = 8.6 Hz, 1 H), 8.11 (d, J = 9.1 Hz, 1 H), 8.15–8.17 (m, 3 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 119.8, 126.1, 127.5, 127.7, 128.9, 129.6, 130.6, 131.3, 131.9, 135.8, 139.2, 146.6, 157.6.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{15}\text{H}_{11}\text{NCl}$: 240.0575; found: 240.0574.

7-Methoxy-2-phenylquinoline (3T)

Yield: 222.1 mg (47%); white solid; mp 116–118 °C.

IR (neat): 3005, 2936, 1557, 1120 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 3.96 (s, 3 H), 7.10 (s, 1 H), 7.39 (dd, J = 9.2, 2.8 Hz, 1 H), 7.44 (t, J = 7.5 Hz, 1 H), 7.52 (t, J = 7.5 Hz, 2 H), 7.84 (d, J = 8.6 Hz, 1 H), 8.07 (d, J = 9.1 Hz, 1 H), 8.11–8.15 (m, 3 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 55.5, 105.0, 119.2, 122.3, 127.3, 128.1, 128.8, 128.9, 131.2, 135.5, 139.8, 144.4, 155.1, 157.6.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{ON}$: 236.1070; found: 236.1067.

4-Methyl-2-phenylquinoline (3U)

Yield: 289.9 mg (66%); yellow oil.

IR (neat): 2972, 2913, 1551 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.78 (s, 3 H), 7.45 (t, J = 7.5 Hz, 1 H), 7.50–7.57 (m, 3 H), 7.70–7.74 (m, 2 H), 8.01 (d, J = 8.2 Hz, 1 H), 8.14–8.19 (m, 3 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 19.0, 119.7, 123.6, 126.0, 127.2, 127.5, 128.7, 129.2, 129.3, 130.2, 139.8, 144.8, 148.1, 157.1.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{14}\text{N}$: 220.1121; found: 220.1119.

4-Methyl-2-(4-methylphenyl)quinoline (3V)

Yield: 305.2 mg (65%); yellow oil.

IR (neat): 2975, 2920, 1598, 1549 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.43 (s, 3 H), 2.76 (s, 3 H), 7.32 (d, J = 7.9 Hz, 2 H), 7.54 (td, J = 7.6, 1.1 Hz, 1 H), 7.68–7.73 (m, 2 H), 7.99 (d, J = 7.3 Hz, 1 H), 8.06 (d, J = 8.4 Hz, 2 H), 8.16 (d, J = 7.9 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 19.0, 21.3, 119.5, 123.5, 125.8, 127.1, 127.3, 129.2, 129.5, 130.2, 136.9, 139.2, 144.6, 148.1, 157.0.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{17}\text{H}_{16}\text{N}$: 234.1277; found: 234.1275.

3-Methyl-2-(4-methylphenyl)quinoline (3W)

Yield: 160.5 mg (34%); yellow oil.

IR (neat): 3057, 1598, 1557 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 2.43 (s, 3 H), 2.48 (s, 3 H), 7.30 (d, J = 7.7 Hz, 2 H), 7.49–7.53 (m, 3 H), 7.65 (td, J = 7.7, 1.6 Hz, 1 H), 7.77 (d, J = 8.2 Hz, 1 H), 8.01 (s, 1 H), 8.11 (d, J = 8.4 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 20.6, 21.2, 126.1, 126.5, 127.3, 128.5, 128.7, 128.8, 129.1 (2 C), 136.5, 137.8 (2 C), 146.5, 160.4.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{17}\text{H}_{16}\text{N}$: 234.1277; found: 234.1274.

2-Isopropylquinoline (3X)

Yield: 158.6 mg (46%); yellow oil.

IR (neat): 3059, 1601, 1561 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 1.40 (d, J = 6.8 Hz, 6 H), 3.27 (sep, J = 7.0 Hz, 1 H), 7.35 (d, J = 8.4 Hz, 1 H), 7.48 (td, J = 7.5, 1.4 Hz, 1 H), 7.68 (td, J = 7.8, 1.6 Hz, 1 H), 7.77 (d, J = 8.2 Hz, 1 H), 8.06 (d, J = 8.4 Hz, 1 H), 8.09 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 22.5, 37.2, 119.1, 125.6, 126.9, 127.4, 128.9, 129.2, 136.3, 147.6, 167.6.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{12}\text{H}_{14}\text{N}$: 172.1121; found: 172.1118.

2-sec-Butylquinoline (3Y)

Yield: 179.0 mg (48%); yellow oil.

IR (neat): 3063, 1601, 1561 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 0.90 (t, J = 7.3 Hz, 3 H), 1.37 (d, J = 7.0 Hz, 3 H), 1.72 (d-quintet, J = 15.0, 7.5 Hz, 1 H), 1.86 (d-quintet, J = 15.0, 7.0 Hz, 1 H), 3.01 (sex, J = 7.3 Hz, 1 H), 7.31 (d, J = 8.4 Hz, 1 H), 7.48 (td, J = 7.6, 1.1 Hz, 1 H), 7.68 (td, J = 7.6, 1.6 Hz, 1 H), 7.78 (d, J = 8.0 Hz, 1 H), 8.05–8.10 (m, 2 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 12.2, 20.3, 29.9, 44.6, 119.5, 125.5, 126.9, 127.4, 129.0, 129.1, 136.2, 147.8, 167.0.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{13}\text{H}_{16}\text{N}$: 186.1277; found: 186.1275.

2-Cyclohexylquinoline (3Z)

Yield: 179.0 mg (36%); yellow oil.

IR (neat): 2924, 2850, 1600, 1502 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 1.35 (tt, J = 12.5, 3.4 Hz, 1 H), 1.48 (qt, J = 13.0, 3.2 Hz, 2 H), 1.58–1.69 (m, 2 H), 1.78–1.81 (m, 1 H), 1.88–1.92 (m, 2 H), 2.01–2.11 (m, 2 H), 2.92 (tt, J = 12.0, 3.4 Hz, 1 H), 7.33 (d, J = 8.4 Hz, 1 H), 7.47 (t, J = 8.2 Hz, 1 H), 7.67 (td, J = 7.7, 1.4 Hz, 1 H), 7.77 (d, J = 8.2 Hz, 1 H), 8.05 (d, J = 8.5 Hz, 1 H), 8.08 (d, J = 8.6 Hz, 1 H).

^{13}C NMR (100 MHz, CDCl_3): δ = 26.0, 26.5, 32.8, 47.6, 119.5, 125.5, 126.9, 127.4, 128.9, 129.1, 136.2, 147.7, 166.8.

HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{15}\text{H}_{18}\text{N}$: 212.1395; found: 212.1393.

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Supporting Information

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