

Supporting Information

Selective Access to Dipyrazolo-Fused Pyridines via Formal [3+2+1] Heteroannulation of Methyl Ketones with Pyrazol-5-Amines

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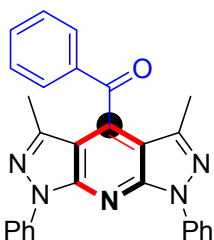
1. General

All substrates and reagents were commercially available and used without further purification. TLC analysis was performed using pre-coated glass plates. Column chromatography was performed using silica gel (200–300 mesh). IR spectra were recorded on a Perkin-Elmer PE-983 infrared spectrometer as KBr pellets with absorption in cm^{-1} . ^1H spectra were recorded in CDCl_3 / $\text{DMSO-}d_6$ on 600 MHz NMR spectrometers and resonances (δ) are given in parts per million relative to tetramethylsilane. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet), coupling constants (Hz) and integration. ^{13}C spectra were recorded in CDCl_3 / $\text{DMSO-}d_6$ on 150 MHz NMR spectrometers and resonances (δ) are given in ppm. HRMS were obtained on a Bruker 7-tesla FT-ICR MS equipped with an electrospray source. The X-ray crystal-structure determinations of **3a** were obtained on a Bruker SMART APEX CCD system. Melting points were determined using XT-4 apparatus and not corrected.

2. General procedure for the synthesis of **3** (**3a** as an example)

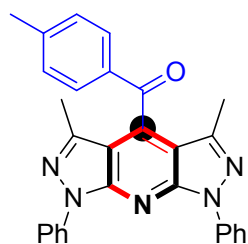
A mixture of acetophenone **1a** (0.5 mmol), 3-methyl-1-phenyl-1*H*-pyrazol-5-amine **2a** (1.0 mmol), iodine (0.75 mmol), and $\text{Cu}(\text{OTf})_2$ (0.25 mmol) in DMSO (2 mL) was stirred at 120 °C. After disappearance of the reactant (monitored by TLC), and added 50 mL water to the mixture, then extracted with EtOAc 3 times (3×50 mL). The extract was washed with 10% $\text{Na}_2\text{S}_2\text{O}_3$ solution (w/w), dried over anhydrous Na_2SO_4 and evaporation. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/EtOAc) to afford the product **3a** as a yellow solid (164 mg, 74% yield).

3. Characterization data for compounds **3**



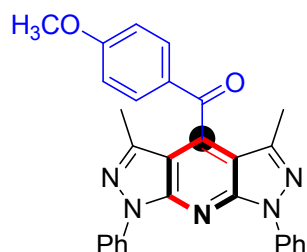
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(phenyl)methanone (**3a**):

Yield 74% (164 mg); yellow solid; mp 212–214 °C; IR (KBr): 3448, 1670, 1595, 1497, 1377, 1226, 750, 686 cm^{-1} ; ^1H NMR (600 MHz, CDCl_3): δ (ppm) 8.39 (d, $J = 8.4$ Hz, 5H), 7.70 (t, $J = 7.2$ Hz, 1H), 7.55 (t, $J = 7.8$ Hz, 7H), 7.34–7.29 (m, 2H), 2.30 (s, 1H); ^{13}C NMR (150 MHz, $\text{DMSO-}d_6$) δ (ppm) 193.5, 150.1, 142.9, 138.8, 137.4, 137.0, 135.9, 135.8, 129.8, 129.3, 125.7, 120.1, 111.0, 13.9; HRMS (ESI): m/z [$\text{M} + \text{Na}$] $^+$ calcd for $\text{C}_{28}\text{H}_{21}\text{N}_5\text{NaO}$: 466.1638; found: 466.1635.



