

Supporting Information

Visible light mediated photocatalytic aerobic oxidative synthesis of pyrazolo[4,3-*d*]pyrimidin-7(6*H*)-ones and sildenafil

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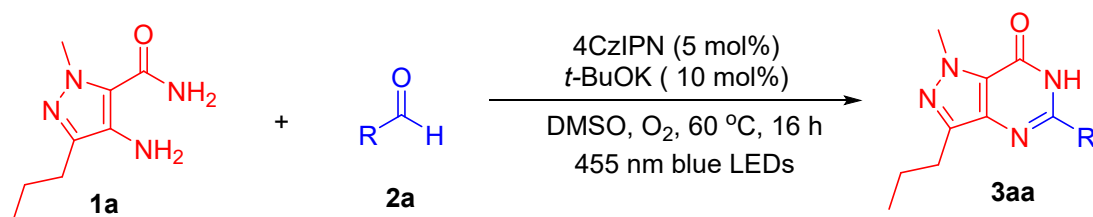
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1. General Information

All reagents were purchased from commercial suppliers (Energy Chemical) without further purification. Column chromatography was carried out over 200-300 mesh silica gel. The ^1H and ^{13}C NMR spectra were recorded on a Bruker Avance III 400 MHz spectrometer with deuterated dimethyl sulfoxide (DMSO-d_6) or CDCl_3 as the solvent and tetramethylsilane (TMS) as an internal standard at room temperature. Chemical shifts are given in δ relative to TMS, and the coupling constants J are given in hertz. High-resolution mass spectra (HRMS) were obtained on an Agilent mass spectrometer using ESI-TOF (electrospray ionization-time of flight). Melting points were determined using an electrothermal capillary melting point apparatus.

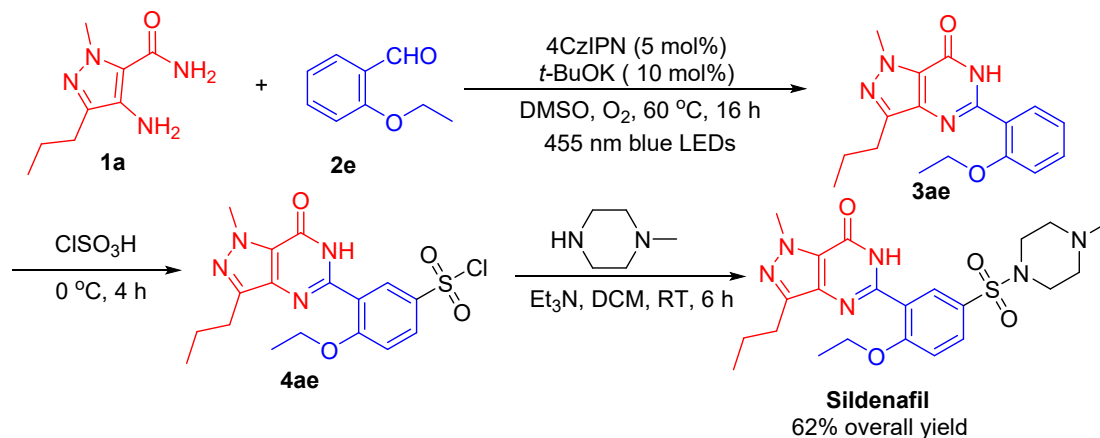
2. General Procedure

(a) General procedure for the synthesis of pyrazolo[4,3-d]pyrimidin-7(6H)-ones



To a mixture of 4-amino-1-methyl-3-propyl-1H-pyrazole-5-carboxamide (1a) (0.5 mmol), aldehydes **2** (0.6 mmol), 4CzIPN (5 mol%), *t*-BuOK (10 mol%) and DMSO (2 mL) were added in a 10 mL Schlenk tube. Then the mixture was stirred under blue light irradiation (455 nm) at 60 °C for 16 h with O_2 balloon. The progress of the reaction was monitored by TLC. After completion of the reaction, the solution was diluted with ethyl acetate, washed with water, and then the organic layer was separated and dried over anhydrous MgSO_4 . The solvent was concentrated under reduced pressure and the crude product was purified by column chromatography on silica gel using hexane/ethyl acetate (8:1 to 2:1 gradually) as eluent to afford pure products **3**. The desired products were fully characterized by ^1H NMR and ^{13}C NMR spectroscopies.

