

Supporting Information

Experimental Section

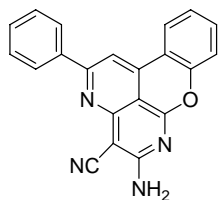
General remarks

All reagents were purchased from commercial sources and used without further purification. Dry active thin-layer chromatographic silica gel (NET114) was used directly. NMR spectra were measured in DMSO-*d*₆ with Me₄Si as the internal standards on a Bruker Advance DPX-400 at room temperature. IR spectra were recorded on Bruker FTIR spectrometer, absorbance were reported in cm⁻¹. MS were recorded on Bruker MicrOTOF-QII.

General procedure for the synthesis of compounds 4.

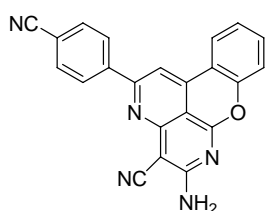
A mixture of substitution-2-hydroxyacetophenone (2.0 mmol), aromatic aldehyde (2.0 mmol), malononitrile (4.0 mmol) and 0.03 g of silica gel was stirred in water (2 mL) at 80 °C. After 2 h reaction, filtered, and then concentrated. The precipitate was collected and purified by 95% EtOH-DMF (10:1). The analytical data for represent compounds are shown below.

4a. 5-amino-2-phenyl-3*H*-chromeno [4,3,2-*de*][1,6]naphthyridine-4-carbonitrile

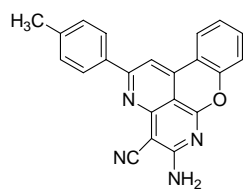


Yellow crystal, m.p. > 300 °C, 0.46 g (69%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63-8.61 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.45-8.44 (1H, d, *J* = 2.0 Hz), 8.43-8.42 (1H, d, *J* = 1.6 Hz), 8.39 (1H, s), 7.74-7.70 (1H, t), 7.63-7.60 (3H, m), 7.60-7.47 (4H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 167.00, 159.20, 155.11, 151.18, 150.20, 139.20, 136.30, 134.12, 130.56, 129.40, 127.31, 125.32, 121.47, 120.88, 120.44, 118.45 117.01, 75.42. IR (cm⁻¹): 3480, 3293, 3163, 2209, 1640, 1624, 1596, 1571, 1557. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂ON₄, 337.1084; found, 337.1010.

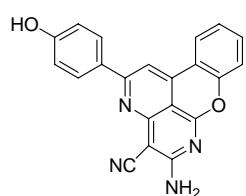
4b. 5-amino-2-(4-cyanophenyl)-3*H*-chromeno [4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



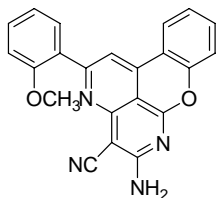
Yellow crystal, m.p. > 300 °C, 0.52 g (72%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.61-8.59 (2H, d, *J* = 8.0 Hz), 8.59 (1H, s), 8.46 (1H, s), 8.10 (1H, s), 8.08 (1H, s), 7.74 (1H, t, *J* = 4.0 Hz), 7.60 (2H, s), 7.54-7.48 (2H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.42, 158.23, 157.43, 153.38, 149.27, 143.24, 141.20, 139.32, 134.25, 132.16, 131.48, 130.82, 130.25, 128.34, 126.32, 125.57, 124.38, 121.99, 120.88, 76.52. IR (cm⁻¹): 3489, 3286, 3161, 2203, 1634, 1593, 1569. HRMS (ESI): *m/z* calcd. for C₂₂H₁₁N₅O, 362.1036; found, 362.0946.

4c. 5-amino-2-p-tolyl-3H-chromeno[4,3,2-de][1,6] naphthyridine-4-carbonitrile

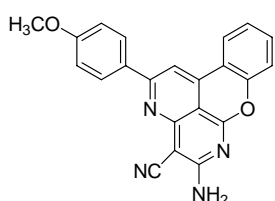
Yellow crystal, m.p. > 300 °C, 0.50 g (71%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 7.94-7.91 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.64 (1H, t), 7.52 (1H, t), 7.30 (1H, t), 6.82 (2H, s), 3.77 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.33, 161.81, 161.74, 161.57, 159.12, 151.72, 138.32, 133.07, 130.16, 129.42, 125.22, 117.37, 114.17, 103.97, 75.57. IR (cm⁻¹): 3487, 3289, 3161, 2206, 1636, 1622, 1595, 1568. HRMS (ESI): *m/z* calcd. for C₂₂H₁₄N₄O, 351.1240; found, 351.1177.

4d. 5-amino-2-(4-hydroxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.51 g (73%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 10.08 (1H, s), 8.59-8.56 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.34 (1H, s), 8.32 (1H, s), 8.26 (1H, s), 7.70 (1H, t, *J* = 8.4 Hz), 7.51 (1H, s), 7.49 (1H, s), 7.47 (1H, s), 7.45 (1H, s), 6.97 (1H, s), 6.95 (1H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.31, 162.11, 161.71, 160.19, 159.05, 155.49, 151.67, 138.06, 132.95, 129.58, 128.64, 125.16, 117.90, 117.37, 116.59, 115.55, 103.71, 101.82, 75.58. IR (cm⁻¹): 3474, 3429, 3302, 3179, 2205, 1634, 1598, 1567. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂N₄O₂, 353.1033; found, 353.0999.

4e. 5-amino-2-(2-methoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

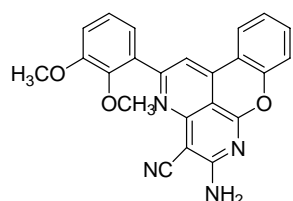
Yellow crystal, m.p. > 300 °C, 0.65 g (74%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.31-8.29 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.11 (1H, s), 7.83-7.80 (1H, dd, *J*₁ = 2.0 Hz, *J*₂ = 8.0 Hz), 7.69-7.67 (1H, m), 7.55-7.43 (5H, m), 7.25-7.23 (1H, d, *J* = 8.0 Hz), 7.15 (1H, t, *J* = 8.0 Hz), 3.91 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.67, 162.32, 161.67, 159.52, 157.28, 155.47, 151.76, 136.94, 133.06, 131.35, 130.96, 128.23, 125.40, 124.68, 120.68, 118.01, 117.09, 112.17, 109.27, 102.11, 75.50, 55.86. IR (cm⁻¹): 3410, 3381, 3321, 2206, 1634, 1597, 1569. HRMS (ESI): *m/z* calcd. for C₂₂H₁₄N₄O₂, 367.1190; found, 367.1157.

