Supporting Information

SULPHAMIC ACID : AN EFICIENT, COST EFFECTIVE CATALYST FOR FACILE SYNTHESIS OF DEAZAOXAFLAVIN AT AMBIENT TEMPARATURE

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A. General remark:

IR spectra were recorded on Agilent Cary 630 spectrophotometer. NMR spectra were recorded on a BrukerAC-300 MHz spectrometer in DMSO-d₆ using tetramethylsilane as internal standard. Mass spectra were recorded on a Shimadzu QP2010 GCMS.

B. Typical procedure:

A mixture of a salicylaldehyde (1 mmol), barbituric acid (2 mmol) and 20 mol % of sulphamic acid in 5 mL ethanol:water (20:80v/v) was stirred at room temperature till completion of reaction for a period mentioned in Table III. The progress of reaction was monitored by TLC.

After completion of the reaction, the reaction mixture was poured into ice water, just filtered and washed with ethanol to furnish corresponding substituted-5-deaza-10-oxaflavin in high yields and purity. These products were characterized by spectral techniques viz. IR, ^1H , ^{13}C NMR, Mass and C H N elemental analysis.

Spectral data of synthesized compounds:

3a : 5-(2,4-Dioxo-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow powder; M.P. Obs : 220 °C; Lit.: 220-222 °C ^[21]; isolated amount : 0.314 gm, % yield: 92 % ; IR : 3486, 3279, 3222, 3019, 1694, 1646, 1581, 1522, 1492, 1376, 1278, 1225, 762 cm⁻¹; ^1H -NMR^[21] (300 MHz, DMSO-*d*₆): δ 3.84-3.85 (d, 1H, *J* = 3 Hz), 4.70-4.71 (d, 1H, *J* = 3 Hz), 7.06-7.14 (m, 1H), 7.17-7.18 (m, 1H), 7.19-7.21 (m, 1H), 7.30-7.34 (m, 1H), 10.95 (s, 1H, -NH), 11.13 (s, 1H, -NH), 11.25 (s, 1H, -NH), 11.93 (s, 1H, -NH); ^{13}C -NMR^[21] (75 MHz, DMSO-*d*₆): δ 33.59, 53.27, 85.17, 116.43, 120.88, 125.54, 128.00, 129.18, 149.10, 149.49, 150.49, 155.37, 163.47, 168.88, 169.54 ppm.; Mass^[21] : Calculated for (M⁺ - Barbituric) : 214 m/z ; found: 214, 171, 143, 128, 115 (m/z)

3b : 5-(2,4-Dioxo-7-chloro-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. Obs : 280 °C ; Lit.: 281-282 °C ^[21] ; isolated amount : 0.238 gm, % yield: 78 % ; IR : 3098, 3012, 2823, 1704, 1637, 1552, 1481, 1350, 1180, 1108, 825 cm⁻¹; ¹H-NMR^[21] (300 MHz, DMSO-d₆): δ 3.92 -3.93 (d, 1H, *J* = 3 Hz), 4.70 (s, 1H), 7.11-7.15 (m, 2H), 7.36 - 7.39 (m, 1H), 11.05 (s, 1H, -NH), 11.17 (s, 1H, -NH), 11.32 (s, 1H, -NH), 12.00 (s, 1H, -NH); ¹³C-NMR^[21] (75 MHz, DMSO-d₆): δ 33.03, 53.45, 84.73, 118.35, 123.48, 127.66, 129.01, 147.94, 149.39, 150.47, 155.11, 163.39, 168.72, 169.28.; Mass^[21]: Calculated for (M⁺ - Barbituric) : 248 ; found : 248, 205, 177, 114, 85, 63 (m/z).

3c:-5-(2,4-Dioxo-7,9-dibromo-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. 270 °C; isolated amount : 0.409 gm, % yield: 82 % ;IR : 3431, 3253, 2967, 1702, 1616, 1524, 1449, 1279, 1098, 785 cm⁻¹ ; ¹H-NMR (300 MHz, DMSO-d₆) : δ 3.95 -3.96 (d, 1H, *J* = 3 Hz), 4.74 (s, 1H), 7.20 - 7.28 (m, 1H), 7.89 (s, 1H), 11.11 (s, 1H, -NH), 11.22 (s, 1H, -NH), 11.34 (s, 1H, -NH), 12.23 (s, 1H, -NH); ¹³C-NMR (75 MHz, DMSO-d₆): δ 33.12, 53.74, 85.09, 111.04, 117.04, 125.56, 130.12, 134.47, 145.68, 149.93, 150.43, 154.80, 163.23, 168.65, 169.09 ppm. Anal. calcd for C₁₅H₈Br₂N₄O₆: C 36.03, H 1.61, Br 31.96, N 11.20, O

19.20; found C 36.06, H 1.59, Br 31.92, N 11.18, O 19.25 ; Mass: Calculated for (M^+ -Barbituric) : 372 m/z ; found : 372, 329, 301, 222, 192, 141, 128, 113 (m/z)