(f) Typical procedure for the synthesis of Sildenafil



(1) Gram-scale synthesis of 3ae

To a mixture of **1a** (5 mmol), **2e** (6 mmol), 4CzIPN (5 mol%), *t*-BuOK (10 mol%) and DMSO (10 mL) were added in a 50 mL Schlenk tube. Then the mixture was stirred under blue light irradiation (455 nm) at 60 °C for 16 h with O₂ balloon. The progress of the reaction was monitored by TLC. After completion of the reaction, the solution was diluted with ethyl acetate, washed with water, and then the organic layer was separated and dried over anhydrous MgSO₄. The solvent was concentrated under reduced pressure and the crude product was purified by recrystallization to afford pure products **3ae** (1.25 g, 80%).

(2) Typical procedure for the synthesis of 4ae

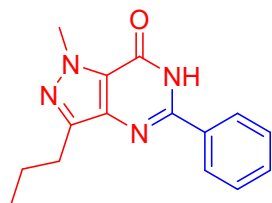
Following a literature procedure, **3ae** (5 mmol, 1.56 g) was added portion wise to chlorosulphonic acid (20 mL) at 0 °C. Then, the reaction mixture was allowed to stir at room temperature for 4 h. The reaction mixture was poured to crushed ice. A white precipitate formed, which was filtered, washed with cold water and dried it under pressure to give **4ae** as a white solid (1.83 g, 89%).

(3) Typical procedure for the synthesis of Sildenafil

To a solution of **4ae** (5 mmol, 2.1 g), *N*-methylpiperazine (6 mmol, 0.6 g), triethylamine (10 mmol, 1.0 g), 25 mL DCM were added in 100 mL Schlenk tube. Then the mixture was stirred at room temperature for 6 h. After the completion of reaction, DCM was concentrated under reduced pressure and the residue was washed with cold water. The

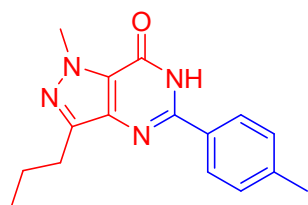
resulting precipitate was filtered, washed with cold water, dried under reduced pressure and recrystallized from ethanol to afford Sildenafil as white solid (2.06 g, 87%).

3. Spectra data



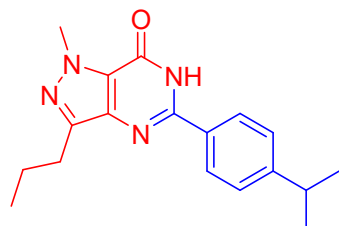
5-Phenyl-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]-pyrimidin-7-one

(3aa)¹: Light yellow solid, 82% yield. ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.43 (s, 1H), 8.07 (d, *J* = 5.6 Hz, 2H), 7.53 (s, 3H), 4.15 (s, 3H), 2.80 (t, *J* = 7.0 Hz, 2H), 1.77 (dd, *J* = 14.1, 7.0 Hz, 2H), 0.95 (t, *J* = 7.0 Hz, 3H). ¹³C NMR (101 MHz, DMSO) δ 155.12, 150.56, 145.42, 138.33, 133.35, 131.12, 128.99, 127.98, 124.80, 38.31, 27.64, 22.16, 14.35.