4f. 5-amino-2-(4-methoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.57 g (78%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.59-8.57 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.42 (2H, d, *J* = 8.0 Hz), 8.29 (1H, s), 7.68 (1H, t, *J* = 4.0 Hz), 7.51-7.47 (4H, m), 7.15 (1H, s), 7.12 (1H, s),

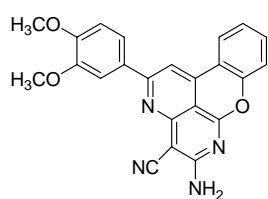
3.88 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 161.85, 161.73, 161.56, 159.07, 155.46, 151.70, 138.25, 133.01, 130.19, 129.39, (125.17, 117.90, 117.33, 116.46, 114.15, 103.95, 102.02, 75.70, 55.39). IR (cm^{-1}): 3374, 3320, 3289, 3183, 2212, 1655, 1634, 16202, 1599, 1566. HRMS (ESI): m/z calcd. for $\text{C}_{22}\text{H}_{14}\text{N}_4\text{O}_2$, 367.1190; found, 367.1103.

4g. 5-amino-2-(2, 3-dimethoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



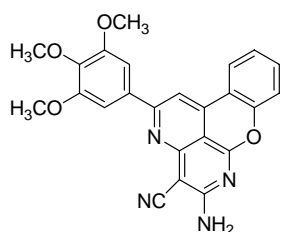
Yellow crystal, m.p. > 300 °C, 0.52 g (66%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 8.35-8.24 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 7.98 (1H, s), 7.72-7.68 (1H, m), 7.54 (1H, s), 7.53 (1H, s), 7.50 (1H, s), 7.47-7.43 (1H, m), 7.31-7.27 (1H, m), 7.25-7.25 (1H, d, $J = 2.0$ Hz), 7.24 (1H, s), 3.90 (3H, s), 3.83 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 163.14, 162.43, 161.69, 159.22, 155.34, 152.93, 151.69, 146.85, 137.53, 134.14, 133.18, 125.45, 124.69, 124.14, 122.11, 117.99, 116.95, 114.21, 108.60, 102.22, 75.52, 61.03, 55.93. IR (cm^{-1}): 3458, 3303, 3196, 3176, 2212, 1628, 1607, 1568. HRMS (ESI): m/z calcd. for $\text{C}_{23}\text{H}_{16}\text{N}_4\text{O}_3$, 397.1295; found, 397.1234.

4h. 5-amino-2-(3,4-dimethoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

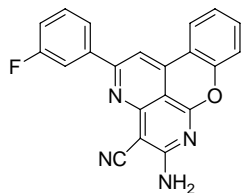


Yellow crystal, m.p. > 300 °C, 0.54 g (68%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 8.63 (1H, d, $J = 8.0$ Hz), 8.30 (1H, s), 8.07 (1H, d, $J = 8.0$ Hz), 8.02 (1H, s), 7.73 (1H, t), 7.53-7.49 (4H, q), 7.17 (1H, d, $J = 8.4$ Hz), 3.93 (3H, s), 3.88 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 161.84, 161.73, 159.40, 155.40, 151.73, 151.42, 148.85, 138.23, 133.03, 130.36, 125.28, 125.13, 121.30, 117.93, 117.37, 16.41, 111.65, 111.08, 104.09, 102.06, 75.68, 55.71, 55.67. IR (cm^{-1}): 3457, 3329, 3201, 2212, 1665, 1624, 1597, 1570. HRMS (ESI): m/z calcd. for $\text{C}_{23}\text{H}_{16}\text{N}_4\text{O}_3$, 397.1295; found, 397.1243.

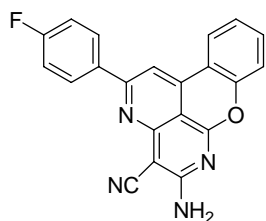
4i. 5-amino-2-(3,4,5-trimethoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine -4-carbonitrile



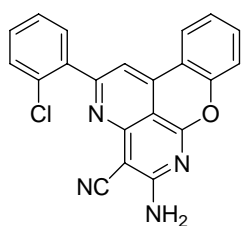
Yellow crystal, m.p. 285-286 °C, 0.59 g (69%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 8.63-8.61 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 8.28 (1H, s), 7.73-7.69 (3H, m), 7.53-7.48 (4H, m), 3.94 (6H, s), 3.78 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 161.80, 161.69, 161.52, 159.07, 155.43, 151.63, 138.23, 133.06, 130.09, 129.37, 125.23, 125.11, 117.90, 117.24, 116.53, 114.12, 103.91, 101.98, 75.58, 55.36. IR (cm^{-1}): 3473, 3279, 3153, 2207, 1632, 1609, 1593, 1568. HRMS (ESI): m/z calcd. for $\text{C}_{24}\text{H}_{18}\text{N}_4\text{O}_4$, 427.1401; found, 427.1315.

4j. 5-amino-2-(3,4,5-trimethoxyphenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

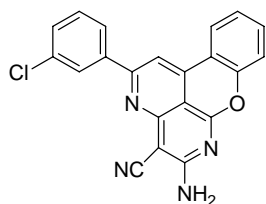
Yellow crystal, m.p. > 300 °C, 0.47 g (67%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.49-8.47 (1H, dd, *J*₁ = 0.8 Hz, *J*₂ = 8.0 Hz), 7.96 (1H, s), 7.80 (1H, d, *J* = 2.0 Hz), 7.71-7.67 (1H, m), 7.65-7.62 (3H, q), 7.60-7.54 (3H, m), 7.46-7.42 (1H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.80, 159.13, 155.31, 138.91, 133.23, 130.31, 125.34, 125.22, 123.74, 123.72, 117.92, 117.50, 117.29, 117.21, 116.28, 114.29, 114.06, 104.87, 102.83, 75.65. IR (cm⁻¹): 3497, 3343, 2202, 1624, 1597, 1570. HRMS (ESI): *m/z* calcd. for C₂₁H₁₁FN₄O, 355.0990; found, 355.0915.

