Supplementary Information

For

Photoredox-Catalyzed Decarboxylative C-H Acylation of Heteroarenes

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1. General information

All the substrates used for irradiation were purchased from Aldrich, Matrix Chemical, Energy Chemicals and Aladdin, Alfa Aesar, or TCI, and used as received unless otherwise noted. Merck 60 silica gel was used for chromatography, and Whatman silica gel plates with a fluorescence F254 indicator were used for thin-layer chromatography (TLC) analysis. \(^1\)H NMR (400 MHz or 600 MHz) and \(^{13}\)C NMR (151 MHz) spectra were recorded on Bruker AV-400 instrument. Chemical shifts in \(^1\)H NMR spectra are reported in parts per million (ppm) relative to residual chloroform (7.26 ppm) or dimethylsulfoxide (2.50 ppm) as internal standards. \(^1\)H NMR data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, m = multiplet), and for \(^{13}\)C NMR chemical shifts are reported in ppm relative to the central peak of CDCl\(_3\) (77.16 ppm) or (CD\(_3\))\(_2\)SO (39.52 ppm) as internal standards. HRMS (ESI) spectra were recorded on a Bruker Esquire LC mass spectrometer using electrospray ionization. GC-MS analysis was performed on a 7890A-5975C/Agilent. Melting points were determined using a capillary melting point apparatus and are uncorrected.

2. Reaction optimization, control and further mechanistic experiments.

2.1 Table S1. Optimization of the decarboxylative formylation of isoquinoline\(^a\)

![Diagram](https://via.placeholder.com/150)

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Table S2. Optimization of the decarboxylative acylation of lepidine

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*General conditions: I (0.10 mmol), 4 (1 mmol), photocatalyst (0.5 mol %), oxidant (0.30 mmol), base (0.20 mmol) and DMSO (1 mL) under argon atmosphere, stirred under 15 W blue LEDs, then 1.2 mL of 3 N HCl was added and see method for detail.

2.2 Control and further mechanistic experiments
3. Preparation of Substrates

Preparation of 2,2-diethoxyacetic acid(2)\(^1\)

To a solution of ethyl 2,2-diethoxyacetate (3.8 g, 21.6 mmol) in EtOH (10 mL) was added 1 N NaOH (21.6 mL). The mixture was stirred for 3 h at rt. The organic solvent was evaporated under vacuum and the aqueous phase was extracted with Et\(_2\)O (1 × 20 mL). The aqueous layer was made acidic with 2.0 N HCl at -10 °C and extracted with EtOAc (4 × 20 mL). The combined organic extracts were dried over anhydrous Na\(_2\)SO\(_4\). The solvent was removed under vacuum to give 2.7 g (85% yield) of compound 2a as a light yellow oil.

4. General Procedures

Procedure A for compounds (3a-3p) in Schemes 2
Heterocycle (0.10mmol, 1 equiv), ammonium persulfate (0.30 mmol, 3 equiv), Cs₂CO₃ (0.20 mmol, 2 equiv) were placed in a dry glass tube. Then, anhydrous DMSO (1 mL) and 2,2-diethoxyacetic acid (0.7 mmol, 7 equiv) were injected into the tube by syringe under a N₂ atmosphere. The solution was then stirred at room temperature under the irradiation of 15 W blue LEDs strip for 24 h. After completion of the reaction, the mixture was quenched by addition of 1.2 mL of 3.0 M HCl, stirred for 20 h, then saturated Na₂CO₃ solution was added to adjust pH to basic; extract with CH₂Cl₂, the combined organic layers was washed with brine, then dry over anhydrous Na₂SO₄. The desired products were obtained in the corresponding yields after purification by flash chromatography on silica gel eluting with petroleum and ethylacetate.

Procedure B for compounds (5a-5z, 5bb) in Schemes 3

Heterocycle (0.10 mmol, 1 equiv), ammonium persulfate (0.20 mmol, 2 equiv), [Ir{dF(CF₃ppy)}₂(dtbbpy)]PF₆ (0.2 mol%), α-keto acids (1.0 mmol, 10 equiv) were placed in a dry glass tube. Then, anhydrous DMSO (1 mL) were injected into the tube by syringe under a N₂ atmosphere. The solution was then stirred at room temperature under the irradiation of 15 W blue LEDs strip for 12 h. After completion of the reaction, then saturated Na₂CO₃ solution was added to adjust pH to basic. The combined organic layer was washed with brine and then dried over anhydrous Na₂SO₄. The desired products were obtained in the corresponding yields after purification by flash chromatography on silica gel eluting with petroleum and ethylacetate.

5. Characterization

Isoquinoline-1-carbaldehyde (3a): The title compound was prepared according to the general procedure A as a yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 10.38 (s, 1H), 9.38 – 9.22 (m, 1H), 8.74 (d, J = 5.5 Hz, 1H), 7.97 – 7.82 (m, 2H), 7.83 – 7.68 (m, 2H). ¹³C NMR (151 MHz, CDCl₃) δ 195.79, 195.74, 149.88, 142.54, 136.97, 130.88, 130.15, 127.05, 126.41, 125.80, 125.63. GC-MS (EI): 157.1, 129.1, 102.1, 75.0, 63.1, 51.1, 29.1. HRMS (ESI): calcd. for C₁₀H₈NO⁺ 158.0605 [M+H]⁺, found: 158.0600