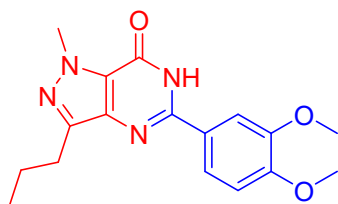
5-(4-Methylphenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-]pyrimidin-7-one

(3ab)²: Light yellow solid, 84% yield. ¹H NMR (400 MHz, DMSO) δ 12.35 (s, 1H), 7.98 (d, *J* = 8.2 Hz, 2H), 7.32 (d, *J* = 8.2 Hz, 2H), 4.15 (s, 3H), 2.80 (t, *J* = 7.5 Hz, 2H), 2.38 (s, 3H), 1.84 – 1.70 (m, 2H), 0.95 (t, *J* = 7.4 Hz, 3H). ¹³C NMR (101 MHz, DMSO) δ 155.14, 150.56, 145.32, 141.02, 138.40, 130.57, 129.57, 127.88, 124.74, 38.31, 27.63, 22.15, 21.39, 14.35.



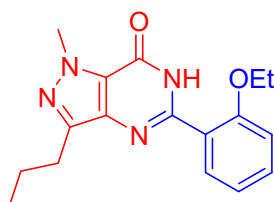
5-(4-Isopropylphenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]

pyrimidin-7-one (3ac): Light yellow solid, 85% yield. ^1H NMR (400 MHz, DMSO) δ 12.35 (s, 1H), 8.00 (d, $J = 8.3$ Hz, 2H), 7.37 (d, $J = 8.3$ Hz, 2H), 4.15 (s, 3H), 2.95 (hept, $J = 6.9$ Hz, 1H), 2.79 (t, $J = 7.5$ Hz, 2H), 1.82 – 1.71 (m, 2H), 1.23 (d, $J = 6.9$ Hz, 6H), 0.95 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 155.13, 151.70, 150.56, 145.31, 138.41, 131.01, 128.02, 126.91, 124.71, 38.29, 33.78, 27.64, 24.09, 22.13, 14.34. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{18}\text{H}_{22}\text{N}_4\text{O}$: 310.1816, found: 310.1814.



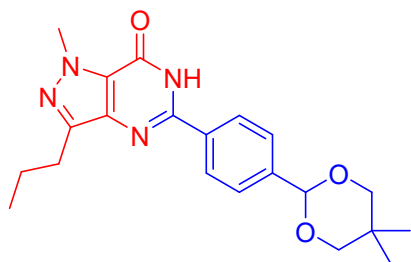
5-(3,4-Dimethoxyphenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]

pyrimidin-7-one (3ad)³: White solid, 90% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.27 (s, 1H), 7.77 – 7.64 (m, 2H), 7.06 (d, $J = 8.5$ Hz, 1H), 4.14 (s, 3H), 3.84 (d, $J = 15.4$ Hz, 6H), 2.79 (t, $J = 7.5$ Hz, 2H), 1.84 – 1.70 (m, 2H), 0.95 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 155.25, 151.32, 150.27, 148.84, 145.13, 138.47, 125.60, 124.53, 121.08, 111.80, 111.00, 56.04, 38.26, 27.61, 22.07, 14.35.

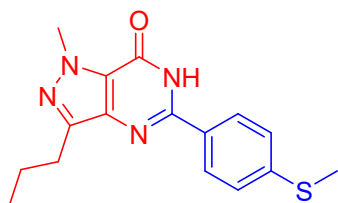


5-(2-Ethoxyphenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin

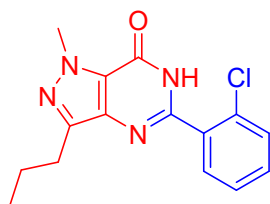
-7-one (3ae)⁴: White solid, 83% yield. ^1H NMR (400 MHz, CDCl_3) δ 11.13 (s, 1H), 8.46 (dd, $J = 7.9, 1.6$ Hz, 1H), 7.44 (t, $J = 8.7$ Hz, 1H), 7.13 (t, $J = 7.6$ Hz, 1H), 7.02 (d, $J = 8.3$ Hz, 1H), 4.35 – 4.22 (m, 5H), 3.00 – 2.85 (m, 2H), 1.94 – 1.82 (m, 2H), 1.59 (t, $J = 7.0$ Hz, 3H), 1.03 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3) δ 156.47, 153.93, 148.38, 146.61, 138.71, 132.36, 131.03, 124.44, 121.81, 120.19, 112.88, 65.26, 38.16, 27.81, 22.39, 14.71, 14.08.