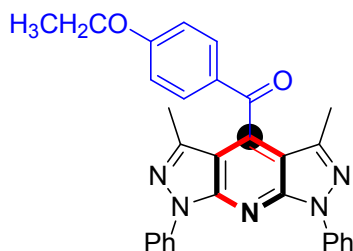
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(*p*-tolyl)methanone (3b):

Yield 65% (148.6 mg); yellow solid; mp 230–233 °C; IR (KBr): 3447, 1670, 1598, 1575, 1496, 1376, 1233, 750, 687 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.39 (d, *J* = 7.8 Hz, 5H), 7.55 (t, *J* = 7.8 Hz, 5H), 7.31 (t, *J* = 7.2 Hz, 4H), 2.46 (s, 3H), 2.31 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 193.4, 150.5, 146.5, 143.4, 139.4, 137.2, 134.1, 130.0, 129.0, 125.4, 120.4, 120.3, 111.4, 22.0, 14.3; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₉H₂₄N₅O: 458.1975; found: 458.1966.



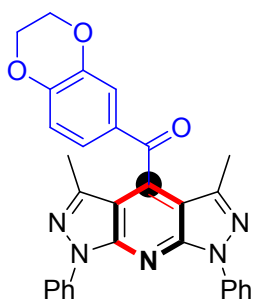
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(4-methoxyphenyl)methanone (3c):

Yield 77% (182.3 mg); yellow solid; mp 203–205 °C; IR (KBr): 3448, 1658, 1593, 1499, 1267, 1235, 1167, 754, 620 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.39 (d, *J* = 8.4 Hz, 5H), 7.55 (t, *J* = 7.8 Hz, 5H), 7.33–7.29 (m, 3H), 7.26 (s, 1H), 3.90 (s, 3H), 2.33 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 192.0, 165.0, 150.6, 143.4, 139.4, 137.3, 129.7, 129.0, 125.4, 120.4, 120.3 (x 2), 111.4, 55.7, 14.2; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₉H₂₄N₅O₂: 474.1925; found: 474.1921.



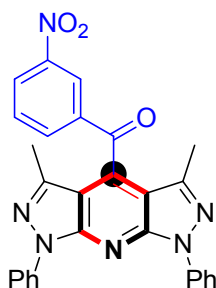
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(4-ethoxyphenyl)methanone (3d):

Yield 53% (129.2 mg); yellow solid; mp 214–217 °C; IR (KBr): 3451, 1663, 1599, 1575, 1500, 1259, 1234, 752, 687 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.39 (d, *J* = 8.4 Hz, 5H), 7.55 (t, *J* = 7.8 Hz, 5H), 7.34–7.29 (m, 3H), 7.26 (s, 1H), 4.13 (q, *J* = 7.2 Hz, 2H), 2.33 (s, 6H), 1.46 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 192.0, 164.5, 150.6, 143.5, 139.4, 137.4, 129.5, 129.0, 125.4, 120.4, 120.3, 111.4, 64.1, 14.6, 14.2; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₃₀H₂₆N₅O₂: 488.2081; found: 488.2088.



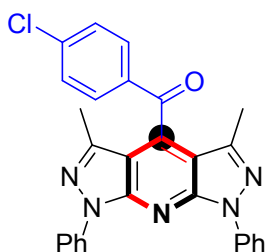
(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3e):

Yield 60% (150.4 mg); yellow solid; mp 255–257 °C; IR (KBr): 3452, 1660, 1598, 1501, 1433, 1293, 1064, 750, 687 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.38 (d, *J* = 7.8 Hz, 5H), 7.55 (t, *J* = 7.8 Hz, 5H), 7.33–7.28 (m, 3H), 4.35 (s, 2H), 4.29 (s, 2H), 2.34 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 192.1, 150.5, 149.8, 143.4, 139.4, 137.2, 130.4, 129.0, 125.4, 120.4, 111.3, 64.8, 64.0, 14.3; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₃₀H₂₄N₅O₃: 502.1874; found: 502.1870.