5-chloroisooquinoline-1-carbaldehyde (3b): The title compound was prepared according to the general procedure A as an off-white solid. mp: 134.7-136.1 °C. ¹H NMR (400 MHz, CDCl₃) δ 10.37 (s, 1H), 9.26 (d, J = 8.6 Hz, 1H), 8.84 (d, J = 5.7 Hz, 1H), 8.29 (dd, J = 5.7, 0.5 Hz, 1H), 7.82 (dd, J = 7.5, 0.8 Hz, 1H), 7.65 (dd, J = 8.5, 7.7 Hz, 1H). ¹³C NMR (151 MHz, CDCl₃) δ 195.26, 195.23, 149.99, 143.60, 134.86, 131.54, 130.89, 129.97, 127.32, 124.81, 121.88. GC-MS (EI): 191.1, 165.1, 125.1, 101.1, 75.0, 29.1. HRMS (ESI): calcd. for C₁₀H₇ClNO⁺ 192.0211 [M+H]⁺, found: 192.0211
5-bromoisoquinoline-1-carbaldehyde (3c): The title compound was prepared according to the general procedure A as an off-white solid. mp: 148.6-150.1°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.38 (s, 1H), 9.33 (d, $J = 8.6$ Hz, 1H), 8.85 (d, $J = 5.8$ Hz, 1H), 8.28 (dd, $J = 5.8$, 0.7 Hz, 1H), 8.04 (dd, $J = 7.5$, 0.8 Hz, 1H), 7.59 (dd, $J = 8.5$, 7.6 Hz, 1H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 195.14, 195.11, 150.08, 143.85, 136.06, 134.70, 130.43, 127.56, 125.49, 124.49, 122.05. GC-MS (EI): 234.8, 209.0, 127.9, 100.0, 74.0, 50.1, 29.1. HRMS (ESI): calcd. for C$_{10}$H$_7$BrNO$^+$ 235.9711 [M+H$^+$], found: 235.9706.

6-methylisoquinoline-1-carbaldehyde (3d): The title compound was prepared according to the general procedure A as an off-white solid. mp: 76.3-77.4°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.36 (s, 1H), 9.19 (d, $J = 8.8$ Hz, 1H), 8.69 (d, $J = 5.5$ Hz, 1H), 7.78 (d, $J = 5.5$ Hz, 1H), 7.66 (s, 1H), 7.57 (dd, $J = 8.8$, 1.5 Hz, 1H), 2.56 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 195.95, 195.91, 149.67, 142.65, 141.39, 137.40, 132.51, 125.88, 125.53, 125.11, 124.86, 22.11. GC-MS (EI): 170.8, 141.9, 114.9, 88.8, 63.1, 29.1. HRMS (ESI): calcd. for C$_{11}$H$_{10}$NO$^+$ 172.0759 [M+H$^+$], found: 172.0757.

5-bromoisoquinoline-1-carbaldehyde (3e): The title compound was prepared according to the general procedure A as an off-white solid. mp: 126.2-128.1°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.33 (s, 1H), 9.18 (d, $J = 9.2$ Hz, 1H), 8.76 (d, $J = 5.6$ Hz, 1H), 8.07 (d, $J = 1.9$ Hz, 1H), 7.98 – 7.59 (m, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 195.47, 195.44, 150.02, 143.60, 138.04, 133.63, 129.15, 127.60, 126.02, 124.71, 124.35. GC-MS (EI): 235.0, 207.0, 128.1, 100.0, 74.0, 50.1, 29.1. HRMS (ESI): calcd. for C$_{10}$H$_7$BrNO$^+$ 235.9711 [M+H$^+$], found: 235.9706.

4-bromoisoquinoline-1-carbaldehyde (3f): The title compound was prepared according to the general procedure A as an off-white solid. mp: 112.1-113.8°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.32 (s, 1H), 9.51 – 9.17 (m, 1H), 8.93 (s, 1H), 8.25 (d, $J = 8.2$ Hz, 1H), 7.99 – 7.71 (m, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.99, 194.96, 148.91, 144.58, 135.64, 132.12, 131.00, 127.29, 126.40, 126.18, 125.57. GC-MS (EI): 235.0, 207.0, 128.1, 100.0, 74.0, 50.1, 29.1. HRMS (ESI): calcd. for C$_{10}$H$_{6}$BrNNaO$^+$ 257.9540 [M+Na$^+$], found: 257.9525.
3-methylisoquinoline-1-carbaldehyde (3g): The title compound was prepared according to the general procedure A as an off-white solid. mp: 73.9-74.7°C. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 10.33 (s, 1H), 9.22 (d, \(J = 8.4\) Hz, 1H), 7.78 (d, \(J = 7.6\) Hz, 1H), 7.73 – 7.59 (m, 3H), 2.77 (s, 3H). \(^{13}\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 195.91, 195.88, 151.37, 149.26, 137.74, 130.71, 129.13, 126.44, 125.66, 124.65, 123.97, 23.96. GC-MS (EI): 171.0, 143.1, 115.1, 89.0, 63.0, 29.1. HRMS (ESI): calcld. for C\(_{11}\)H\(_{10}\)NO\(^+\) 172.0761 [M+H]\(^+\), found: 172.0757.

8-chloroisoquinoline-1-carbaldehyde (3h): The title compound was prepared according to the general procedure A as an off-white solid. mp: 103.5-105.9°C. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 10.96 (s, 1H), 8.68 (d, \(J = 5.6\) Hz, 1H), 7.85 (d, \(J = 8.1\) Hz, 1H), 7.80 (d, \(J = 5.5\) Hz, 1H), 7.75 (dd, \(J = 7.5, 1.0\) Hz, 1H), 7.71 – 7.63 (m, 1H). \(^{13}\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 192.06, 154.88, 142.86, 138.89, 130.94, 130.46, 130.32, 126.85, 124.65, 123.38. GC-MS (EI): 191.1, 163.0, 135.9, 127.0, 100.1, 75.1, 51.1, 29.0. HRMS (ESI): calcld. for C\(_{10}\)H\(_7\)ClNO\(^+\) 192.0205 [M+H]\(^+\), found: 192.0211.