5-(5,5-Dimethyl-1,3-dioxan-2-yl-phenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo [4,3-*d*] pyrimidin-7-one (3af): White solid, 87% yield. ^1H NMR (400 MHz, DMSO) δ 12.46 (s, 1H), 8.06 (d, $J = 7.7$ Hz, 2H), 7.55 (d, $J = 7.7$ Hz, 2H), 5.48 (s, 1H), 4.15 (s, 3H), 3.70 (d, $J = 10.7$ Hz, 2H), 3.65 (d, $J = 10.6$ Hz, 2H), 2.80 (t, $J = 7.1$ Hz, 2H), 1.77 (dd, $J = 14.3, 7.1$ Hz, 2H), 1.20 (s, 3H), 0.95 (t, $J = 7.3$ Hz, 3H), 0.76 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 155.09, 150.27, 145.45, 141.33, 138.29, 133.57, 127.80, 126.74, 124.82, 100.64, 77.02, 38.30, 30.32, 27.61, 23.19, 22.12, 21.84, 14.33. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{21}\text{H}_{26}\text{N}_4\text{O}_3$: 382.4615, found: 382.2085.

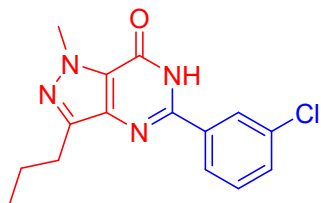


5-(4-Methylthiophenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*] pyrimidin-7-one (3ag): Light yellow solid, 80% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.36 (s, 1H), 8.03 (d, $J = 7.2$ Hz, 2H), 7.36 (d, $J = 6.9$ Hz, 2H), 4.15 (s, 3H), 2.90 – 2.71 (m, 2H), 1.77 (d, $J = 6.9$ Hz, 2H), 1.04 – 0.84 (m, 3H). ^{13}C NMR (101 MHz, DMSO) δ 155.10, 150.07, 145.31, 142.39, 138.35, 129.41, 128.25, 125.59, 124.70, 38.28, 27.64, 22.12, 14.63, 14.34. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{18}\text{N}_4\text{OS}$: 314.4125, found: 314.4122.

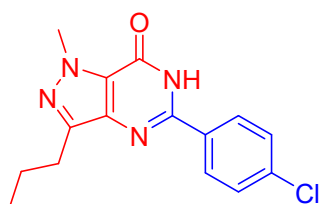


5-(2-Chlorophenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3ah)⁵: Light yellow solid, 75% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.58

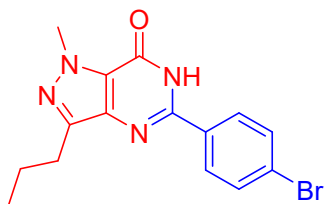
(s, 1H), 7.60 (dd, $J = 7.8, 2.1$ Hz, 2H), 7.55 (t, $J = 7.6$ Hz, 1H), 7.47 (t, $J = 7.3$ Hz, 1H), 4.17 (s, 3H), 2.75 (t, $J = 7.5$ Hz, 2H), 1.78 – 1.65 (m, 2H), 0.92 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.49, 149.83, 145.40, 137.99, 134.26, 132.27, 131.87, 131.58, 130.02, 127.62, 124.95, 38.35, 27.60, 22.26, 14.29.



5-(3-Chlorophenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin-7-one (3ai)²: Light yellow solid, 78% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.50 (s, 1H), 8.12 (s, 1H), 8.04 (d, $J = 7.7$ Hz, 1H), 7.61 (d, $J = 8.6$ Hz, 1H), 7.55 (t, $J = 7.9$ Hz, 1H), 4.16 (s, 3H), 2.80 (t, $J = 7.5$ Hz, 2H), 1.83 – 1.68 (m, 2H), 0.95 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.94, 149.13, 145.58, 138.05, 135.30, 133.80, 130.91, 127.69, 126.66, 124.91, 38.33, 27.58, 22.14, 14.33.