(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(3-nitrophenyl)methanone (3f):

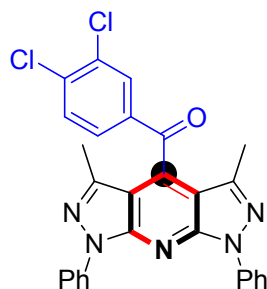
Yield 79% (193 mg); yellow solid; mp 244–246 °C; IR (KBr): 3448, 1687, 1596, 1499, 1382, 751, 685 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.56 (d, *J* = 9.0 Hz, 1H), 8.37 (d, *J* = 8.4 Hz, 5H), 7.58–7.54 (m, 5H), 7.33 (t, *J* = 7.2 Hz, 3H), 2.29 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 191.9, 150.5, 148.9, 142.5, 139.1, 137.7, 134.6, 130.8, 129.1, 125.7, 120.5, 111.1, 14.5; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₈H₂₁N₆O₃: 489.1670; found: 489.1666.



(4-chlorophenyl)(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3g):

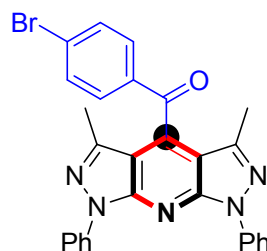
Yield 75% (179.2 mg); yellow solid; mp 218–221 °C; IR (KBr): 3445, 1675, 1583, 1502, 1230, 750, 686 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.38 (d, *J* = 7.2 Hz, 5H), 7.55 (t, *J* = 7.8 Hz, 6H), 7.34–7.30 (m, 3H), 2.31 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 192.6,

150.5, 143.0, 141.9, 139.3, 136.0, 134.8, 129.0, 125.6, 120.4, 120.4, 120.4, 111.2, 14.3; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{28}H_{21}ClN_5O$: 478.1429; found: 478.1425.



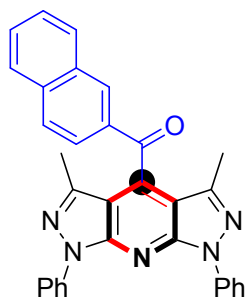
(3,4-dichlorophenyl)(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3h):

Yield 70% (179.2 mg); yellow solid; mp 246–248 °C; IR (KBr): 3447, 1671, 1595, 1574, 1493, 1377, 1214, 754, 688 cm^{-1} ; 1H NMR (600 MHz, $CDCl_3$): δ (ppm) 8.38 (d, $J = 7.8$ Hz, 5H), 7.56 (t, $J = 7.8$ Hz, 5H), 7.35–7.30 (m, 3H), 2.32 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ (ppm) 191.7, 150.5, 142.8, 140.1, 139.2, 135.9, 135.1, 131.5, 129.2, 129.0, 125.6, 120.9, 120.4, 111.1, 14.4; HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{28}H_{20}Cl_2N_5O$: 512.1039; found: 512.1052.



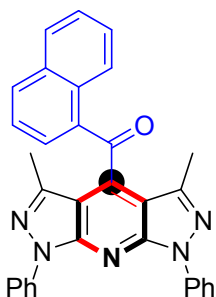
(4-bromophenyl)(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3i):

Yield 67% (175 mg); yellow solid; mp 209–211 °C; IR (KBr): 3448, 1680, 1580, 1498, 1378, 1225, 753, 688 cm^{-1} ; 1H NMR (600 MHz, $CDCl_3$): δ (ppm) 8.37 (d, $J = 7.8$ Hz, 5H), 7.57–7.53 (m, 6H), 7.31 (t, $J = 7.2$ Hz, 3H), 2.30 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ (ppm) 192.9, 150.5, 143.0, 139.3, 136.0, 135.2, 132.8, 130.9, 129.0, 129.0, 125.6, 120.4, 111.2, 14.3; HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{28}H_{20}BrN_5NaO$: 544.0743; found: 544.0739.