4k. 5-amino-2-(4-fluorophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.55 g (78%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63-8.60 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.53-8.49 (2H, m), 8.39 (1H, s), 7.72 (1H, t, *J* = 8.0 Hz), 7.54-7.50 (3H, m), 7.48-7.43 (3H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.49, 161.82, 159.30, 155.39, 151.80, 139.03, 137.93, 133.36, 131.39, 131.23, 130.78, 129.94, 127.42, 125.42, 125.11, 118.02, 116.92, 116.38, 109.01, 102.51, 75.49. IR (cm⁻¹): 3484, 3294, 3166, 2207, 1638, 1611, 1597, 1571. HRMS (ESI): *m/z* calcd. for C₂₁H₁₁FN₄O, 355.0990; found, 355.0915.

4l. 5-amino-2-(2-chlorophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

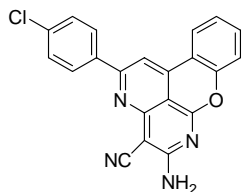
Yellow crystal, m.p. > 300 °C, 0.47 g (64%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.39 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.99 (1H, s), 7.73-7.65 (3H, m), 7.59-7.54 (5H, m), 7.45 (1H, t, *J* = 8.0 Hz). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.49, 161.82, 159.30, 155.39, 151.80, 139.03, 137.93, 133.36, 131.39, 131.23, 130.78, 129.94, 127.42, 125.42, 125.11, 118.02, 116.92, 116.38, 109.01, 102.51, 75.49. IR (cm⁻¹): 3484, 3294, 3166, 2207, 1638, 1611, 1597, 1571. HRMS (ESI): *m/z* calcd. for C₂₁H₁₁ClN₄O, 371.0694; found, 371.0616.

4m. 5-amino-2-(3-chlorophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.49 g (66%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.38 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.98 (1H, s), 7.73-7.65 (3H, m), 7.58-7.54 (5H, m), 7.45 (1H, t, *J* = 8.0 Hz). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.33, 160.89, 159.18, 151.79, 138.89, 136.66, 135.68, 133.25, 129.46, 128.85,

125.34, 125.26, 117.98, 117.27, 1126.33, 104.68, 102.72, 75.64. IR (cm⁻¹): 3481, 3299, 3170, 2212, 1642, 1620, 1604, 1572. HRMS (ESI): m/z calcd. for C₂₁H₁₁ClN₄O, 371.0694; found, 371.1902.

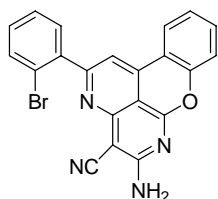
4n. 5-amino-2-(4-chlorophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.55 g (75%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.61-8.59 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.38 (1H, s), 8.24 (1H, s), 8.22 (1H, s), 8.00 (1H, s), 7.98 (1H, s), 7.72 (1H, t, *J* = 8.0 Hz), 7.55-7.47 (4H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.31, 162.11, 161.71, 160.19, 159.05, 155.49, 151.67, 138.06, 132.95, 129.58, 128.64, 125.16, 117.90, 117.37, 116.59, 115.55, 103.70,

101.81, 75.58. IR (cm⁻¹): 3443, 3325, 3211, 2224, 1657, 1626, 1600, 1575, 1551. HRMS (ESI): m/z calcd. for C₂₁H₁₁ClN₄O, 371.0694; found, 371.0613.

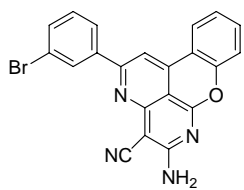
4o. 5-amino-2-(2-bromophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.54 g (65%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.42-8.40 (1H, dd, *J*₁ = 1.6 Hz, *J*₂ = 8.0 Hz), 7.95 (1H, s), 7.84-7.82 (1H, dd, *J*₁ = 0.8 Hz, *J*₂ = 8.0 Hz), 7.74-7.69 (1H, m), 7.65-7.63 (1H, dd, *J*₁ = 2.0 Hz, *J*₂ = 8.0 Hz), 7.60-7.54 (4H, m), 7.50-7.43 (2H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 164.85,

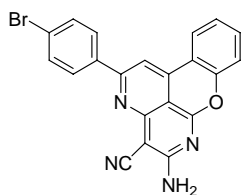
161.82, 159.26, 155.29, 151.76, 141.00, 137.53, 133.33, 133.04, 131.24, 130.83, 127.87, 125.40, 125.09, 120.94, 117.99, 116.90, 116.38, 108.95, 102.43, 75.53. IR (cm⁻¹): 3487, 3288, 3162, 2205, 1636, 1609, 1594, 1569. HRMS (ESI): m/z calcd. for C₂₁H₁₁BrN₄O, 415.0189; found, 415.0096.

4p. 5-amino-2-(3-bromophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

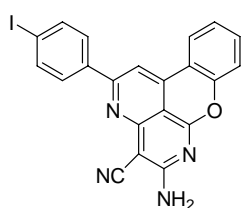


Yellow crystal, m.p. > 300 °C, 0.56 g (68%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.60-8.58 (2H, m), 8.43 (1H, d, *J* = 8.0 Hz), 8.35 (1H, s), 7.77-7.74 (2H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.72-7.68 (2H, m), 7.57-7.44 (3H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.76, 160.21, 159.05, 155.22, 151.64, 139.98, 138.83, 133.24,

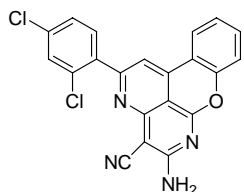
133.16, 130.79, 130.07, 126.61, 125.34, 125.11, 122.35, 117.84, 117.13, 116.34, 104.78, 102.73, 75.75. IR (cm⁻¹): 3482, 3300, 3175, 2212, 1638, 1603, 1570. HRMS (ESI): m/z calcd. for C₂₁H₁₁BrN₄O, 415.0189; found, 415.0097.

4q. 5-amino-2-(4-bromophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

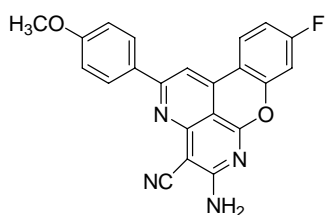
Yellow crista, m.p. > 300 °C, 0.63 g (76%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.59 (1H, d, *J* = 7.2 Hz), 8.46 (1H, d, *J* = 8.8 Hz), 8.37 (1H, s), 7.82 (1H, d, *J* = 12.0 Hz), 7.73-7.66 (3H, m), 7.53-7.47 (4H, q). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.78, 160.87, 159.13, 155.34, 151.69, 138.82, 136.91, 133.23, 131.75, 129.63, 125.24, 124.61, 117.93, 117.13, 116.37, 104.55, 102.65, 75.55. IR (cm⁻¹): 3464, 3305, 3178, 2208, 1643, 1624, 1598, 1570. HRMS (ESI): *m/z* calcd. for C₂₁H₁₁BrN₄O, 415.0189; found, 413.2552.