4-chloroquinoline-2-carbaldehyde (3i): The title compound was prepared according to the general procedure A as an off-white solid. mp: 138.1-139.2°C. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 10.18 (s, 1H), 8.38 – 8.24 (m, 2H), 8.10 (s, 1H), 7.95 – 7.84 (m, 1H), 7.84 – 7.75 (m, 1H). \(^{13}\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 192.77, 152.46, 148.81, 144.38, 131.49, 130.99, 130.38, 128.22, 124.58, 117.74. GC-MS (EI): 191.1, 163.1, 142.8, 128.0, 115.0, 75.1, 50.1, 29.1. HRMS (ESI): calcld. for C\(_{10}\)H\(_7\)ClNO\(^+\) 192.0217 [M+H]\(^+\), found: 192.0211.

4-methylquinoline-2-carbaldehyde (3j): The title compound was prepared according to the general procedure A as an off-white solid. mp: 68.9-70.2°C. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 10.20 (s, 1H), 8.25 (d, \(J = 8.4\) Hz, 1H), 8.06 (d, \(J = 8.4\) Hz, 1H), 7.87 (s, 1H), 7.81 (t, \(J = 7.6\) Hz, 1H), 7.71 (t, \(J = 7.6\) Hz, 1H), 7.28 (s, 3H). \(^{13}\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 194.27, 152.46, 148.81, 144.38, 131.49, 130.99, 130.38, 128.22, 124.58, 117.74. GC-MS (EI): 171.1, 143.1, 115.1, 89.0, 75.1, 63.1, 39.1, 29.1. HRMS (ESI): calcld. for C\(_{11}\)H\(_{10}\)NO\(^+\) 172.0769 [M+H]\(^+\), found: 172.0757.
2-methylquinoline-4-carbaldehyde(3k): The title compound was prepared according to the general procedure A as an off-white solid. mp: 83.0-83.9°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.34 (s, 1H), 8.83 (d, $J = 8.4$ Hz, 1H), 8.03 (d, $J = 8.5$ Hz, 1H), 7.69 (t, $J = 7.7$ Hz, 1H), 7.63 – 7.45 (m, 2H), 2.76 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 192.95, 192.90, 159.05, 148.85, 136.82, 130.05, 129.09, 128.21, 127.11, 124.17, 122.05. GC-MS (EI): 171.1, 143.1, 128.1, 115.1, 101.1, 89.1, 75.1, 51.1, 29.1. HRMS(ESI): calcd. for C$_{11}$H$_{10}$NO $^{172.076}$ [M+H]$^+$, found: 172.0757.

Quinoxaline-2-carbaldehyde(3l): The title compound was prepared according to the general procedure A as an off-white solid. mp: 107.9-108.6°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.28 (s, 1H), 9.42 (s, 1H), 8.43 – 8.07 (m, 2H), 7.92 (dddd, $J = 17.9, 8.3, 6.9, 1.6$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 192.89, 192.84, 146.06, 144.59, 142.63, 142.03, 133.04, 131.31, 130.60, 129.76. GC-MS (EI): 158.0, 130.0, 103.0, 76.3, 62.3, 49.9, 28.0. HRMS(ESI): calcd. for C$_9$H$_7$N$_2$O $^{159.0555}$ [M+H]$^+$, found: 159.0553.

1-methyl-1H-benzo[d]imidazole-2-carbaldehyde(3m): The title compound was prepared according to the general procedure A as an off-white solid. $^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 10.12 (s, 1H), 7.93 (d, $J = 8.0$ Hz, 1H), 7.48 (s, 1H), 7.41 (d, $J = 5.4$ Hz, 1H), 4.16 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 185.26, 146.30, 142.88, 137.10, 126.99, 124.24, 122.50, 110.78, 31.50. GC-MS (EI): 160.1, 104.1, 90.0, 77.1, 63.1, 51.1, 29.1. Analytical data are consistent with those reported previously.

Phenantridine-6-carbaldehyde(3n): The title compound was prepared according to the general procedure A as an off-white solid. mp: 136.6-137.4°C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 10.39 (s, 1H), 9.38 (d, $J = 8.3$ Hz, 1H), 8.62 (d, $J = 8.4$ Hz, 1H), 8.59 – 8.52 (m, 1H), 8.35 – 8.24 (m, 1H), 7.91 – 7.84 (m, 1H), 7.84 – 7.73 (m, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 195.82, 195.76, 150.28, 143.37, 133.46, 131.35, 131.25, 129.99, 129.27, 128.80, 126.98, 125.64, 123.60, 122.00. GC-MS (EI): 207.0, 179.0, 151.0, 103.0, 88.0, 75.0. HRMS(ESI): calcd. for C$_{14}$H$_{10}$NO $^{208.0757}$ [M+H]$^+$, found: 208.0757.
benzo[d]thiazole-2-carbaldehyde(o)\(^3\): The title compound was prepared according to the general procedure A as a colorless oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 10.18 (s, 1H), 8.33 – 8.15 (m, 1H), 8.09 – 7.95 (m, 1H), 7.77 – 7.51 (m, 2H). \(^13\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 185.65, 165.49, 153.70, 136.54, 128.59, 127.55, 125.95, 122.82. GC-MS (EI): 163.0, 135.0, 108.0, 82.0, 69.0, 29.0. Analytical data are consistent with those reported previously.