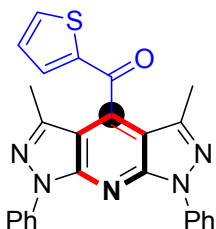
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(naphthalen-2-yl)methanone (3j):

Yield 80% (197.4 mg); yellow solid; mp 246–248 °C; IR (KBr): 3449, 1662, 1575, 1496, 1434, 1380, 1328, 1104, 759, 688 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.42 (d, *J* = 7.8 Hz, 5H), 7.94 (d, *J* = 8.4 Hz, 2H), 7.69–7.65 (m, 2H), 7.60–7.53 (m, 6H), 7.35–7.30 (m, 2H), 2.30 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 193.8, 150.6, 143.4, 139.4, 137.0, 136.4, 134.0, 132.3, 130.0, 129.8, 129.5, 129.0, 128.0, 127.4, 125.5, 120.4, 111.5, 14.4; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₃₂H₂₄N₅O: 494.1975; found: 494.1979.



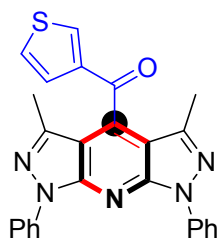
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(naphthalen-1-yl)methanone (3k):

Yield 81% (199.8 mg); yellow solid; mp 295–297 °C; IR (KBr): 3448, 1667, 1594, 1495, 1435, 1377, 1330, 1233, 751, 685 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 9.53 (d, *J* = 8.4 Hz, 1H), 8.40 (d, *J* = 7.8 Hz, 4H), 8.17 (d, *J* = 7.8 Hz, 1H), 8.02 (d, *J* = 8.4 Hz, 1H), 7.87 (t, *J* = 7.8 Hz, 1H), 7.74–7.68 (m, 2H), 7.56 (t, *J* = 7.8 Hz, 4H), 7.41 (t, *J* = 7.8 Hz, 1H), 7.35–7.30 (m, 2H), 2.28 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 195.4, 150.7, 143.5, 139.4, 138.3, 136.4, 135.9, 134.1, 132.1, 130.5, 130.0, 129.0, 127.3, 126.0, 125.4, 124.5, 120.4, 111.5, 14.5; HRMS (ESI): *m/z* [M + Na]⁺ calcd for C₃₂H₂₄N₅O: 494.1975; found: 494.1967.



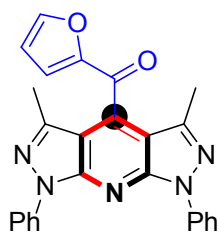
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(thiophen-2-yl)methanone (3l):

Yield 78% (175.3 mg); brown solid; mp 207–209 °C; IR (KBr): 3450, 1653, 1583, 1498, 1409, 1328, 1235, 752, 684 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.37 (d, *J* = 7.8 Hz, 5H), 7.57–7.50 (m, 5H), 7.29 (t, *J* = 7.2 Hz, 3H), 2.39 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 185.3, 150.5, 143.7, 143.2, 139.3, 137.3, 135.8, 129.0, 125.4, 120.3, 111.1, 14.2; HRMS (ESI): *m/z* [M + Na]⁺ calcd for C₂₆H₁₉N₅NaOS: 472.1203; found: 472.1193.



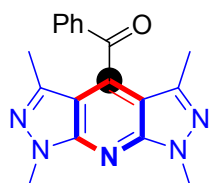
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(thiophen-3-yl)methanone (3m):

Yield 46% (103.4 mg); brown solid; mp 197–199 °C; IR (KBr): 3448, 1667, 1595, 1499, 1460, 1429, 1377, 1328, 1235, 897, 752, 686 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.38 (d, *J* = 7.8 Hz, 5H), 7.57–7.53 (m, 5H), 7.32 (t, *J* = 7.2 Hz, 3H), 2.36 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 187.0, 150.6, 143.2, 142.3, 139.3, 136.9, 129.0, 128.0, 126.7, 126.6, 125.5, 120.3, 111.0, 14.3; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₆H₁₉N₅NaOS: 472.1203; found: 472.1202.