4r. 5-amino-2-(4-iodophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.74 g (80%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.64-8.62 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.49 (1H, s), 8.47 (1H, s), 8.42 (1H, s), 8.75-8.68 (3H, m), 7.59-7.49 (4H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.81, 161.22, 159.13, 155.37, 151.74, 138.79, 137.64, 137.35, 133.19, 125.27, 117.22, 116.31, 104.51, 102.72, 98.28, 75.70. IR (cm⁻¹): 3487, 3285, 3161, 2204, 1635, 1609, 1594, 1568. HRMS (ESI): *m/z* calcd. for C₂₁H₁₁IN₄O, 463.0050; found, 462.9958.

4s. 5-amino-2-(2,4-dichlorophenyl)-3H-chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

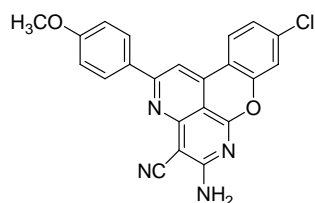
Yellow crystal, m.p. > 300 °C, 0.50 g (62%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.37 (1H, m), 8.01 (1H, d, *J* = 12.0 Hz), 7.84-7.69 (3H, m), 7.65-7.60 (3H, m), 7.56-7.53 (1H, d, *J* = 12.0 Hz), 7.45 (1H, t, *J* = 8.0 Hz). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 160.48, 159.42, 155.43, 152.12, 148.54, 143.24, 139.21, 137.10, 135.46, 131.58, 131.43, 131.31, 130.75, 129.32, 126.32, 125.77, 125.26, 124.58, 124.38, 122.99, 121.71, 75.42. IR (cm⁻¹): 3482, 3396, 3320, 3208, 2210, 1648, 1621, 1597. HRMS (ESI): *m/z* calcd. for C₂₁H₁₀Cl₂N₄O, 405.0304; found, 405.0239.

4t. 5-amino-9-fluoro-2-(4-methoxyphenyl)chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.56 g (73%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.60-8.58 (1H, d, *J* = 8.8 Hz), 8.58 (1H, s), 8.40 (1H, s), 8.38 (1H, s), 8.28 (1H, s), 7.67-7.66 (1H, s), 7.54-7.53 (1H, d, *J* = 1.6 Hz), 7.51 (1H, s), 7.13 (1H, s), 7.11 (1H, s), 3.88 (3H, s), ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.48,

159.30, 156.45, 151.87, 148.53, 141.14, 139.72, 134.85, 134.42, 131.46, 131.49, 131.91, 131.25, 130.75, 130.34, 129.32, 127.49, 125.29, 124.38, 123.31, 121.97, 121.91, 120.86, 120.49, 77.42, 56.48, 55.98. IR (cm^{-1}): 3459, 3293, 3163, 2209, 1630, 1627, 1596, 1571, 1557.

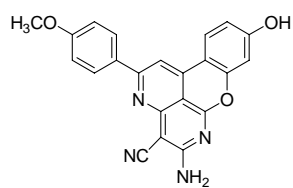
4u. 5-amino-9-chloro-2-(4-methoxyphenyl)chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.59 g (74%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 8.64-8.60 (1H, dd, $J_1 = 0.4$ Hz, $J_2 = 8.0$ Hz), 8.38 (1H, s), 8.36 (1H, s), 8.22 (1H, s), 7.48-7.43 (3H, m), 7.37- 7.32 (1H, m), 7.12 (1H, s), 7.10 (1H, s), 3.88 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 160.78, 159.20, 156.41, 152.18,

148.00, 141.24, 139.20, 135.10, 134.42, 131.56, 131.40, 131.15, 131.06, 130.75, 130.34, 126.32, 125.47, 124.38, 123.38, 121.99, 120.88, 120.44, 77.42, 55.36. IR (cm^{-1}): 3380, 3295, 3161, 2209, 1640, 1627, 1593, 1581, 1567.

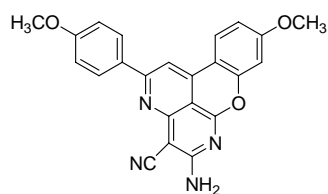
4v. 5-amino-9-hydroxy-2-(4-methoxyphenyl)chromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.62 g (81%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 10.68 (1H, s), 8.41-8.38 (3H, q), 8.14 (1H, s), 7.95 (1H, s), 7.40 (1H, s), 7.14 (1H, s), 7.12 (1H, s), 6.91-6.88 (1H, dd, $J_1 = 2.0$ Hz, $J_2 = 8.0$ Hz), 6.84-6.83 (1H, d, $J = 2.0$ Hz), 3.87 (1H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 161.58,

159.28, 156.47, 152.10, 148.50, 141.94, 136.20, 135.98, 134.42, 131.56, 131.31, 131.25, 130.75, 130.34, 126.32, 125.47, 124.38, 123.38, 121.79, 121.51, 120.88, 120.44, 77.42, 55.32. IR (cm^{-1}): 3456, 3380, 3293, 3163, 2209, 1640, 1624, 1596, 1571, 1557, 1478, 1359.

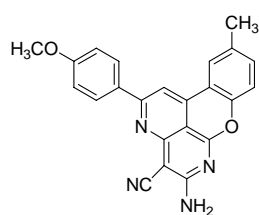
4w 5-amino-2-(4-methoxyphenyl)-10-methylchromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.61 g (77%). ^1H NMR (400 MHz, $\text{DMSO-}d_6$): δ 8.40-8.38 (2H, d, $J = 8.8$ Hz), 8.35 (1H, s), 8.21 (1H, s), 7.48 (1H, s), 7.46 (1H, s), 7.44 (1H, s), 7.37-7.34 (1H, d, $J = 8.0$ Hz), 7.14 (1H, s), 7.12 (1H, s), 3.88 (3H, s), 3.88 (3H, s). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$): δ 162.38, 159.87,

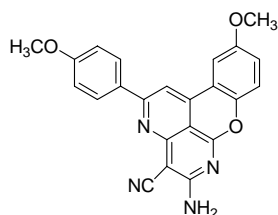
157.40, 152.28, 147.01, 142.24, 139.29, 135.20, 134.47, 131.56, 131.41, 131.32, 131.15, 131.06, 130.74, 130.35, 126.33, 125.47, 125.29, 124.48, 123.38, 121.99, 120.88, 120.44, 77.42, 75.88.