1,3,9-trimethyl-2,6-dioxo-2,3,6,9-tetrahydro-1H-purine-8-carbaldehyde(3p)\(^4\): The title compound was prepared according to the general procedure A as an off-white solid. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 9.92 (s, 1H), 4.35 (s, 3H), 3.62 (s, 3H), 3.43 (s, 3H). \(^13\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 182.96, 156.05, 151.49, 147.63, 143.60, 111.25, 34.14, 29.97, 28.45. Analytical data are consistent with those reported previously.

phenyl(quinolin-2-yl)methanone(5aa)\(^5\): The title compound was prepared according to the general procedure B as a yellow viscous oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.35 (d, \(J = 8.5\) Hz, 1H), 8.22 (dd, \(J = 14.4, 8.1\) Hz, 3H), 8.11 (d, \(J = 8.5\) Hz, 1H), 7.91 (d, \(J = 8.1\) Hz, 1H), 7.79 (t, \(J = 7.6\) Hz, 1H), 7.72 – 7.57 (m, 2H), 7.52 (t, \(J = 7.6\) Hz, 2H). \(^13\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 193.98, 154.82, 146.86, 137.26, 136.25, 133.23, 131.60, 130.69, 130.24, 129.04, 128.57, 128.30, 127.79, 120.95. GC-MS (EI): 233.1, 204.1, 128.1, 105.1, 77.0, 51.1. Analytical data are consistent with those reported previously.

quinoline-2,4-diylbis(phenylmethanone)(5ab)\(^5\): The title compound was prepared according to the general procedure B as a yellow viscous oil. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.34 – 8.23 (m, 2H), 8.13 (s, 1H), 7.98 (d, \(J = 8.4\) Hz, 1H), 7.91 (d, \(J = 7.7\) Hz, 2H), 7.84 (t, \(J = 7.7\) Hz, 1H), 7.66 (dd, \(J = 12.9, 6.6\) Hz, 3H), 7.52 (dd, \(J = 18.4, 7.9\) Hz, 4H). \(^13\)C NMR (151 MHz, CDCl\(_3\)) \(\delta\) 195.81, 193.15, 153.93, 147.33, 145.59, 136.49, 135.90, 134.54, 133.44, 131.60, 131.21, 130.76, 130.52, 129.69, 129.03, 128.37, 125.81, 125.49, 119.56. GC-MS (EI): 337.1, 308.1, 280.1, 232.1, 204.1, 105.0, 77.1, 51.1, 28.0. Analytical data are consistent with those reported previously.
(4-methylquinolin-2-yl)(phenyl)methanone (5b): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.22 (dd, $J = 14.0$, 7.9 Hz, 3H), 8.07 (d, $J = 8.3$ Hz, 1H), 7.94 (s, 1H), 7.77 (t, $J = 7.6$ Hz, 1H), 7.72 – 7.65 (m, 1H), 7.62 (t, $J = 7.4$ Hz, 1H), 7.51 (t, $J = 7.7$ Hz, 2H), 2.80 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.33, 154.52, 146.72, 145.78, 136.32, 133.18, 131.59, 131.27, 129.86, 129.08, 128.30, 128.27, 123.90, 121.43, 19.08. GC-MS (EI): 247.1, 232.1, 218.1, 204.1, 140.0, 105.0, 77.1, 51.1, 28.1. Analytical data are consistent with those reported previously.

(4-chloroquinolin-2-yl)(phenyl)methanone (5c): The title compound was prepared according to the general procedure B as a brownish solid. mp: 132.4 – 133.1 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.31 (dd, $J = 8.4$, 1.0 Hz, 1H), 8.23 (dd, $J = 9.7$, 8.3 Hz, 4H), 7.84 (ddd, $J = 8.4$, 7.0, 1.4 Hz, 1H), 7.76 (ddd, $J = 8.2$, 7.0, 1.2 Hz, 1H), 7.70 – 7.59 (m, 1H), 7.52 (dd, $J = 10.6$, 4.7 Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 192.66, 154.46, 147.65, 143.94, 135.83, 133.43, 131.56, 131.07, 131.03, 129.60, 128.34, 127.20, 124.25, 121.10. GC-MS (EI): 267.0, 232.1, 204.1, 127.0, 105.0, 77.1, 55.1, 27.1. HRMS (ESI): calcd. for C$_{16}$H$_{11}$ClNO $^{+}$ 268.0528 [M+H]$^+$, found: 268.0524

(4-bromoquinolin-2-yl)(phenyl)methanone (5d): The title compound was prepared according to the general procedure B as a brownish solid. mp: 135.0 – 136.5 °C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.41 (s, 1H), 8.32 – 8.14 (m, 4H), 7.83 (t, $J = 7.6$ Hz, 1H), 7.76 (t, $J = 7.6$ Hz, 1H), 7.64 (t, $J = 7.4$ Hz, 1H), 7.52 (t, $J = 7.4$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 192.52, 154.26, 147.38, 135.85, 135.34, 133.44, 131.56, 131.11, 131.09, 129.87, 128.61, 128.35, 126.92, 124.92. GC-MS (EI): 312.0, 294.0, 232.1, 204.1, 127.0, 105.0, 77.1, 51.1. HRMS (ESI): calcd. for C$_{16}$H$_{10}$BrNaN$^{+}$O $^{+}$ 333.9836 [M+Na]$^+$, found: 333.9838

(2-methylquinolin-4-yl)(phenyl)methanone (5e): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.13 (d, $J = 8.5$ Hz, 1H), 7.87 (d, $J = 7.6$ Hz, 2H), 7.80 (d, $J = 8.3$ Hz, 1H), 7.74 (t, $J = 7.6$ Hz, 1H), 7.66 (t, $J = 7.4$ Hz, 1H), 7.49 (dd, $J = 16.7$, 8.3 Hz, 3H), 7.30 (d, $J = 10.9$ Hz, 1H), 2.81 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 196.50, 158.41, 148.38, 144.88, 136.78, 134.31, 130.41, 130.15, 129.31,
Analytical data are consistent with those reported previously.