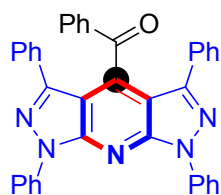
(3,5-dimethyl-1,7-diphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)(furan-2-yl)methanone (3n):

Yield 82% (177.4 mg); yellow solid; mp 225–228 °C; IR (KBr): 3447, 1655, 1597, 1501, 1456, 1378, 1328, 776, 750 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 8.37 (d, *J* = 8.4 Hz, 5H), 7.54 (t, *J* = 7.8 Hz, 5H), 7.32–7.27 (m, 3H), 2.39 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 180.1, 152.2, 150.5, 149.2, 143.1, 139.3, 134.9, 129.0, 125.4, 120.4, 120.3, 113.3, 111.3, 14.3; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₆H₂₀N₅O₂: 434.1612; found: 434.1594.



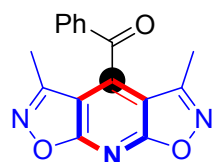
phenyl(1,3,5,7-tetramethyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3o):

Yield 47% (75 mg); yellow solid; mp 175–177 °C; IR (KBr): 3445, 2922, 1666, 1593, 1452, 1320, 1229, 1038, 741, 674, 605 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 7.66 (t, *J* = 7.2 Hz, 2H), 7.51–7.46 (m, 2H), 7.28 (s, 1H), 4.10 (s, 6H), 2.19 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 194.5, 151.9, 141.0, 136.5, 136.2, 134.8, 129.1, 109.4, 33.5, 14.1; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₈H₁₈N₅O: 320.1506; found: 320.1500.



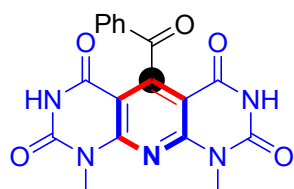
phenyl(1,3,5,7-tetraphenyl-1,7-dihydrodipyrzolo[3,4-*b*:4',3'-*e*]pyridin-4-yl)methanone (3p):

Yield 32% (90.8 mg); yellow solid; mp 259–262 °C; IR (KBr): 3445, 1672, 1595, 1423, 1345, 1117, 754, 689 cm^{-1} ; ^1H NMR (600 MHz, CDCl_3): δ (ppm) 8.51 (d, $J = 8.4$ Hz, 4H), 7.60 (t, $J = 7.8$ Hz, 4H), 7.41–7.35 (m, 3H), 7.33 (d, $J = 7.2$ Hz, 2H), 7.30 (d, $J = 7.2$ Hz, 4H), 7.23 (t, $J = 7.2$ Hz, 2H), 7.17–7.11 (m, 6H); ^{13}C NMR (150 MHz, CDCl_3) δ (ppm) 192.7, 150.5, 147.1, 139.3, 137.7, 136.7, 133.9, 131.8, 129.4, 129.3, 129.1, 128.8, 128.2, 128.0, 126.0, 120.9, 111.5; HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{38}\text{H}_{26}\text{N}_5\text{O}$: 568.2132; found: 568.2136.



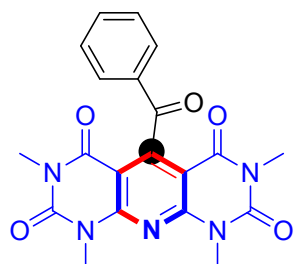
(3,5-dimethyldiisoxazolo[5,4-*b*:4',5'-*e*]pyridin-4-yl)(phenyl)methanone (3q):

Yield 30% (44 mg); yellow solid; mp 165–168 °C; IR (KBr): 3448, 1669, 1593, 1431, 1357, 1286, 1241, 848, 680 cm^{-1} ; ^1H NMR (600 MHz, CDCl_3): δ (ppm) 7.81–7.76 (m, 2H), 7.59 (d, $J = 7.2$ Hz, 2H), 7.28 (s, 1H), 2.22 (s, 6H); ^{13}C NMR (150 MHz, CDCl_3) δ (ppm) 190.7, 170.1, 155.4, 140.1, 136.0, 135.4, 129.7, 109.0, 12.0; HRMS (ESI): m/z $[\text{M} + \text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{12}\text{N}_3\text{O}_3$: 294.0873; found: 294.0875.