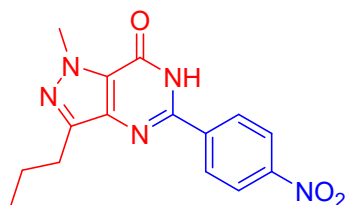


5-(4-Chlorophenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin-7-one (3aj)³: Light yellow solid, 80% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.47 (s, 1H), 8.08 (d, $J = 8.6$ Hz, 2H), 7.57 (d, $J = 8.6$ Hz, 2H), 4.15 (s, 3H), 2.79 (t, $J = 7.5$ Hz, 2H), 1.84 – 1.63 (m, 2H), 0.95 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 155.01, 149.47, 145.49, 138.16, 135.98, 132.12, 129.77, 129.03, 124.79, 38.31, 27.62, 22.14, 14.34.

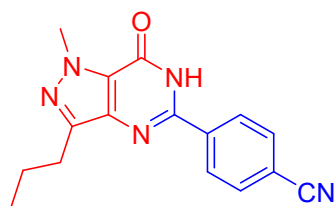


5-(4-Bromophenyl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin-7-one (3ak)²: Light yellow solid, 82% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.47

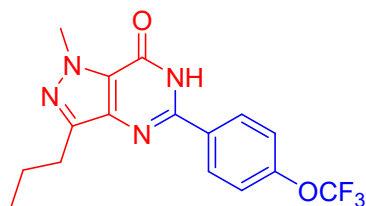
(s, 1H), 8.01 (d, $J = 8.6$ Hz, 2H), 7.71 (d, $J = 8.6$ Hz, 2H), 4.15 (s, 3H), 2.79 (t, $J = 7.5$ Hz, 2H), 1.82 – 1.71 (m, 2H), 0.95 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.99, 149.56, 145.49, 138.15, 132.47, 131.95, 129.96, 124.85, 124.79, 38.31, 27.62, 22.13, 14.35.



1-Methyl-5-(4-nitrophenyl)-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3al)¹: Yellow solid, 76% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.73 (s, 1H), 8.33 (d, $J = 7.2$ Hz, 4H), 4.17 (s, 3H), 2.82 (s, 2H), 1.78 (d, $J = 7.0$ Hz, 2H), 0.96 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.91, 148.97, 148.74, 145.89, 139.10, 138.03, 129.41, 125.03, 124.09, 38.38, 27.62, 22.14, 14.34.

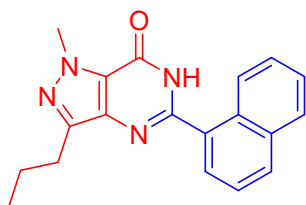


5-(4-Cyano)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3am): Light yellow solid, 81% yield. ^1H NMR (400 MHz, DMSO) δ 12.60 (s, 1H), 8.21 (d, $J = 8.3$ Hz, 2H), 7.96 (d, $J = 8.2$ Hz, 2H), 4.14 (s, 3H), 2.78 (t, $J = 7.4$ Hz, 2H), 1.76 (dd, $J = 14.8, 7.4$ Hz, 2H), 0.94 (t, $J = 7.3$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.87, 148.86, 145.80, 137.99, 137.33, 132.89, 128.72, 124.94, 118.86, 113.35, 38.33, 27.61, 22.11, 14.33. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{16}\text{H}_{15}\text{N}_5\text{O}$: 293.3316, found: 293.1322.

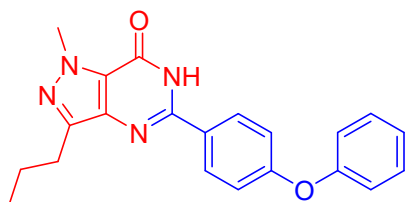


1-Methyl-3-propyl-5-(4-trifluoromethoxyphenyl)-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3an)³: White solid, 84% yield. ^1H NMR (400 MHz, DMSO- d_6) δ

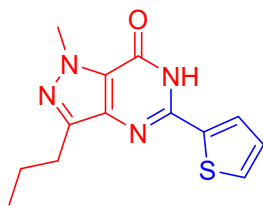
12.54 (s, 1H), 8.18 (d, $J = 5.5$ Hz, 2H), 7.52 (d, $J = 5.4$ Hz, 2H), 4.16 (s, 3H), 2.80 (s, 2H), 1.77 (d, $J = 5.2$ Hz, 2H), 0.95 (s, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.98, 150.35, 150.33, 149.29, 145.51, 138.14, 132.49, 130.18, 124.79, 121.27, 120.47 (dd, $J = 258.0$ Hz), 38.27, 27.61, 22.10, 14.29.