(6-methylquinolin-2-yl)(phenyl)methanone (5fa): The title compound was prepared according to the general procedure B as a yellow viscous oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.24 (dd, $J$ = 7.9, 2.9 Hz, 3H), 8.09 (d, $J$ = 8.4 Hz, 2H), 7.66 (s, 1H), 7.65 – 7.58 (m, 2H), 7.51 (t, $J$ = 7.6 Hz, 2H), 2.59 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.01, 153.97, 145.46, 138.88, 136.45, 136.41, 133.09, 132.58, 131.59, 130.35, 129.13, 128.25, 126.61, 121.03, 21.95. GC-MS (EI): 247.1, 219.1, 204.1, 142.1, 105.1, 77.1, 55.1. HRMS (ESI): calcd. for C$_{17}$H$_{13}$NNaO$^+$.278.0896 [M+Na]$^+$, found: 278.0889.

(6-methylquinoline-2,4-diyl)bis(phenyl)methanone (5fb): The title compound was prepared according to the general procedure B as a yellow viscous oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.31 – 8.23 (m, 2H), 8.19 (d, $J$ = 8.6 Hz, 1H), 8.10 (s, 1H), 7.98 – 7.88 (m, 2H), 7.76 (s, 1H), 7.70 – 7.59 (m, 3H), 7.52 (dd, $J$ = 14.9, 7.5 Hz, 4H), 2.52 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 196.05, 193.19, 152.93, 146.03, 140.42, 136.53, 136.07, 134.50, 133.31, 133.13, 131.60, 130.89, 130.55, 129.01, 128.33, 125.89, 124.23, 119.58, 22.20. GC-MS (EI): 351.1336, 322.1, 308.1, 294.1, 246.1, 140.0, 105.0, 77.1, 51.1, 27.1. HRMS (ESI): calcd. for C$_{24}$H$_{18}$NO$_2$$^+$.352.1350 [M+H]$^+$, found: 352.1332.

Isoquinolin-1-yl(phenyl)methanone (5g): The title compound was prepared according to the general procedure B as a yellow viscous oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.60 (d, $J$ = 5.5 Hz, 1H), 8.21 (d, $J$ = 8.5 Hz, 1H), 7.96 (d, $J$ = 7.6 Hz, 2H), 7.91 (d, $J$ = 8.4 Hz, 1H), 7.80 (d, $J$ = 5.5 Hz, 1H), 7.73 (t, $J$ = 7.5 Hz, 1H), 7.60 (t, $J$ = 7.9 Hz, 2H), 7.47 (t, $J$ = 7.5 Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.84, 156.48, 141.22, 136.75, 136.66, 133.78, 130.82, 128.55, 128.41, 127.18, 126.47, 126.21, 122.70. GC-MS (EI): 233.1, 204.1, 176.1, 128.1, 105.1, 77.1, 51.1, 39.1, 27.1. Analytical data are consistent with those reported previously.
(6-methylisoquinolin-1-yl)(phenyl)methanone(5h): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.55 (d, $J = 5.6$ Hz, 1H), 8.11 (d, $J = 8.7$ Hz, 1H), 8.01 – 7.89 (m, 2H), 7.76 – 7.64 (m, 2H), 7.61 (dd, $J = 13.8$, 6.4 Hz, 1H), 7.52 – 7.40 (m, 3H), 2.53 (d, $J = 18.9$ Hz, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) δ 195.01, 156.15, 141.36, 141.33, 137.16, 136.78, 133.72, 130.86, 130.75, 128.55, 126.03, 124.97, 122.21, 22.11. GC-MS (EI): 246.1, 232.1, 218.1, 204.1, 140.1, 105.0, 77.1, 51.1, 27.1. Analytical data are consistent with those reported previously.

(6-bromoisoquinolin-1-yl)(phenyl)methanone(5i): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.61 (d, $J = 5.6$ Hz, 1H), 8.16 – 8.04 (m, 2H), 7.94 (d, $J = 7.8$ Hz, 2H), 7.69 (t, $J = 8.1$ Hz, 2H), 7.61 (t, $J = 7.3$ Hz, 1H), 7.47 (t, $J = 7.6$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) δ 194.27, 156.45, 142.24, 137.82, 136.41, 133.91, 131.98, 130.85, 129.31, 128.59, 128.02, 125.75, 124.92, 121.62. GC-MS (EI): 312.0, 284.0, 232.1, 204.1, 176.1, 127.1, 105.1, 77.1, 55.1, 27.1. Analytical data are consistent with those reported previously.

(5-chloroisoquinolin-1-yl)(phenyl)methanone(5j): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.71 (d, $J = 5.9$ Hz, 1H), 8.22 (d, $J = 5.9$ Hz, 1H), 8.14 (d, $J = 8.5$ Hz, 1H), 8.01 – 7.89 (m, 2H), 7.82 (dd, $J = 7.5$, 0.7 Hz, 1H), 7.62 (t, $J = 7.4$ Hz, 1H), 7.57 – 7.43 (m, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) δ 194.44, 156.85, 142.43, 136.43, 134.66, 134.02, 131.67, 130.85, 130.79, 128.66, 128.26, 127.38, 125.33, 118.99. GC-MS (EI): 267.1, 238.1, 204.1, 126.1, 105.1, 77.1, 55.1, 27.1. Analytical data are consistent with those reported previously.