4x 5-amino-2-(4-methoxyphenyl)-10-methylchromeno[4,3,2-de][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.58 g (76%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.44-8.42 (1H, d, *J* = 9.6 Hz), 8.39 (1H, s), 8.37 (1H, s), 8.12 (1H, s), 7.40 (2H, s), 7.13 (1H, s), 7.11 (1H, s), 7.03 (2H, t, *J* = 8.0 Hz), 3.90 (3H, s), 3.88 (3H, s).

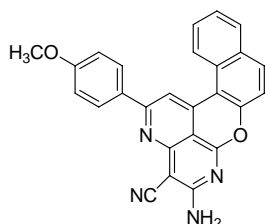
4y 5-amino-10-methoxy-2-(4-methoxyphenyl)chromeno[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.63 g (80%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.44 (1H, s), 8.41 (1H, s), 8.27 (1H, s), 7.98 (1H, d, *J* = 2.8 Hz), 7.44 (1H, s), 7.43 (1H, s), 7.42 (1H, s), 7.27-7.24 (1H, dd, *J*₁ = 2.8 Hz, *J*₂ = 9.2 Hz), 7.14 (1H, s), 7.12 (1H, s), 3.93 (3H, s), 3.88 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 160.48, 159.65, 157.41, 153.28, 148.72, 141.24, 139.34, 135.18, 134.62, 131.55, 131.48,

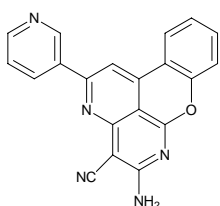
131.25, 131.06, 130.74, 130.24, 127.32, 125.47, 125.29, 124.28, 123.18, 121.96, 121.71, 120.44, 77.42, 58.32, 55.89. IR (cm⁻¹): 3450, 3296, 3063, 2209, 1659, 1634, 1658, 1596, 1578, 1557.

4z.5-amino-2-(4-methoxyphenyl)-3*H*-benzo[*f*]chromeno[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



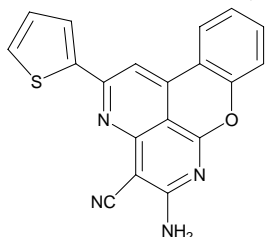
Yellow crystal, m.p. > 300 °C, 0.63 g (80%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.85 (1H, d, *J* = 8.8 Hz), 8.18 (1H, d, *J* = 9.2 Hz), 8.12 (1H, d, *J* = 8.0 Hz), 7.78-7.76 (1H, q), 7.73 (1H, s), 7.67-7.64 (2H, t), 7.60-7.57 (1H, d, *J* = 9.2 Hz), 7.18-7.17 (3H, m), 7.15 (2H, s), 6.08(3H, m).

4aa.5-amino-2-(Pyridine-3-yl)-3*H*-chromeno[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.465 g (69%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 7.94 (2H, d, *J* = 8.0 Hz), 7.65-7.63 (2H, m), 7.52 (2H, d, *J* = 8.0 Hz), 7.31 (2H, t, *J* = 4.0 Hz), 6.84 (3H, s). HRMS (ESI): *m/z* calcd. for C₂₀H₁₁N₅O, 338.1042; found, 338.1043.

4bb .5-amino-2-(Thiophene-2-yl)-3*H*-chromeno[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile

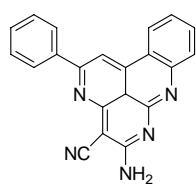


Yellow crystal, m.p. > 300 °C, 0.454 g (67%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.90 (1H, d, *J* = 8.8 Hz), 7.96 (2H, d, *J* = 8.8 Hz), 7.87-7.85 (1H, m), 7.76 (2H, d, *J* = 8.4 Hz), 7.57-7.53 (1H, m), 7.03 (2H, d, *J* = 8.8 Hz), 6.93 (1H, s). HRMS (ESI): *m/z* calcd. for C₂₀H₁₁N₄OS, 338.1042; found, 338.1043.

General procedure for the synthesis of compounds 6.

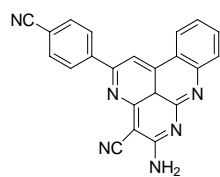
A mixture of 2-aminoacetophenone (2.0 mmol), aromatic aldehyde (2.0 mmol), malononitrile (4.0 mmol) and 0.03 g of silica gel was stirred in water (2 mL) at 95 °C. After 6 h reaction, concentrated, the precipitate was collected and purified by 95% EtOH-DMF (10:1) after washed with water three times. The analytical data for represent compounds are shown below.

6a. 5-amino-2-phenyl-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



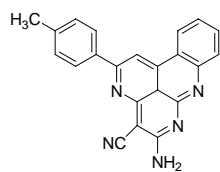
Yellow crystal, m.p. > 300 °C, 0.13 g (39%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63-8.61 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.45-8.44 (2H, dd, *J*₁ = 2.4 Hz, *J*₂ = 8.0 Hz), 8.39 (1H, s), 7.74-7.70 (1H, m), 7.63-7.58 (3H, m), 7.52-7.47 (4H, m). IR (cm⁻¹): 3480, 3293, 3163, 2209, 1640, 1624, 1596, 1571, 1557. HRMS (ESI): *m/z* calcd. for C₂₁H₁₃N₅, 337.1084; found, 337.1010.

6b. 5-amino-2-(4-cyanophenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



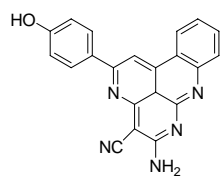
Yellow crystal, m.p. > 300 °C, 0.13 g (35%) ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.61 (3H, d, *J* = 8.0 Hz), 8.46 (1H, s), 8.11 (1H, s), 8.08 (1H, s), 7.75-7.71 (1H, m), 7.61 (2H, s), 7.55-7.48 (2H, m). IR (cm⁻¹): 3489, 3286, 3161, 2203, 1634, 1593, 1569. HRMS (ESI): *m/z* calcd. for C₂₂H₁₂N₆, 361.1196; found, 362.1548.

6c. 5-amino-2-*p*-tolyl-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.13 g (37%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 7.94~7.91 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.65 (1H, m), 7.52-7.50 (1H, t), 7.30 (1H, m), 6.82 (1H, s), 2.77 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.33, 161.81, 161.74, 161.57, 159.12, 151.72, 138.32, 133.07, 130.16, 129.42, 125.22, 117.37, 114.17, 103.97, 75.57. IR (cm⁻¹): 3487, 3289, 3161, 2206, 1636, 1622, 1595, 1568. HRMS (ESI): *m/z* calcd. for C₂₂H₁₅N₅, 351.1240; found, 351.1177.