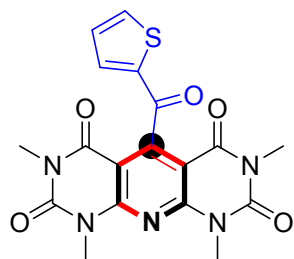
5-benzoyl-1,9-dimethylpyrido[2,3-*d*:6,5-*d'*]dipyrimidine-2,4,6,8(1*H*,3*H*,7*H*,9*H*)-tetraone (3r):

Yield 58% (109.9 mg); white solid; mp >300 °C; IR (KBr): 3444, 1568, 1123, 615 cm^{-1} ; ^1H NMR (600 MHz, $\text{DMSO-}d_6$): δ (ppm) 11.72 (s, 2H), 7.71 (d, $J = 7.2$ Hz, 2H), 7.56 (t, $J = 6.6$ Hz, 1H), 7.47–7.44 (m, 2H), 3.55 (s, 6H); ^{13}C NMR (150 MHz, $\text{DMSO-}d_6$) δ (ppm) 193.1, 159.8, 155.3, 153.8, 150.9, 136.7, 133.3, 128.9, 128.3, 105.0, 29.6; HRMS (ESI): m/z $[\text{M} + \text{Na}]^+$ calcd for $\text{C}_{24}\text{H}_{20}\text{N}_6\text{O}_4$: 402.0809; found: 402.0799.



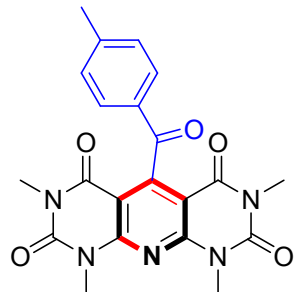
5-benzoyl-1,3,7,9-tetramethylpyrido[2,3-*d*:6,5-*d'*]dipyrimidine-2,4,6,8(1*H*,3*H*,7*H*,9*H*)-tetraone (3s):

Yield 72% (146.6 mg); white solid; mp >300 °C; IR (KBr): 3433, 1714, 1668, 1577, 1427, 1378, 750, 684 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 7.82 (d, *J* = 7.2 Hz, 2H), 7.59–7.54 (m, 1H), 7.48–7.43 (m, 2H), 3.79 (s, 6H), 3.33 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 193.1, 158.8, 155.8, 153.6, 150.6, 136.0, 133.2, 128.7, 127.6, 104.6, 30.4, 28.5; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₀H₁₈N₅O₅: 408.1302; found: 408.1300.



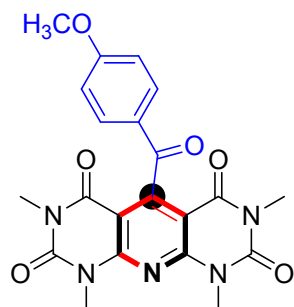
1,3,7,9-tetramethyl-5-(thiophene-2-carbonyl)pyrido[2,3-*d*:6,5-*d'*]dipyrimidine-2,4,6,8(1*H*,3*H*,7*H*,9*H*)-tetraone (3t):

Yield 61% (126.1 mg); green solid; mp >300 °C; IR (KBr): 3435, 1714, 1680, 1569, 1422, 1372, 1274, 1061, 753 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 7.10 (d, *J* = 3.6 Hz, 2H), 6.82 (d, *J* = 3.6 Hz, 2H), 3.78 (s, 6H), 3.36 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 183.5, 158.5, 154.1, 153.6, 150.6, 150.5, 141.5, 132.3, 126.2, 104.2, 30.4, 28.6; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₁₈H₁₆N₅O₅S: 414.0867; found: 414.0851.