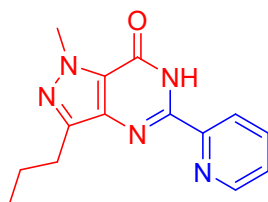
1-Methyl-5-(naphthalen-1-yl)-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3ao): Light yellow solid, 83% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.61 (s, 1H), 8.09 (t, $J = 7.5$ Hz, 2H), 8.04 (dd, $J = 7.1, 2.2$ Hz, 1H), 7.73 (d, $J = 7.1$ Hz, 1H), 7.66 – 7.60 (m, 1H), 7.60 – 7.52 (m, 2H), 4.21 (s, 3H), 2.78 (t, $J = 7.5$ Hz, 2H), 1.81 – 1.67 (m, 2H), 0.94 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.93, 151.31, 145.33, 138.23, 133.59, 132.23, 130.98, 130.51, 128.77, 128.22, 127.41, 126.74, 125.57, 125.50, 125.04, 38.36, 27.65, 22.30, 14.29. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{19}\text{H}_{18}\text{N}_4\text{O}$: 318.3896, found: 318.3890.



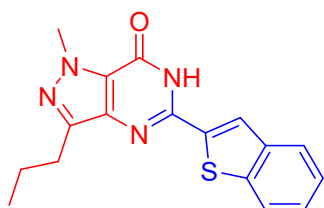
1-Methyl-5-(4-phenoxyphenyl)-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3ap): White solid, 85% yield. ^1H NMR (400 MHz, DMSO- d_6) δ 12.37 (s, 1H), 8.10 (d, $J = 8.8$ Hz, 2H), 7.45 (t, $J = 7.9$ Hz, 2H), 7.22 (t, $J = 7.4$ Hz, 1H), 7.13 – 7.05 (m, 4H), 4.14 (s, 3H), 2.78 (t, $J = 7.5$ Hz, 2H), 1.81 – 1.71 (m, 2H), 0.94 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 159.54, 156.13, 156.10, 155.12, 150.01, 145.31, 138.38, 130.72, 130.00, 128.11, 124.76, 119.93, 118.23, 38.31, 27.64, 22.15, 14.35. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{21}\text{H}_{20}\text{N}_4\text{O}_2$: 360.4265, found: 360.4259.



1-Methyl-3-propyl-5-(2-thienyl)-1,6-dihydro-7H-pyrazolo[4,3-*d*] pyrimidin-7-one (3aq)³: Yellow solid, 70% yield. ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.52 (s, 1H), 8.10 (d, *J* = 3.7 Hz, 1H), 7.76 (d, *J* = 5.0 Hz, 1H), 7.21 – 7.13 (m, 1H), 4.14 (s, 3H), 2.76 (t, *J* = 7.5 Hz, 2H), 1.82 – 1.67 (m, 2H), 0.95 (t, *J* = 7.4 Hz, 3H). ¹³C NMR (101 MHz, DMSO) δ 154.71, 146.07, 145.00, 138.00, 137.90, 131.23, 128.72, 128.69, 124.63, 38.35, 27.61, 21.96, 14.33.