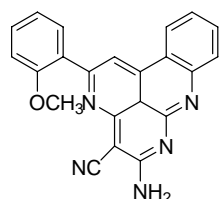
6d. 5-amino-2-(4-hydroxyphenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



Yellow crystal, m.p. > 300 °C, 0.13 g (39%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 10.09 (1H, s), 8.59 (1H, d, *J* = 8.0 Hz), 8.34 (1H, s), 8.32 (1H, s), 8.26 (1H, s), 7.71-7.67 (1H, m), 7.51-7.45 (4H, m), 6.97 (1H, s), 6.95 (1H, s). ¹³C NMR (100 MHz,

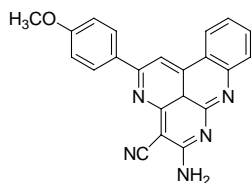
DMSO-*d*₆): δ 162.31, 162.11, 161.71, 160.19, 159.05, 155.49, 151.67, 138.06, 132.95, 129.58, 128.64, 125.16, 117.90, 117.37, 116.59, 115.55, 103.71, 101.82, 75.58. IR (cm⁻¹): 3474, 3429, 3302, 3179, 2205, 1634, 1598, 1567. HRMS (ESI): *m/z* calcd. for C₂₁H₁₃N₅O, 353.1033; found, 353.0999.

6e. 5-amino-2-(2-methoxyphenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-Carbonitrile



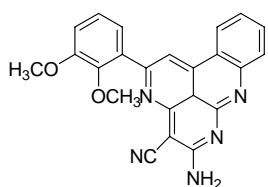
Yellow crystal, m.p. > 300 °C, 0.14 g (39%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.31-8.29 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 8.11 (1H, s), 7.83-7.80 (1H, dd, $J_1 = 2.0$ Hz, $J_2 = 8.0$ Hz), 7.69-7.67 (1H, m), 7.55-7.43 (5H, m), 7.25-7.23 (1H, d, $J = 8.0$ Hz), 7.16-7.13 (1H, t), 3.91 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.67, 162.32, 161.67, 159.52, 157.28, 155.47, 151.76, 136.94, 133.06, 131.35, 130.96, 128.23, 125.40, 124.68, 120.68, 118.01, 117.09, 112.17, 109.27, 102.11, 75.50, 55.86. IR (cm⁻¹): 3410, 3381, 3321, 2206, 1634, 1597, 1569. HRMS (ESI): *m/z* calcd. for C₂₂H₁₅N₅O, 367.1190; found, 367.1157.

6f. 5-amino-2-(4-methoxyphenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile

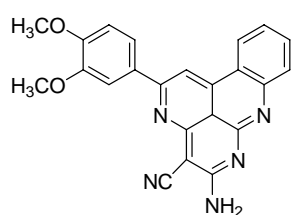


Yellow crystal, m.p. > 300 °C, 0.14 g (38%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.59-8.57 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 8.42 (2H, d, $J = 9.2$ Hz), 8.30 (1H, s), 7.72-7.67 (1H, m), 7.51-7.46 (4H, m), 7.15 (2H, d, $J_2 = 9.2$ Hz), 3.88 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.85, 161.73, 161.56, 159.07, 155.46, 151.70, 138.25, 133.01, 130.19, 129.39, 125.17, 117.90, 117.33, 116.46, 114.15, 103.95, 102.02, 75.70, 55.39. IR (cm⁻¹): 3374, 3320, 3289, 3183, 2212, 1655, 1634, 16202, 1599, 1566. HRMS (ESI): *m/z* calcd. for C₂₂H₁₅N₅O, 366.1349; found, 366.1316.

6g. 5-amino-2-(2, 3-dimethoxyphenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile

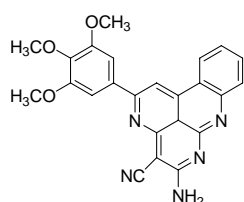


Yellow crystal, m.p. > 300 °C, 0.15 g (40%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.35-8.33 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 7.98 (1H, s), 7.72-7.68 (1H, m), 7.54-7.52 (3H, m), 7.47-7.45 (1H, m), 7.31-7.27 (1H, m), 7.25-7.25 (1H, d, $J = 2.0$ Hz), 7.24 (1H, s), 3.90 (3H, s), 3.83 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.14, 162.43, 161.69, 159.22, 155.34, 152.93, 151.69, 146.85, 137.53, 134.14, 133.18, 125.45, 124.69, 124.14, 122.11, 117.99, 116.95, 114.21, 108.60, 102.22, 75.52, 61.03, 55.93. IR (cm⁻¹): 3458, 3303, 3196, 3176, 2212, 1628, 1607, 1568. HRMS (ESI): *m/z* calcd. for C₂₃H₁₈N₅O₂, 396.1455; found, 397.1303.

6h. 5-amino-2-(3,4-dimethoxyphenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

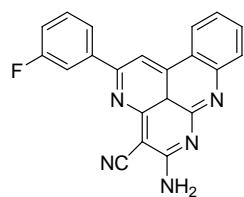
Yellow crystal, m.p. > 300 °C, 0.15 g (37%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63 (1H, d, *J* = 5.2 Hz), 8.30 (1H, s), 8.09 (1H, d, *J* = 8.8 Hz), 8.02 (1H, s), 7.73-7.69 (1H, q), 7.53-7.49 (4H, q), 7.17 (1H, d, *J* = 8.4 Hz), 3.93 (3H, s), 3.88 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.84, 161.73, 159.40, 155.40, 151.73, 151.42, 148.85, 138.23, 133.03, 130.36, 125.28, 125.13, 121.30, 117.93,

117.37, 16.41, 111.65, 111.08, 104.09, 102.06, 75.683, 55.71, 55.67. IR (cm⁻¹): 3457, 3329, 3201, 2212, 1665, 1624, 1597, 1570. HRMS (ESI): *m/z* calcd. for C₂₃H₁₇N₅O₂, 396.1455; found, 396.1434.