(5-bromoisoquinolin-1-yl)(phenyl)methanone(5k): The title compound was prepared according to the general procedure B as a brownish solid. mp: 139.6-140.5°C. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.71 (d, $J = 5.8$ Hz, 1H), 8.28 – 8.08 (m, 2H), 8.02 (d, $J = 7.4$ Hz, 1H), 7.92 (d, $J = 7.6$ Hz, 2H), 7.61 (t, $J = 7.4$ Hz, 1H), 7.46 (dd, $J = 14.7$, 7.4 Hz, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) δ 194.27, 156.45, 142.24, 137.82, 136.41, 133.91, 131.98, 130.85, 129.31, 128.59, 128.02, 125.75, 124.92, 121.62. GC-MS (EI): 312.0, 284.0, 232.1, 204.1, 176.1, 127.1, 105.1, 77.1, 55.1, 27.1. Analytical data are consistent with those reported previously.
CDCl$_3$ $\delta$ 194.37, 156.96, 142.68, 136.42, 135.84, 134.55, 134.02, 130.82, 128.71, 128.65, 127.53, 126.01, 122.16, 121.54. GC-MS (EI): GC-MS (EI): 312.1, 284.0, 266.1, 232.1, 204.1, 176.1, 127.1, 105.1, 77.1, 55.1, 27.1. HRMS (ESI): calcld. for C$_{16}$H$_{10}$BrNNaO$_3$ M$^+$ 333.9835 [M+Na$^+$], found: 333.9838

(8-chloroisooquinolin-1-yl)(phenyl)methanone (5l): The title compound was prepared according to the general procedure B as a brownish solid. mp: 122.8 – 123.6 $^\circ$C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.62 (d, $J$ = 5.4 Hz, 1H), 7.87 (t, $J$ = 8.4 Hz, 3H), 7.79 (d, $J$ = 5.5 Hz, 1H), 7.65 (d, $J$ = 4.4 Hz, 2H), 7.59 (t, $J$ = 7.3 Hz, 1H), 7.46 (t, $J$ = 7.4 Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.07, 155.78, 140.19, 136.54, 135.61, 134.17, 131.65, 130.85, 129.34, 128.65, 127.66, 126.74, 126.58, 121.89. GC-MS (EI): 266.6, 238.9, 193.0, 127.1, 105.0, 77.1, 51.0, 27.1. HRMS (ESI): calcld. for C$_{16}$H$_{11}$ClNO$_3$ M$^+$ 268.0524, found: 268.0524.

(4-bromoisoquinolin-1-yl)(phenyl)methanone (5m): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.80 (s, 1H), 8.28 (d, $J$ = 8.5 Hz, 1H), 8.23 (d, $J$ = 8.5 Hz, 1H), 8.00 – 7.91 (m, 2H), 7.86 (ddd, $J$ = 8.4, 6.9, 1.1 Hz, 1H), 7.68 (ddd, $J$ = 8.2, 7.0, 1.1 Hz, 1H), 7.65 – 7.57 (m, 1H), 7.48 (dd, $J$ = 10.6, 4.8 Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.00, 165.05, 157.26, 140.19, 136.54, 134.17, 131.65, 131.11, 130.58, 128.71, 128.68, 127.63, 126.56, 125.70, 53.16. GC-MS (EI): 312.0, 284.0, 266.1, 239.1, 204.1, 127.1, 105.1, 77.1, 51.1, 39.1. Analytical data are consistent with those reported previously.

methyl 1-benzoilisoquinoline-3-carboxylate (5n): The title compound was prepared according to the general procedure B as a brownish oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.75 (s, 1H), 8.19 (d, $J$ = 8.4 Hz, 1H), 8.10 (d, $J$ = 8.2 Hz, 1H), 8.00 (d, $J$ = 7.7 Hz, 2H), 7.85 (t, $J$ = 7.6 Hz, 1H), 7.75 (t, $J$ = 7.7 Hz, 1H), 7.64 (t, $J$ = 7.4 Hz, 1H), 7.49 (t, $J$ = 7.7 Hz, 2H), 4.05 (s, 3H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.00, 166.05, 157.26, 140.19, 136.54, 136.16, 134.17, 131.65, 131.11, 130.58, 128.71, 128.68, 127.63, 126.56, 125.70, 53.16. GC-MS (EI): 291.1, 276.1, 262.1, 248.1, 231.1, 203.1, 176.1, 127.1, 105.0, 77.1, 55.1, 29.1. HRMS (ESI): calcld. for C$_{16}$H$_{11}$NO$_3$ M$^+$ 292.0965, found: 292.0968.
(3-methylisoquinolin-1-yl)(phenyl)methanone (5o): The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.06 (d, $J = 8.5$ Hz, 1H), 7.96 (d, $J = 7.6$ Hz, 2H), 7.80 (d, $J = 8.3$ Hz, 1H), 7.65 (t, $J = 7.5$ Hz, 1H), 7.63 – 7.55 (m, 2H), 7.53 – 7.41 (m, 3H), 2.72 (s, 3H).

$^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 195.03, 156.37, 150.35, 137.42, 136.50, 133.81, 130.93, 130.67, 128.52, 127.28, 126.58, 126.02, 124.47, 120.54, 24.23.

GC-MS (EI): 247.1, 218.1, 140.1, 115.1, 105.0, 77.1, 51.1, 39.1, 27.1. Analytical data are consistent with those reported previously.

Phenyl(quinazolin-4-yl)methanone (5p): The title compound was prepared according to the general procedure B as a brownish solid. mp: 90.1 – 91.8 $^\circ$C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 9.43 (s, 1H), 8.17 (d, $J = 8.5$ Hz, 1H), 8.08 (d, $J = 8.4$ Hz, 1H), 7.98 (dd, $J = 14.7, 7.6$ Hz, 3H), 7.67 (dd, $J = 12.2, 7.4$ Hz, 2H), 7.51 (t, $J = 7.7$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 193.12, 164.21, 153.97, 153.94, 151.37, 135.30, 134.82, 134.67, 130.79, 129.19, 129.13, 128.94, 128.91, 125.97, 122.21.

GC-MS (EI): 234.1, 206.1, 179.1, 129.0, 105.0, 77.0, 51.1, 39.1, 27.1. Analytical data are consistent with those reported previously.