1,3,7,9-tetramethyl-5-(3-methylbenzoyl)pyrido[2,3-*d*:6,5-*d'*]dipyrimidine-2,4,6,8(1*H*,3*H*,7*H*,9*H*)-tetraone (3u):

Yield 71% (149.6 mg); white solid; mp >300 °C; IR (KBr): 3441, 1718, 1671, 1567, 1457, 1424, 1374, 1265, 750 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 7.71 (d, *J* = 7.2 Hz, 2H), 7.25 (d, *J* = 7.8 Hz, 2H), 3.78 (s, 6H), 3.32 (s, 6H), 2.39 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 192.8, 158.8, 156.2, 153.6, 150.7, 144.1, 133.8, 129.5, 127.7, 104.6, 30.4, 28.6, 21.8; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₁H₂₀N₅O₅: 422.1459; found: 422.1465.



5-(3-methoxybenzoyl)-1,3,7,9-tetramethylpyrido[2,3-*d*:6,5-*d'*]dipyrimidine-2,4,6,8(1*H*,3*H*,7*H*,9*H*)-tetraone (3v):

Yield 75% (164 mg); white solid; mp >300 °C; IR (KBr): 3440, 1721, 1672, 1569, 1456, 1424, 1376, 1260, 1145, 715 cm⁻¹; ¹H NMR (600 MHz, CDCl₃): δ (ppm) 7.78 (br, 2H), 6.93 (d, *J* = 8.4 Hz, 2H), 3.84 (s, 3H), 3.78 (s, 6H), 3.33 (s, 6H); ¹³C NMR (150 MHz, CDCl₃) δ (ppm) 191.8, 163.5, 158.7, 156.1, 153.6, 150.7, 129.8, 129.4, 114.1, 104.5, 55.4, 30.4, 28.5; HRMS (ESI): *m/z* [M + H]⁺ calcd for C₂₁H₂₀N₅O₆: 438.1408; found: 438.1412.

4. Crystallographic data and molecular structure of compounds 3a

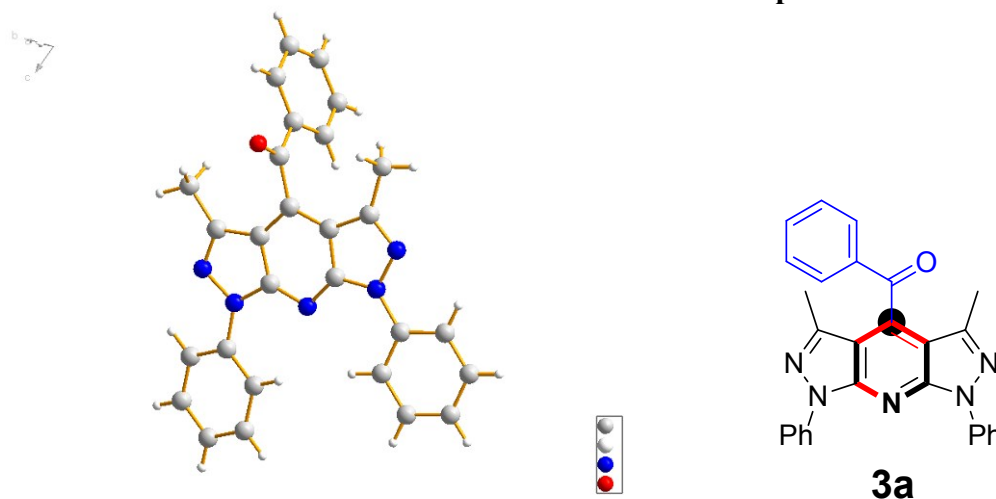


Figure S1. X-ray crystal structure of **3a**

Crystal Data for Compound **3a**: C₂₈H₂₁N₅O, MW = 443.50, Triclinic, *a* = 7.483(2) Å, *b* = 12.280(4) Å, *c* = 13.156(4) Å, α = 73.055(4)°, β = 75.131(5)°, γ = 76.779(5)°, *V* = 1102.2(6) Å³, *T* = 296(2) K, space group P-1, *Z* = 2, *m*(Mo-Kα) = 0.084 mm⁻¹, 10907 Reflections collected, 5863 unique [*R*(int) = 0.0993] which were used in all calculations. The final *wR*₂ (*F*₂) was 0.1352. CCDC 1498632 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

5. ^1H and ^{13}C NMR spectra of compounds 3