6i. 5-amino-2-(3,4,5-trimethoxyphenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

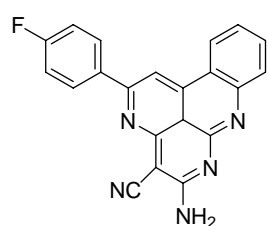
Yellow crystal, m.p. 285-286 °C, 0.15 g (34%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63-8.61 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.32 (1H, s), 7.73-7.69 (3H, m), 7.53-7.48 (4H, m), 3.94 (6H, s), 3.78 (3H, s). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.80, 161.69, 161.52, 159.07, 155.43, 151.63, 138.23, 133.06, 130.09, 129.37,

125.23, 125.11, 117.90, 117.24, 116.53, 114.12, 103.91, 101.98, 75.58, 55.36. IR (cm⁻¹): 3473, 3279, 3153, 2207, 1632, 1609, 1593, 1568. HRMS (ESI): *m/z* calcd. for C₂₄H₁₉N₅O₃, 426.1566; found, 426.1233.

6j. 5-amino-2-(3,4,5-trimethoxyphenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.14 g (40%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.49-8.47 (1H, dd, *J*₁ = 0.8 Hz, *J*₂ = 8.0 Hz), 7.96 (1H, s), 7.80 (1H, d, *J* = 4.0 Hz), 7.70-7.67 (1H, m), 7.65-7.62 (3H, q), 7.60-7.54 (3H, m), 7.46-7.42 (1H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.80, 159.13, 155.31, 138.91, 133.23, 130.31

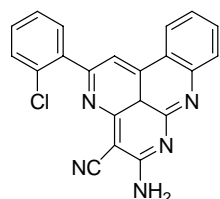
125.34, 125.22, 123.74, 123.72, 117.92, 117.50, 117.29, 117.21, 116.28, 114.29, 114.06, 104.87, 102.83, 75.65. IR (cm⁻¹): 3497, 3343, 2202, 1624, 1597, 1570. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂FN₅, 355.0990; found, 355.0915.

6k. 5-amino-2-(4-fluorophenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.15 g (42%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.63-8.60 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.53-8.49 (2H, m), 8.39 (1H, s), 7.74-7.70 (1H, m), 7.54-7.51 (3H, m), 7.50-7.43 (3H, m). ¹³C NMR (100 MHz,

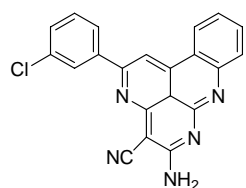
DMSO-*d*₆): δ 159.40, 156.96, 154.46, 153.96, 150.10, 147.68, 145.67, 138.23, 135.21, 132.82, 132.38, 131.62, 128.49, 127.76, 123.57, 123.60, 122.33, 121.09, 120.00, 119.66, 119.61, 118.61, 118.25, 106.62, 106.56, 106.15, 60.69, 60.51, 60.39, 56.97, 56.42, 56.05. IR (cm⁻¹): 3482, 3300, 3174, 3076, 2209, 1647, 1624, 1599, 1555. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂FN₅, 355.0990; found, 355.0915.

6l. 5-amino-2-(2-chlorophenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



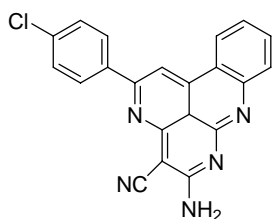
Yellow crystal, m.p. > 300 °C, 0.15 g (41%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.39 (1H, dd $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 7.99 (1H, s), 7.73-7.65 (3H, m), 7.59-7.54 (5H, m), 7.43 (1H, d, $J = 8.4$ Hz). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 163.49, 161.82, 159.30, 155.39, 151.80, 139.03, 137.93, 133.36, 131.39, 131.23, 130.78, 129.94, 127.42, 125.42, 125.11, 118.02, 116.92, 116.38, 109.01, 102.51, 75.49. IR (cm⁻¹): 3484, 3294, 3166, 2207, 1638, 1611, 1597, 1571. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂ClN₅, 371.0694; found, 371.1902.

6m. 5-amino-2-(3-chlorophenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



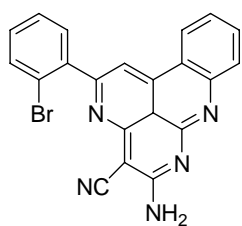
Yellow crystal, m.p. > 300 °C, 0.15 g (32%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.38 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 7.98 (1H, s), 7.73-7.65 (3H, m), 7.58-7.54 (5H, m), 7.43 (1H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.33, 160.89, 159.18, 151.79, 138.89, 136.66, 135.68, 133.25, 129.46, 128.85, 125.34, 125.26, 117.98, 117.27, 1126.33, 104.68, 102.72, 75.64. IR (cm⁻¹): 3481, 3299, 3170, 2212, 1642, 1620, 1604, 1572. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂ClN₅, 371.0694; found, 371.1902.

6n. 5-amino-2-(4-chlorophenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



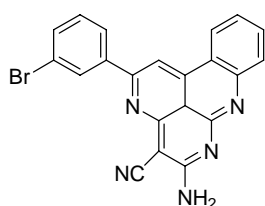
Yellow crystal, m.p. > 300 °C, 0.16 g (42%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.61-8.59 (1H, dd, $J_1 = 1.2$ Hz, $J_2 = 8.0$ Hz), 8.38 (1H, s), 8.23 (1H, s), 8.22 (1H, s), 8.00 (1H, s), 7.98 (1H, s), 7.74-7.70 (1H, m), 7.55-7.47 (4H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 162.31, 162.11, 161.71, 160.19, 159.05, 155.49, 151.67, 138.06, 132.95, 129.58, 128.64, 125.16, 117.90, 117.37, 116.59, 115.55, 103.70, 101.81, 75.58. IR (cm⁻¹): 3443, 3325, 3211, 2224, 1657, 1626, 1600, 1575, 1551. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂ClN₅, 371.0694; found, 371.1902.

6o. 5-amino-2-(2-bromophenyl)-3*H*-quinolino[4,3,2-*de*][1,6]naphthyridine-4-carbonitrile



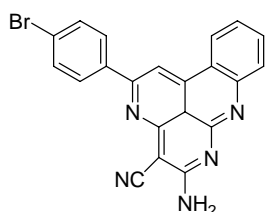
Yellow crystal, m.p. > 300 °C, 0.16 g (38%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.42-8.40 (1H, dd, *J*₁ = 1.6 Hz, *J*₂ = 8.0 Hz), 7.95 (1H, s), 7.84-7.82 (1H, dd, *J*₁ = 0.8 Hz, *J*₂ = 7.6 Hz), 7.74-7.69 (1H, m), 7.60-7.54 (5H, m), 7.50-7.43 (2H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 164.85, 161.82, 159.26, 155.29, 151.76, 141.00, 137.53, 133.33, 133.04, 131.24, 130.83, 127.87, 125.40, 125.09, 120.94, 117.99, 116.90, 116.38, 108.95, 102.43, 75.53. IR (cm⁻¹): 3487, 3288, 3162, 2205, 1636, 1609, 1594, 1569. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂BrN₅, 415.0189; found, 415.0096.