Phenyl(quinoxalin-2-yl)methanone (5q): The title compound was prepared according to the general procedure B as a brownish solid. mp: 140.5 – 142.2 $^\circ$C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 9.50 (s, 1H), 8.34 – 8.10 (m, 4H), 7.98 – 7.78 (m, 2H), 7.67 (t, $J = 7.4$ Hz, 1H), 7.55 (t, $J = 7.7$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 192.52, 148.77, 145.48, 145.45, 143.32, 140.58, 135.63, 133.81, 132.19, 131.41, 130.98, 130.61, 129.56, 128.55.

GC-MS (EI): 234.1, 206.1, 179.1, 129.1, 105.0, 77.1, 51.1, 39.1, 27.1. Analytical data are consistent with those reported previously.

(3-chloroquinoxalin-2-yl)(phenyl)methanone (5r): The title compound was prepared according to the general procedure B as a brownish solid. mp: 140.5 – 142.2 $^\circ$C. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.13 (dd, $J = 12.1, 8.9$ Hz, 2H), 7.88 (ddd, $J = 16.5, 15.2, 7.2$ Hz, 4H), 7.67 (t, $J = 7.4$ Hz, 1H), 7.52 (t, $J = 7.7$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 191.38, 150.37, 144.10, 142.19,
The title compound was prepared according to the general procedure B as a yellow viscous oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.62 (d, $J = 5.2$ Hz, 1H), 8.13 – 7.99 (m, 3H), 7.58 (t, $J = 7.4$ Hz, 1H), 7.48 (dd, $J = 8.3, 5.0$ Hz, 3H), 1.38 (s, 9H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.64, 161.54, 155.15, 148.63, 136.66, 132.95, 131.13, 128.26, 123.44, 121.81, 35.21, 30.66. GC-MS (EI): 239.1, 224.1, 211.1, 196.1, 183.1, 155.1, 118.1, 105.1, 77.1, 51.1, 28.1. Analytical data are consistent with those reported previously.

The title compound was prepared according to the general procedure B as a brownish solid. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.72 (d, $J = 8.3$ Hz, 1H), 8.66 (d, $J = 7.8$ Hz, 1H), 8.22 (d, $J = 7.6$ Hz, 1H), 8.15 (d, $J = 8.2$ Hz, 1H), 8.05 (d, $J = 7.8$ Hz, 2H), 7.90 (t, $J = 7.6$ Hz, 1H), 7.85 – 7.72 (m, 2H), 7.71 – 7.55 (m, 2H), 7.48 (t, $J = 7.5$ Hz, 2H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 194.95, 157.62, 142.78, 136.25, 134.14, 131.41, 130.96, 130.77, 129.24, 128.72, 128.33, 127.95, 127.46, 124.60, 123.92, 122.45, 122.31. GC-MS (EI): 283.1, 254.1, 177.1, 151.1, 105.0, 77.1, 51.0, 39.0, 27.1. Analytical data are consistent with those reported previously.

The title compound was prepared according to the general procedure B as a yellow viscous oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.55 (dd, $J = 5.2, 3.3$ Hz, 2H), 7.96 (d, $J = 8.0$ Hz, 1H), 7.80 – 7.64 (m, 2H), 7.57 (ddd, $J = 8.3, 7.4, 4.0$ Hz, 3H), 7.53 – 7.44 (m, 1H). $^{13}$C NMR (151 MHz, CDCl$_3$) $\delta$ 180.75, 157.62, 142.78, 136.25, 134.14, 133.41, 131.41, 130.96, 130.77, 129.41, 128.33, 127.95, 127.46, 124.60, 123.92, 122.45, 122.31. GC-MS (EI): 223.1, 195.1, 105.0, 77.1, 63.1, 51.0, 39.0, 27.1. Analytical data are consistent with those reported previously.
8-benzoyl-1,3,7-trimethyl-3,4,5,7-tetrahydro-1H-purine-2,6-dione (5v): The title compound was prepared according to the general procedure B as a white solid. mp: 168.4–170.1°C. 1H NMR (400 MHz, CDCl₃) δ 8.36 – 8.14 (m, 2H), 7.65 (t, J = 7.4 Hz, 1H), 7.52 (t, J = 7.7 Hz, 2H), 4.37 (s, 3H), 3.62 (s, 3H), 3.45 (s, 3H). 13C NMR (151 MHz, CDCl₃) δ 184.07, 155.96, 151.67, 146.68, 144.40, 136.30, 134.02, 131.22, 128.52, 110.39, 35.06, 30.06, 28.39. GC-MS (EI): 298.1, 269.1, 240.1, 184.1, 105.0, 77.1, 67.0, 55.1, 28.1. HRMS (ESI): calcd. for C₁₅H₁₄N₄NaO₃ + 321.0963 [M+Na]+, found: 321.0958.

1-(isoquinolin-1-yl)-3-phenylpropan-1-one (5w): The title compound was prepared according to the general procedure B as a yellow viscous oil. 1H NMR (400 MHz, CDCl₃) δ 9.11 – 8.79 (m, 1H), 8.57 (d, J = 5.5 Hz, 1H), 7.86 – 7.79 (m, 1H), 7.77 (d, J = 5.5 Hz, 1H), 7.73 – 7.61 (m, 2H), 7.40 – 7.28 (m, 4H), 7.26 – 7.17 (m, 1H), 3.99 – 3.29 (m, 2H). 13C NMR (151 MHz, CDCl₃) δ 203.58, 152.78, 141.39, 141.05, 136.96, 130.30, 129.02, 128.52, 128.44, 126.98, 126.68, 126.00, 125.75, 124.50, 41.82, 30.15. GC-MS (EI): 261.1, 233.1, 156.1, 129.1, 102.1, 77.1, 51.1, 39.1, 27.1. Analytical data are consistent with those reported previously.