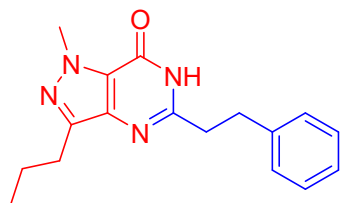


1-Methyl-5-(2-Pyridinyl)-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3ar)⁵: Light yellow solid, 62% yield. ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.67 (s, 1H), 8.71 (d, *J* = 4.7 Hz, 1H), 8.34 (d, *J* = 7.9 Hz, 1H), 8.04 (t, *J* = 8.4 Hz, 1H), 7.65 – 7.55 (m, 1H), 4.16 (s, 3H), 2.83 (t, *J* = 7.5 Hz, 2H), 1.88 – 1.72 (m, 2H), 0.97 (t, *J* = 7.4 Hz, 3H). ¹³C NMR (101 MHz, DMSO) δ 153.66, 149.29, 149.21, 148.21, 145.76, 138.44, 138.04, 126.40, 125.80, 121.97, 38.38, 27.64, 22.13, 14.36.

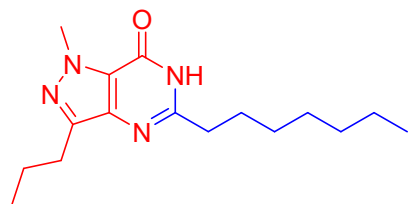


5-(Benzo[b]thiophen-2-yl)-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-*d*]pyrimidin-7-one (3as): Light yellow solid, 86% yield. ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.42 (s, 1H), 8.85 (d, *J* = 8.0 Hz, 1H), 8.64 (s, 1H), 8.08 (d, *J* = 7.9 Hz, 1H), 7.49 (dt, *J* = 22.8, 7.2 Hz, 2H), 4.17 (s, 3H), 2.85 (t, *J* = 7.3 Hz, 2H), 1.82 (dd, *J* = 14.6, 7.3 Hz, 2H), 0.97 (t, *J* = 7.3 Hz, 3H). ¹³C NMR (101 MHz, DMSO) δ 154.99, 146.91, 145.48, 140.13, 137.99, 136.97, 131.42, 128.60, 125.54, 125.48, 125.47, 124.88,

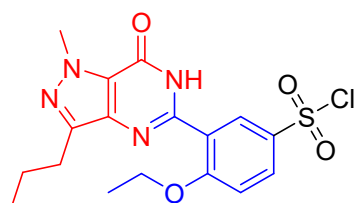
123.35, 38.38, 27.69, 22.12, 14.33. HR-MS (EI): m/z $[M+H]^+$ calcd for $C_{17}H_{16}N_4OS$: 324.4025, found: 324.4020.



1-Methyl-5-(2-phenylethyl)-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin-7-one (3at): Light yellow solid, 60% yield. 1H NMR (400 MHz, $DMSO-d_6$) δ 12.17 (s, 1H), 7.28 – 7.25 (m, 4H), 7.18 (td, J = 6.0, 3.3 Hz, 1H), 4.10 (s, 3H), 3.03 – 2.95 (m, 2H), 2.90 – 2.83 (m, 2H), 2.72 (t, J = 7.5 Hz, 2H), 1.76 – 1.65 (m, 2H), 0.91 (t, J = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, DMSO) δ 154.86, 154.13, 144.57, 141.23, 138.26, 128.85, 128.74, 126.47, 124.72, 38.19, 36.29, 33.31, 27.58, 22.17, 14.28. HR-MS (EI): m/z $[M+H]^+$ calcd for $C_{17}H_{20}N_4O$: 296.3754, found: 296.3750.

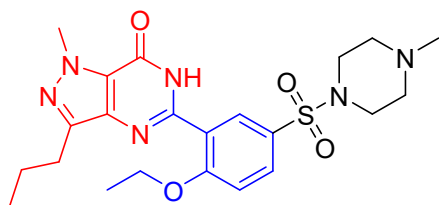


5-Heptyl-1-methyl-3-propyl-1,6-dihydro-7H-pyrazolo[4,3-d]pyrimidin-7-one (3au) ⁶: Light yellow solid, 51% yield. 1H NMR (400 MHz, $DMSO-d_6$) δ 12.07 (s, 1H), 4.10 (s, 3H), 2.71 (t, J = 7.5 Hz, 2H), 2.59 – 2.53 (m, 2H), 1.70 (tt, J = 13.4, 6.8 Hz, 4H), 1.26 (dd, J = 9.2, 5.4 Hz, 8H), 0.91 (t, J = 7.4 Hz, 3H), 0.85 (t, J = 6.8 Hz, 4H). ^{13}C NMR (101 MHz, DMSO) δ 155.08, 154.92, 144.48, 138.37, 124.67, 38.18, 34.36, 31.60, 28.80, 28.79, 27.57, 27.55, 22.49, 22.16, 14.38, 14.26.