6p. 5-amino-2-(3-bromophenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile



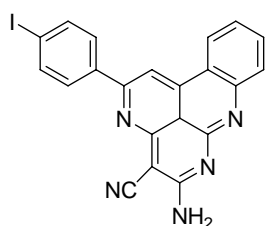
Yellow crystal, m.p. > 300 °C, 0.14 g (34%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.60-8.58 (2H, m), 8.43 (1H, d, *J* = 8.0 Hz), 8.35 (1H, s), 7.77-7.74 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 7.72-7.68 (1H, m), 7.57-7.44 (5H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.76, 160.21, 159.05, 155.22, 151.64, 139.98, 138.83, 133.24, 133.16, 130.79, 130.07, 126.61, 125.34, 125.11, 122.35, 117.84, 117.13, 116.34, 104.78, 102.73, 75.75. IR (cm⁻¹): 3482, 3300, 3175, 2212, 1638, 1603, 1570. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂BrN₅, 415.0189; found, 415.0096.

6q. 5-amino-2-(4-bromophenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

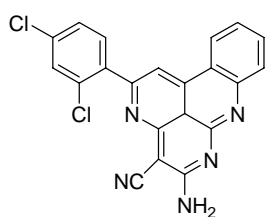


Yellow crystal, m.p. > 300 °C, 0.15 g (36%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.59 (1H, d, *J* = 7.2 Hz), 8.46 (2H, d, *J* = 8.8 Hz), 8.37 (1H, d), 7.82-7.66 (3H, m), 7.53-7.47 (4H, q). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.78, 160.87, 159.13, 155.34, 151.69, 138.82, 136.91, 133.23, 131.75, 129.63, 125.24, 124.61, 117.93, 117.13, 116.37, 104.55, 102.65, 75.55. IR (cm⁻¹): 3464, 3305, 3178, 2208, 1643, 1624, 1598, 1570. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂BrN₅, 415.0189; found, 415.0096.

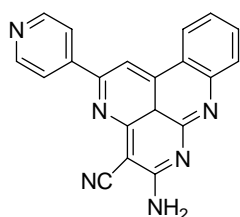
6r. 5-amino-2-(4-iodophenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile



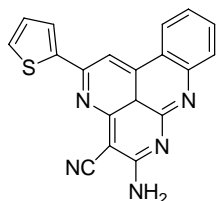
Yellow crystal, m.p. > 300 °C, 0.13 g (27%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.64-8.62 (1H, dd, *J*₁ = 1.2 Hz, *J*₂ = 8.0 Hz), 8.49 (1H, s), 8.47 (1H, s), 8.42 (1H, s), 8.75-8.68 (3H, m), 7.59-7.49 (4H, m). ¹³C NMR (100 MHz, DMSO-*d*₆): δ 161.81, 161.22, 159.13, 155.37, 151.74, 138.79, 137.64, 137.35, 133.19, 125.27, 117.22, 116.31, 104.51, 102.72, 98.28, 75.70. IR (cm⁻¹): 3487, 3285, 3161, 2204, 1635, 1609, 1594, 1568. HRMS (ESI): *m/z* calcd. for C₂₁H₁₂IN₅, 463.0050; found, 462.9958.

6s. 5-amino-2-(2,4-dichlorophenyl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.14 g (35%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.41-8.37 (1H, m), 8.01 (1H, d, *J* = 9.2 Hz), 7.84-7.69 (3H, m), 7.65-7.60 (3H, m), 7.56 (1H, d, *J* = 12.0 Hz), 7.47-7.43 (1H, t). IR (cm⁻¹): 3482, 3396, 3320, 3208, 2210, 1648, 1621, 1597, 0569. HRMS (ESI): *m/z* calcd. For C₂₁H₁₂Cl₂N₅, 404.0470; found, 404.0403.

6t. 5-amino-2-(Pyridine-4-yl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.15 g (35%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 9.59 (1H, d, *J* = 1.2 Hz), 8.77-8.76 (2H, m), 8.64 (1H, d, *J* = 8.0 Hz), 8.49 (1H, d), 7.73-7.64 (1H, m), 7.63-7.61 (2H, m), 7.57 (1H, s), 7.54 (2H, m). HRMS (ESI): *m/z* calcd. for C₂₀H₁₂N₆, 343.0654; found, 343.0657.

6u. 5-amino-2-(Thiophene-2-yl)-3H-quinolino[4,3,2-de][1,6]naphthyridine-4-carbonitrile

Yellow crystal, m.p. > 300 °C, 0.13 g (33%). ¹H NMR (400 MHz, DMSO-*d*₆): δ 8.62 (1H, d, *J* = 8.0 Hz), 8.28 (2H, t, *J* = 4.0 Hz), 8.24 (1H, d, *J* = 12.0 Hz), 7.65-7.59 (2H, m), 7.53 (1H, d, *J* = 8.0 Hz), 7.40-7.32 (2H, m), 6.97(1H, s). HRMS (ESI): *m/z* calcd. For C₁₉H₁₁N₅S, 342.0813; found, 343.0856.

Figure. 1 The fluorescence of compound **4** under 360 nm (**4a** to **4bb**, left to right).

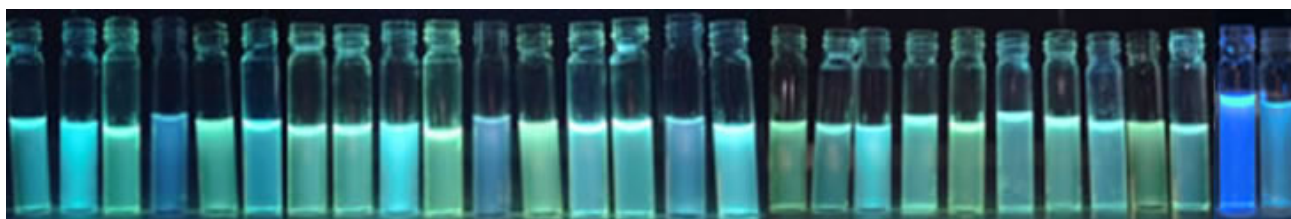


Figure. 2 The fluorescence of compound **6** under 360 nm (**6a** to **6u**, left to right).