3 d: 5-(2,4-Dioxo-7-hydroxy-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Pink brown solid; M.P. 234 °C; isolated amount : 0.341 gm, % yield: 95 % ; IR : 3409, 3260, 2816, 1687, 1625, 1586, 1536, 1370, 1237, 1180, 786 cm^{-1} ; ^1H -NMR (300 MHz, DMSO-d_6) : δ 3.84 -3.84 (d, 1H, $J = 1.8$ Hz), 4.61 – 4.62 (d, 1H, $J = 1.8$ Hz), 6.51 - 6.52 (d, 1H, $J = 1.8$ Hz), 6.66 – 6.69 (m, 1H), 6.88 – 6.90 (m, 1H), 9.52 (s, 1H, -OH), 10.95 (s, 1H, -NH), 11.06 (s, 1H, -NH), 11.24 (s, 1H, -NH), 11.80 (s, 1H, -NH); ^{13}C -NMR (75 MHz, DMSO-d_6): δ 33.71, 53.04, 85.61, 113.35, 115.85, 117.22, 121.60, 141.86, 149.51, 150.55, 154.60, 155.58, 163.56, 168.92, 168.48 ppm ; Anal. calcd for $\text{C}_{15}\text{H}_{10}\text{N}_4\text{O}_7$: C 50.29, H 2.81, N 15.64, O 31.26; found C 50.32, H 2.77, N 15.61, O 31.24; Mass: Calculated for (M^+ - Barbituric) : 230 ; found 230, 187, 159, 103, 76, 51 (m/z).

3e : 5-(2,4-Dioxo-7-bromo-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. obs: 243 °C; Lit. : 240-242 °C^[23] ; isolated amount : 0.238 gm, % yield: 88 % ;IR : 3400, 3398, 3012, 2823, 1704, 1637, 1552, 1481, 1421, 1350, 1180, 1108, 825 cm⁻¹; ¹H-NMR (300 MHz, DMSO-d₆)^[23] : δ 3.92 -3.93 (d, 1H, *J* = 3 Hz), 4.70 – 4.701 (d, 1H, *J* = 3 Hz), 7.05 - 7.07 (m, 1H), 7.28 – 7.29 (m, 1H), 7.49 – 7.51 (m, 1H), 11.05 (s, 1H, -NH), 11.73 (s, 1H, -NH), 11.32 (s, 1H, -NH), 12.00 (s, 1H, -NH); ¹³C-NMR (75 MHz, DMSO-d₆): δ 33.92, 53.51, 84.80, 116.93, 118.66, 123.92, 130.58, 131.88, 148.38, 149.39, 150.47, 155.05, 163.39, 168.75, 169.28 ppm ; Anal. calcd for C₁₅H₉BrN₄O₆ : C 42.78, H 2.15, Br 18.97, N 13.30, O 22.79; found C 42.81, H 2.18, Br 18.92, N 13.32, O 22.77 ; Mass : Calculated for (M⁺-Barbituric) : 294 ; found : 294, 266, 251, 174, 147, 119, 91, 77, 59 (m/z).

3f: 5-(2,4-Dioxo-7,9-dichloro-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. 264 °C; isolated amount : 0.354 gm, % yield: 87 % ; IR : 3240, 3025, 2858, 1744, 1697, 1639, 1536, 1451, 1361, 1305, 1183, 1116, 751 cm⁻¹; ¹H-NMR (300 MHz, DMSO-d₆) : δ 3.97 -3.97 (d, 1H, *J* = 0.9 Hz), 4.74 (s, 1H), 7.05 - 7.13 (m, 1H), 7.52 (s, 1H), 11.12 (s, 1H, -NH), 11.24 (s, 1H, -NH), 11.34 (s, 1H, -NH), 12.21 (s, 1H, -NH); ¹³C-NMR (75 MHz,

DMSO- d_6): δ 33.99, 53.67, 84.99, 121.79, 126.66, 128.97, 129.06, 144.26, 149.30, 150.43, 154.70, 163.25, 168.61, 169.07 ppm; Anal. calcd for $C_{15}H_8Cl_2N_4O_6$: C 43.82, H 1.96, Cl 17.25, N 13.63, O 23.35 ; found C 43.78, H 1.98, Cl 17.27, N 13.59, O 23.38 ; Mass : Calculated for (M^+ - Barbituric) : 282 ; found 282, 239, 211, 148, 128, 85 (m/z).

3g : 5-(2,4-Dioxo-7-methoxy-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Pink Brown solid; M.P. > 300 °C; isolated amount : 0.341 gm, % yield: 92 % ; IR : 3455, 3189, 2858, 1753, 1695, 1543, 1495, 1425, 1366, 1276, 1199, 1010, 831 cm^{-1} ; 1H -NMR (300 MHz, DMSO- d_6) : δ 3.71 (s, 3H, -OMe), 3.86 -3.87 (d, 1H, J = 3 Hz), 4.66 – 4.67 (d, 1H, J = 3 Hz), 6.62 - 6.63 (m, 1H), 6.87 – 6.90 (m, 1H), 7.01 – 7. 03 (m, 1H), 10.96 (s, 1H, -NH), 11.10 (s, 1H, -NH), 11.30 (s, 1H, -NH), 11.87 (s, 1H, -NH); ^{13}C -NMR (75 MHz, DMSO- d_6): δ 34.28, 52.96, 55.43, 84.54, 112.00, 114.99, 117.42, 121.45, 142.96, 149.50, 150.55, 155.49, 156.21, 163.50, 168.82, 169.68 ppm; Anal.calcd for $C_{16}H_{12}N_4O_7$: C 51.62, H 3.25, N 15.05, O 30.08 ; found : C 51.58, H 3.20, N 15.10, O 30.12 ; Mass : Calculated for (M^+ - Barbituric) : 244 ; found: 244, 201, 158, 130, 102 (m/z).