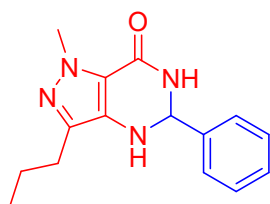


4-Ethoxy-3-(1-methyl-7-oxo-3-propyl-6,7-dihydro-1H-pyrazolo[4,3-d]pyrimidin-5-yl)benzene-1-sulfonyl chloride (4ae) ⁴: White solid, 89% yield. 1H NMR (400 MHz, $CDCl_3$) δ 10.81 (s, 1H), 9.09 (d, J = 2.6 Hz, 1H), 8.11 (dd, J = 8.9, 2.6 Hz, 1H), 7.23

(d, $J = 9.0$ Hz, 1H), 4.44 (q, $J = 7.0$ Hz, 2H), 4.27 (s, 3H), 2.99 – 2.87 (m, 2H), 1.93 – 1.82 (m, 2H), 1.67 (t, $J = 7.0$ Hz, 3H), 1.05 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3) δ 160.86, 153.54, 147.23, 145.66, 138.18, 137.51, 130.99, 130.92, 124.51, 121.83, 113.53, 66.61, 38.27, 27.63, 22.35, 14.47, 14.02.



5-(2-Ethoxy-5-((4-methylpiperazin-1-yl)sulfonyl)phenyl)-1-methyl-3-propyl-1H-pyrazolo[4,3-*d*]pyrimidin-7(6*H*)-one [Sildenafil]⁴: White solid, 86% yield. ^1H NMR (400 MHz, CDCl_3) δ 10.87 (s, 1H), 8.79 (s, 1H), 7.82 (dd, $J = 8.7, 2.4$ Hz, 1H), 7.15 (d, $J = 8.8$ Hz, 1H), 4.37 (q, $J = 7.0$ Hz, 2H), 4.27 (s, 3H), 3.10 (s, 4H), 2.93 (t, $J = 7.5$ Hz, 2H), 2.50 (t, $J = 4.6$ Hz, 4H), 2.27 (s, 3H), 1.94 – 1.79 (m, 2H), 1.64 (t, $J = 7.0$ Hz, 3H), 1.02 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR (101 MHz, CDCl_3) δ 159.31, 153.64, 146.95, 146.44, 138.36, 131.66, 131.12, 128.82, 124.48, 121.10, 113.03, 66.07, 54.04, 45.97, 45.73, 38.21, 27.74, 22.25, 14.53, 14.05.



1-methyl-5-phenyl-3-propyl-1,4,5,6-tetrahydro-7*H*-pyrazolo[4,3-*d*]pyrimidin-7-one (II): Light yellow solid. ^1H NMR (400 MHz, DMSO) δ 8.64 (s, 1H), 8.01 (s, 1H), 7.91 (d, $J = 7.4$ Hz, 2H), 7.79 (s, 1H), 7.54 (d, $J = 5.9$ Hz, 3H), 4.04 (s, 3H), 2.70 (t, $J = 7.5$ Hz, 2H), 1.71 – 1.59 (m, 2H), 0.93 (t, $J = 7.3$ Hz, 3H). ^{13}C NMR (400 MHz, DMSO) δ 161.38, 160.93, 141.27, 136.45, 132.2, 131.28, 129.50, 129.01, 128.77, 39.92, 29.00, 21.53, 14.44. HR-MS (EI): m/z $[\text{M}+\text{H}]^+$ calcd for $\text{C}_{15}\text{H}_{18}\text{N}_4\text{O}$: 270.3425, found: 270.3421.

4. References

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5. The ^1H and ^{13}C NMR spectra