isoquinolin-1-yl(thiophen-2-yl)methanone (5x): The title compound was prepared according to the general procedure B as a brownish oil. 1H NMR (400 MHz, CDCl₃) δ 8.63 (d, J = 5.6 Hz, 1H), 8.56 (d, J = 8.5 Hz, 1H), 7.91 (d, J = 4.8 Hz, 2H), 7.84 (d, J = 5.6 Hz, 1H), 7.75 (dd, J = 13.5, 6.5 Hz, 2H), 7.66 (t, J = 7.7 Hz, 1H), 7.16 (t, J = 4.3 Hz, 1H). 13C NMR (151 MHz, CDCl₃) δ 186.22, 154.79, 142.72, 140.99, 137.05, 136.74, 136.15, 130.82, 128.76, 128.20, 127.21, 126.56, 126.39, 123.66. GC-MS (EI): 239.0, 210.1, 177.1, 154.1, 139.1, 111.0, 83.0, 51.1, 39.1, 28.1. Analytical data are consistent with those reported previously.
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-1-(1H-indol-3-yl)vinylisoquinoline (5y): The title compound was prepared according to the general procedure B as a yellow solid. mp: 181.9-183.1 °C. 

$^1$H NMR (400 MHz, DMSO) δ 12.13 (s, 1H), 8.60 (d, $J = 5.6$ Hz, 1H), 8.34 – 8.25 (m, 1H), 8.18 (d, $J = 8.5$ Hz, 1H), 8.09 (d, $J = 8.3$ Hz, 1H), 8.02 (d, $J = 5.7$ Hz, 1H), 7.90 – 7.77 (m, 2H), 7.68 (t, $J = 7.6$ Hz, 1H), 7.54 (dd, $J = 5.8$, 3.1 Hz, 1H), 7.29 (dd, $J = 5.9$, 3.2 Hz, 2H). 

$^{13}$C NMR (151 MHz, DMSO) δ 189.01, 157.85, 141.26, 137.99, 136.72, 136.26, 130.73, 128.14, 127.20, 126.02, 125.92, 125.05, 123.32, 122.37, 121.98, 121.38, 115.65, 112.51. 

GC-MS (EI): 272.1, 243.1, 207.0, 144.0, 128.1, 116.1, 102.0, 89.0, 77.1, 50.1, 28.1. 


1-(isoquinolin-1-yl)ethan-1-one (5z)$^{11}$: The title compound was prepared according to the general procedure B as a brownish oil. 

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.95 (d, $J = 8.3$ Hz, 1H), 8.56 (d, $J = 5.5$ Hz, 1H), 7.84 (d, $J = 7.7$ Hz, 1H), 7.79 (d, $J = 5.5$ Hz, 1H), 7.74 – 7.61 (m, 2H), 2.85 (s, 3H). 

$^{13}$C NMR (151 MHz, CDCl$_3$) δ 202.79, 152.83, 141.11, 137.09, 129.21, 128.92, 128.36, 127.43, 126.19, 119.91, 40.01, 31.35. 

GC-MS (EI): 171.1, 154.0, 143.1, 129.1, 101.1, 75.1, 63.1, 51.1, 28.1. 

Analytical data are consistent with those reported previously.

1-(tert-butyl)isoquinoline (5bb)$^{12}$: The title compound was prepared according to the general procedure B as a brownish oil. 

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.53 (d, $J = 8.8$ Hz, 1H), 8.44 (d, $J = 5.6$ Hz, 1H), 7.82 (d, $J = 7.7$ Hz, 1H), 7.66 – 7.58 (m, 1H), 7.54 (ddd, $J = 8.4$, 6.9, 1.4 Hz, 1H), 7.49 (d, $J = 5.6$ Hz, 1H), 1.67 (s, 9H). 

$^{13}$C NMR (151 MHz, CDCl$_3$) δ 167.48, 140.73, 137.51, 130.40, 129.21, 127.05, 126.92, 125.79, 124.72, 119.91, 40.01, 31.35. 


Analytical data are consistent with those reported previously.

1-(diethoxymethyl)isoquinoline (6a): As a yellow viscous oil. 

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.76 (d, $J = 8.5$ Hz, 1H), 8.44 (d, $J = 5.7$ Hz, 1H), 7.81 (d, $J = 8.2$ Hz, 1H), 7.67 (t, $J = 7.5$ Hz, 1H), 7.60 (dd, $J = 15.2$, 6.9 Hz, 2H), 5.84 (s, 1H), 3.97 – 3.76 (m, 2H), 3.61 (dq, $J = 9.5$, 7.0 Hz, 2H), 1.24 (t, $J = 7.0$ Hz, 6H). 

$^{13}$C NMR (151 MHz, CDCl$_3$) δ 157.29, 141.04, 137.18, 130.21, 127.17, 127.12, 126.97.
125.93, 121.71, 106.67, 63.54, 15.41. HRMS (ESI): calcd. for C_{14}H_{17}NNaO\_2 +$^{254.1144}$ [M+Na]^+. found: 254.1151

6. References

7.\(^1\)H and \(^{13}\)C spectrum for all the related compounds

3a\(^1\)H

3a\(^{13}\)C
$^{3}e^1H$

$^{3}e^{13}C$
$^3$H

$^3$C
$3n^1H$

$3n^{13}C$
$5aa^1H$

$5aa^{13}C$
$5\text{ab}^1\text{H}$

$5\text{ab}^{13}\text{C}$
$^{1}H$ spectrum of 5fa

$^{13}C$ spectrum of 5fa
$^{5h} \text{H}$

$^{5h} \text{C}$
$5 \text{i} \, ^1\text{H}$

$5 \text{i} \, ^{13}\text{C}$
5j^1H

5j^{13}C
$5m^1H$

$5m^{13}C$
$5bb^1H$

$5bb^{13}C$
$^{5}H$

$^{13}C$