3h : 5-(2,4-Dioxo-7-nitro-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Pink Brown solid; M.P. Obs.: 254 °C; Lit.: 250-251 °C ^[23]; isolated amount : 0.272 gm, % yield: 70 % ; IR : 3335, 3259, 3092, 2943, 1734, 1703, 1640, 1679, 1528, 1433, 1346, 1262, 1092, 760 cm⁻¹; ¹H-NMR^[23] (300 MHz, DMSO-d₆): δ 4.08 -4.08 (d, 1H, *J* = 0.9 Hz), 4.84 (s, 1H), 7.23 - 7.35 (m, 1H), 7.94 – 8.07 (m, 1H), 8.14 – 8.37 (m, 1H), 11.11 (s, 1H, -NH), 11.24 (s, 1H, -NH), 11.36 (s, 1H, -NH), 12.17 (s, 1H, -NH); ¹³C-NMR (75 MHz, DMSO-d₆): δ 32.11, 53.81, 84.94, 117.77, 124.17, 125.64, 125.79, 150.41, 153.97, 154.69, 163.27, 168.60, 169.09 ppm; Mass : Calculated for (M⁺ - Barbituric) : 259 ; found : 259, 216, 188, 142, 128, 114, 85, 63 (m/z).

3i : 5-(2,4-Dioxo-9-ethoxy-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. 282 °C ; isolated amount : 0.338 gm, % yield: 88 % ; IR : 3355, 3049, 2829, 1701, 1664, 1584, 1552, 1472, 1281, 1247, 1067, 776 cm⁻¹; ¹H-NMR (300 MHz, DMSO-d₆) : δ 1.33 – 1.36 (t, 3H, *J* = 9.0 Hz), 3.81 -3.82 (d, 1H, *J* = 3 Hz), 4.06 – 4.11 (m, 2H), 4.68 - 4.69 (d, 1H, *J* = 3 Hz), 6.64 - 6.66 (m, 1H), 7.00 – 7.02 (m, 1H), 7.07 – 7.11 (m, 1H), 10.94 (s,

1H, -NH), 11.10 (s, 1H, -NH), 11.24 (s, 1H, -NH), 11.94 (s, 1H, -NH); ¹³C-NMR (75 MHz, DMSO-d₆): δ 14.54, 33.81, 53.15, 64.34, 85.04, 113.19, 118.83, 121.72, 125.34, 138.90, 146.51, 149.44, 150.50, 155.36, 163.47, 168.90, 169.56 ppm; Anal.calcd for C₁₇H₁₄N₄O₇: C 52.85, H 3.65, N 14.50, O 28.99; found: C 52.82, H 3.63, N 14.47, O 29.08; Mass: Calculated for (M⁺ - Barbituric): 258; found: 258, 230, 187, 159, 128, 103, 76 (m/z).

3j: 5-(2,4-Dioxo-9-hydroxy-2,3,4,5-tetrahydro-1*H*-chromeno[2,3-*d*]pyrimidin-5-yl)pyrimidine-2,4,6(1*H*,3*H*,5*H*)-trione

Yellow solid; M.P. 244 °C; isolated amount: 0.270 gm, % yield: 75%; IR: 3303, 3190, 2816, 1687, 1625, 1587, 1534, 1425, 1357, 1236, 1180, 1011, 771 cm⁻¹; ¹H-NMR (300 MHz, DMSO-d₆): δ 3.79-3.80 (d, 1H, *J* = 3 Hz), 4.65 – 4.66 (d, 1H, *J* = 3 Hz), 6.50 - 6.52 (m, 1H), 6.81 – 6.83 (m, 1H), 6.93 – 6.97 (m, 1H), 10.01 (s, 1H, -OH), 10.93 (s, 1H, -NH), 11.08 (s, 1H, -NH), 11.22 (s, 1H, -NH), 11.87 (s, 1H, -NH); ¹³C-NMR (75 MHz, DMSO-d₆): δ 34.02, 53.08, 85.01, 115.67, 117.25, 121.81, 125.16, 137.98, 145.46, 149.47, 150.54, 155.48, 163.51, 168.92, 169.65 ppm; Anal.calcd for C₁₅H₁₀N₄O₇: C 50.29, H 2.81, N 15.64, O 31.26; found C 50.32, H 2.78, N 15.59, O 31.31; Mass: Calculated for (M⁺ - Barbituric): 230; found: 230, 187, 159, 103, 76 (m/z).

3a :

3b:

3c:

3d :

3e :

3f :

3g :

3h :

3i :

3j: