SUPPORTING INFORMATION

(±)-CAMPHOR-10-SULFONIC ACID AS RECYCLABLE AND EFFICIENT CATALYST FOR THE SYNTHESIS OF SOME NOVEL COUMARIN DERIVATIVES

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MATERIALS AND INSTRUMENTS

All chemicals were used commercially available and purchased from Sigma Aldrich. Melting points were taken on a melting point apparatus and are uncorrected. The reactions were monitored by thin layer chromatography (TLC). Proton nuclear magnetic resonance (^1H NMR) and ^{13}C NMR Spectra were recorded on a Bruker DPX 300 MHz/ 75 MHz frequencies, respectively using DMSO d_6 as a solvent and tetramethylsilane (TMS) as an internal standard. Infrared (IR) Spectra were recorded on a Perkin Elmer spectra 100 and JASCO, FTIR 4600 spectrophotometer. Mass Spectra were recorded on a Shimadzu mass spectrophotometer. Elemental analysis was done on a elemental analyzer EURO EA-3000.

General procedure for the syntheses of compounds [3a-j]

In a 25 ml round-bottom flask substituted 3-formylchromone 1 (1 mmol) and cyclic 1, 3 diketone compounds 2 (2 mmol) went in 5-10 ml of water: ethanol (1:1) and ($\pm$)-camphor-10-sulfonic acid 20 mol% there was mixture stirred for appropriate time at reflux condition after 30 to 60 min. solid separates and completion of the reaction monitored by TLC. Then the reaction mixture cooled and separated solid filtered wash with water, then with hot ethanol and diethyl ether further purified by recrystallization from EtOH mixture to give a targeted compound 3a-j and 4k-n in 85-91 % yield (Table 2). Filtrate was collected and evaporate solvent under reduced pressure to recover CAS catalyst it is further used for same reaction.

General procedure for the syntheses of compounds [4k-n]

In a 25 ml round-bottom flask substituted 3-formylchromone 1 (1 mmol) and cyclic 1, 3 diketone compounds 2 (1 mmol) went in 5 ml of water: ethanol (1:1) and ($\pm$)-camphor-10-sulfonic acid 20 mol% there was mixture stirred for appropriate time at reflux condition after 20 to 25 min. solid separates and completion of the reaction monitored by TLC. Then the reaction mixture cooled and separated solid filtered wash with water, then with hot ethanol

and diethyl ether further purified by recrystallization from EtOH mixture to give a targeted compound 4k-n in 76- 80 % yield (Table 2).

SPECTRAL DATA :

7-(4-Oxo-4*H*-chromen-3-yl)-7*H*-pyrano [3, 2-*c*; 5, 6-*c*] dichromene-6, 8-dione (3a)

Off-white colored powder; yield 85 %; mp 228-230° C, IR (ν max): 1663, 1614, 1566, 1497, 1467, 1354, 1168 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 6.036 (s, 1H), 7.361-7.413 (m, 5H), 7.456-7.484 (d, 1H, *J* = 8.4 Hz), 7.594-7.705 (m, 3H), 7.922-7.926 (d, 1H), 8.029-8.055 (d, 2H, *J* = 7.8 Hz), 8.095-8.121 (m, 1H) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 30.47, 103.88, 116.62, 116.64, 117.96, 118.74, 123.39, 124.30, 124.80, 125.21, 125.88, 132.81, 133.72, 152.27, 153.42, 156.21, 164.41, 168.03, 176.91 ppm; Mass (*m/z*): 462 (M⁺); anal. calcd. for C₂₈H₁₄O₇ : C, 72.73; H, 3.05; Found: C, 72.48; H, 3.20%.

3, 3, 6, 6- Tetramethyl -9- (4-oxo-4*H*-chromen-3-yl)-3, 4, 5, 6, 7, 9 - hexahydro- 2*H* - xanthene-1, 8-dione (3b)

White colored powder; yield 80 %; mp 262-264° C, IR (ν max): 3070, 2953, 2874, 1655, 1633, 1569, 1466, 1362, 1203 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 0.962-0.968 (d, 6H, *J* = 1.8 Hz), 1.081-1.088 (d, 6H, *J* = 2.1 Hz), 2.135-2.267 (m, 3H), 2.396-2.575 (m, 5H), 4.494 (s, 1H), 7.273-7.329 (m, 1H), 7.391-7.419 (m, 1H), 7.559-7.611 (m, 1H), 8.051- 8.088 (m, 1H), 8.234-8.242 (d, 1H, *J* = 2.4 Hz) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 26.95, 27.04, 29.32, 32.14, 40.74, 50.84, 110.99, 118.18, 121.60, 124.70, 124.81, 125.23, 133.03, 156.15, 165.11, 176.86, 197.31 ppm; Mass (*m/z*): 418(M⁺); anal. calcd. for C₂₆H₂₆O₅ : C, 74.62; H, 6.26 ; Found: C, 74.30; H, 6.10 %.

5- (4-Oxo-4*H*-chromen-3-yl)- 2, 8 -dithioxo-2, 3, 5, 7, 8, 9 - hexahydro-1*H*-pyrano[2, 3-*d*;6, 5-*d*] dipyrimidine-4, 6-dione (3c)

Orange colored powder; yield 82 %; mp 280-282° C, IR (ν max): 3054, 2904, 1656, 1577, 1510, 1460, 1418, 1360, 1311, 1246, 1190, 1153, 1000 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 5.772 (s, 1H), 7.432-7.559 (m, 1H), 7.714-7.742 (m, 1H), 7.766-7.772 (d, 2H, *J* = 1.8 Hz), 8.114-8.146 (m, 1H), 8.638 (s, 1H), 9.897 (s, 1H), 11.185 (s, 1H), 11.374 (s, 1H) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 24.96, 117.67, 118.24, 119.08, 120.29, 123.11, 123.55, 125.11, 125.49, 125.74, 126.99, 133.67, 135.48, 153.72, 156.09, 163.29, 173.02, 176.75, 188.69 ppm; anal. calcd. for C₁₈H₁₀N₄O₅S₂ : C, 50.70; H, 2.36; N , 13.14; Found: C, 50.45; H, 2.20; N, 13.30%.

3, 6- Dimethyl-9-(4-oxo-4*H*-chromen-3-yl)-9*H*-2,7,10-trioxa-anthracene-1,8-dione (3d)

Yellow colored powder; yield 80 %; mp 218-220° C, IR (ν max): 3436, 3076, 2615, 1672, 1583, 1415, 1291, 1169 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 2.142 (s, 6H), 5.459 (s, 1H), 5.942 (s, 2H), 7.429 -7.479 (t, 1H, *J* = 7.5Hz), 7.584 -7.612 (d, 1H, *J* = 8.4 Hz), 7.683 (s, 1H), 7.743 -7.794 (t, 1H, *J* = 7.5 Hz), 8.001-8.027 (d, 1H, *J* = 7.8 Hz) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 19.63, 29.15, 100.43, 100.93, 118.59, 123.22, 123.76, 125.44, 125.54, 134.14, 152.89, 156.26, 160.62, 164.62, 166.54, 176.49 ppm; anal. calcd. for C₂₂H₁₄O₇ : C, 67.69; H, 3.62 ; Found: C, 67.42; H, 3.84 %.

(4-Oxo-4*H*-chromen-3-yl)-7, 9-dihydro-5*H*-14-oxa-5, 9-diaza-dibenzo [*a*, *j*] anthracene-6, 8-dione (3e)

Milky white colored powder; yield 88 %; mp >300° C, IR (ν max): 3456, 3109, 2974, 2582, 1630, 1465, 1390 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 6.064 (s, 1H), 7.258 -7.308 (t, 1H, *J* = 7.5 Hz), 7.404 -7.458 (m, 3H), 7.553 -7.630 (m, 3H), 7.747 -7.799 (t, 1H, *J* = 7.8

Hz), 7.918 -7.957 (m, 3H), 8.00 (s, 1H), 12.167 (s, 2H) ppm; ^{13}C NMR (75 MHz, DMSO - d_6): δ , 30.04, 116.29, 116.89, 118.56, 119.88, 122.99, 123.26, 123.60, 125.50, 125.65, 131.44, 134.36, 137.28, 150.31, 154.19, 156.04, 161.36, 166.11, 176.49 ppm; anal. calcd. for $\text{C}_{28}\text{H}_{16}\text{N}_2\text{O}_5$: C, 73.04; H, 3.50; N, 6.08; Found: C, 73.24; H, 3.64; N, 6.14 %.

7-(6-Fluoro-4-oxo-4H-chromen-3-yl)-7H-pyrano[3,2-c;5,6-c'] dichromene-6,8-dione (3f)

White colored powder; yield 84 %; mp 268-270° C, IR (v max): 3070, 2745, 2610, 1655, 1613, 1566, 1482, 1325 cm^{-1} ; ^1H NMR (300 MHz, DMSO - d_6): δ , 6.024 (s, 1H), 7.271 - 7.346 (m, 4H), 7.543 -7.594 (t, 2H, J = 7.7 Hz), 7.635- 7.725 (m, 3H), 7.877 -7.903 (d, 2H, J = 7.8 Hz), 8.028 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO - d_6): δ , 30.79, 103.39, 116.33, 118.37, 121.53, 122.38, 123.95, 124.09, 132.01, 152.63, 152.73, 163.90, 164.75 ppm; anal. calcd. for $\text{C}_{28}\text{H}_{13}\text{FO}_7$: C, 70.00; H, 2.73; Found: C, 70.16; H, 2.58 %.

9 - (6-Fluoro-4-oxo-4H-chromen-3-yl) - 3, 3, 6, 6-tetramethyl - 3, 4, 5, 6, 7, 9 - hexahydro -2H-xanthene-1, 8-dione (3g)

White colored powder; yield 82 %; mp 240-242° C, IR (v max): 3069, 2957, 2875, 1652, 1575, 1480, 1362 cm^{-1} ; ^1H NMR (300 MHz, DMSO - d_6): δ , 0.976 (s, 6H), 1.101 (s, 6H), 2.146 -2.280 (q, 4H), 2.411 -2.584 (q, 4H), 4.510 (s, 1H), 7.321 -7.353 (m, 1H), 7.407 -7.450 (m, 1H), 7.701 -7.720 (d, 1H, J = 5.7 Hz) 8.264 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO - d_6): δ , 26.91, 27.03, 29.32, 32.15, 40.76, 50.85, 109.88, 110.19, 110.86, 120.24, 120.35, 121.10, 121.14, 121.48, 125.87, 125.97, 152.31, 156.40, 157.65, 159.14, 160.91, 163.59, 165.17, 170.74, 176.11, 197.28 ppm; anal. calcd. for $\text{C}_{26}\text{H}_{25}\text{FO}_5$: C, 71.55; H, 5.77; Found: C, 71.68; H, 5.58 %.

5 - (6-Fluoro-4-oxo-4*H*-chromen-3-yl) - 2, 8-dithioxo-2, 3, 5, 7, 8, 9 - hexahydro-1*H*-pyrano[2, 3-*d*;6, 5-*d'*]dipyrimidine-4, 6-dione (3h)

Orange colored powder; yield 90 %; mp 232-234° C, IR (ν max): 3074, 2922, 1661, 1512, 1460, 1360, 1310, 1191 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 5.742 (s, 1H), 7.566 - 7.687 (m, 4H), 8.055 (s, 1H), 8.157 (s, 1H), 11.716 (s, 1H), 12.014 (s, 1H) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 117.78, 119.39, 120.00, 120.45, 123.47, 125.11, 125.78, 126.17, 127.24, 135.73, 145.64, 155.74, 156.08, 160.68, 161.72, 162.97, 164.06, 175.11, 175.41, 176.36, 178.97, 188.91 ppm; anal. calcd. for C₁₈H₉FN₄O₅S₂: C, 48.65; H, 2.04, N, 12.61; Found, : C, 48.44; H, 2.24; N, 12.42 %.

9- (6-Fluoro-4-oxo-4*H*-chromen-3-yl) - 3, 6 - dimethyl-9*H*- 2, 7, 10 - trioxa-anthracene-1, 8 -dione (3i)

Yellow colored powder; yield 75 %; mp 242-244° C, IR (ν max): 3077, 2913, 1672, 1583, 1415, 1292, 1218, 1169 cm⁻¹ ; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 2.133 (s, 6H), 5.448 (s, 1H), 5.918 (s, 2H), 7.663 - 7.715 (m, 4H) ppm; ¹³C NMR (75 MHz, DMSO - *d*₆): δ, 19.66, 28.40, 100.5, 101.56, 118.24, 123.33, 124.96, 125.48, 133.61, 152.84, 156.25, 160.55, 165.93, 167.57, 176.56 ppm; anal. calcd. for C₂₂H₁₃FO₇: C, 64.71 ; H, 3.21 ; Found: C, 64.58; H, 3.42 %.

7 - (6-Fluoro-4-oxo-4*H*-chromen-3-yl) - 7, 9-dihydro- 5*H*- 14-oxa- 5, 9-diaza-dibenzo [*a,j*]anthracene-6, 8-dione (3j)

White colored powder; yield 80 %; mp >300° C, IR (ν max): 3058, 3008, 2963, 2857, 1677, 1633, 1609, 1547, 1484, 1279 cm⁻¹; ¹H NMR (300 MHz, DMSO - *d*₆): δ, 5.726 (s, 1H), 7.133-7.298 (m, 2H), 7.314 -7.510 (m, 3H), 7.575-7.696 (m, 3H), 7.757 -7.784 (m, 2H), 7.909 -7.958 (m, 2H), 11.961 (s, 1H), 12.185 (s, 1H) ppm; ¹³C NMR (75 MHz, DMSO): δ,

29.50, 106.31, 115.50, 116.25, 123.11, 123.59, 131.53, 133.07, 137.18, 138.91, 143.77, 145.96, 152.50, 161.29, 185.37 ppm; anal. calcd. for $C_{28}H_{15}FN_2O_5$: C, 70.29; H, 3.16; N, 5.86; Found: C, 70.52; H, 3.32; N, 5.62 %.

5-(4-Oxo-4H-chromen-3-ylmethylene)-pyrimidine-2, 4, 6-trione (4k)

Yellow colored powder; yield 78 %; mp 288-290° C, IR (v max): 3238, 3086, 2829, 1683, 1630, 1537, 1463, 1346, 1311, 1220, 1192 cm^{-1} ; 1H NMR (300 MHz, DMSO - d_6): δ , 7.465-7.515 (t, 1H, J = 7.8 Hz), 7.586-7.614 (d, 1H, J = 9 Hz), 7.760-7.812 (t, 1H, J = 7.2 Hz), 7.971 (s, 1H), 8.121 -8.147 (d, 1H, J = 7.8 Hz), 8.58 (s, 1H), 9.88 (s, 1H), 11.36 (s, 1H), 11.43 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO - d_6): δ , 117.58, 118.79, 123.51, 126.19, 126.65, 133.31, 135.00, 146.27, 150.32, 155.71, 162.78, 163.20, 164.15, 175.32 ppm; Mass (m/z): 312 (M^+); anal. calcd. for : C, 59.16; H, 2.84; N, 9.86; Found: C, 59.38; H, 2.58; N, 9.66 %.

2-(4-Oxo-4H-chromen-3-ylmethylene)-indan-1,3-dione (4l)

Yellow-orange colored powder; yield 80 %; mp 246-248° C, IR (v max): 3086, 3050, 2924, 1731, 1688, 1655, 1610, 1547, 1464, 1234, 1194 cm^{-1} ; 1H NMR (300 MHz, DMSO - d_6): δ , 7.437-7.553 (m, 1H), 7.581-7.776 (m, 2H), 7.809-7.838 (m, 1H), 7.921-7.958 (m, 2H), 8.167-8.220 (m, 2H), 10.294 (s, 1H) ppm; Mass (m/z): 302 (M^+); anal. calcd. for : C, 75.49; H, 3.33; Found: C, 75.16; H, 3.58 %.

5-(6-Fluoro-4-oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4m)

Yellow colored powder; yield 76 %; mp >300° C, IR (v max): 3242, 3097, 1769, 1674, 1548, 1482, 1435, 1315, 1221 cm^{-1} ; 1H NMR (300 MHz, DMSO - d_6): δ , 7.664 – 7.691 (t, 1H, J = 6 Hz), 7.745 -7.806 (m, 2H), 8.119 (s, 1H), 8.498 (s, 1H), 9.829 (s, 1H), 11.392 (s, 1H),

11.474 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO- d_6): 110.70, 111.02, 117.06, 120.29, 122.26, 123.42, 123.74, 124.84, 144.43, 150.55, 152.27, 158.38, 162.76, 163.37, 163.53, 170.27, 174.66 ppm; anal. calcd. for $\text{C}_{14}\text{H}_7\text{FN}_2\text{O}_5$: C, 55.64; H, 2.33; N, 9.27; Found: C, 55.48; H, 2.54; N, 9.12 %.

2-(6-Fluoro-4-oxo-4*H*-chromen-3ylmethylene)-indan-1, 3-dione (4n)

Yellow-orange colored powder; yield 80 %; mp 258-260° C, IR (v max): 3055, 1722, 1680, 1667, 1593, 1552, 1478, 1312, 1254, 1141 cm^{-1} ; ^1H NMR (300 MHz, DMSO - d_6): δ , 7.833-7.871 (m, 2H), 7.973 -8.003 (m, 4H), 8.069 (s, 1H), 8.229 (s, 2H) ppm; anal. calcd. for $\text{C}_{19}\text{H}_9\text{FO}_4$: C, 71.25; H, 2.83; Found: C, 71.42; H, 2.98 %.

IR Spectrum of 7-(4-Oxo-4H-chromen-3-yl)-7H-pyrano [3, 2-c; 5, 6-c'] dichromene-6, 8-dione (3a)

¹H NMR Spectrum of 7-(4-Oxo-4H-chromen-3-yl)-7H-pyrano [3, 2-c; 5, 6-c'] dichromene-6, 8-dione (3a)

¹³C NMR Spectrum of 7-(4-Oxo-4*H*-chromen-3-yl)-7*H*-pyrano [3, 2-*c*; 5, 6-*c'*] dichromene-6, 8-dione (3a)

Mass Spectrum of 7-(4-Oxo-4H-chromen-3-yl)-7H-pyrano [3, 2-c; 5, 6-c'] dichromene-6, 8-dione (3a)

IR Spectrum of 3,3,6,6-Tetramethyl-9-(4-oxo-4H-chromen-3-yl)-3,4,5,6,7,9-hexahydro-2H-xanthene-1,8-dione (3b)

¹H NMR Spectrum of 3,3,6,6- Tetramethyl -9- (4-oxo-4H-chromen-3-yl)-3,4,5,6,7,9 - hexahydro- 2H -xanthene-1,8-dione

(3b)

¹³C NMR Spectrum of 3,3,6,6-Tetramethyl-9-(4-oxo-4*H*-chromen-3-yl)-3,4,5,6,7,9-hexahydro-2*H*-xanthene-1,8-dione (3b)

Mass Spectrum of 3,3,6,6-Tetramethyl-9-(4-oxo-4H-chromen-3-yl)-3,4,5,6,7,9-hexahydro-2H-xanthene-1,8-dione

(3b)

IR Spectrum of 5-(4-Oxo-4H-chromen-3-yl)-2,8-dithioxo-2,3,5,7,8,9-hexahydro-1H-pyrano[2,3-d;6,5-d]dipyrimidine-4,6-dione (3c)

IR Spectrum of 3,6- Dimethyl-9-(4-oxo-4H-chromen-3-yl)-9H-2,7,10-trioxa-anthracene-1,8-dione (3d)

^1H NMR Spectrum of 3,6- Dimethyl-9-(4-oxo-4*H*-chromen-3-yl)-9*H*-2,7,10-trioxa-anthracene-1,8-dione (3d)

¹³C NMR Spectrum of 3,6- Dimethyl-9-(4-oxo-4*H*-chromen-3-yl)-9*H*-2,7,10-trioxa-anthracene-1,8-dione (3d)

IR Spectrum of 7-(4-Oxo-4H-chromen-3-yl)-7,9-dihydro-5H-14-oxa-5,9-diaza-dibenzo[a,j]anthracene-6,8-dione (3e)

¹H NMR Spectrum of 7-(4-Oxo-4*H*-chromen-3-yl)-7,9-dihydro-5*H*-14-oxa-5,9-diaza-dibenzo[*a,j*]anthracene-6,8-dione (3e)

^{13}C NMR Spectrum of 7-(4-Oxo-4*H*-chromen-3-yl)-7,9-dihydro-5*H*-14-oxa-5,9-diaza-dibenzo[*a,j*]anthracene-6,8-dione (3e)

IR Spectrum of 7-(6-Fluoro-4-oxo-4H-chromen-3-yl)-7H-pyrano[3,2-c;5,6-c'] dichromene-6,8-dione (3f)

^1H NMR Spectrum of 7-(6-Fluoro-4-oxo-4H-chromen-3-yl)-7H-pyrano[3,2-c;5,6-c'] dichromene-6,8-dione (3f)

¹³C NMR Spectrum of 7-(6-Fluoro-4-oxo-4H-chromen-3-yl)-7H-pyrano[3,2-c;5,6-c'] dichromene-6,8-dione (3f)

IR Spectrum of 9-(6-Fluoro-4-oxo-4H-chromen-3-yl)-3,3,6,6-tetramethyl-3,4,5,6,7,9-hexahydro-2H-xanthene-1,8-dione (3g)

¹H NMR Spectrum of 9-(6-Fluoro-4-oxo-4*H*-chromen-3-yl)-3,3,6,6-tetramethyl-3,4,5,6,7,9-hexahydro-2*H*-xanthene-1,8-dione (3g)

^{13}C NMR Spectrum of 9-(6-Fluoro-4-oxo-4H-chromen-3-yl)-3,3,6,6-tetramethyl-3,4,5,6,7,9-hexahydro-2H-xanthene-1,8-dione (3g)

IR Spectrum of 5-(6-Fluoro-4-oxo-4H-chromen-3-yl)-2,8-dithioxo-2,3,5,7,8,9-hexahydro-1H-pyrano[2,3-d;6,5-d']dipyrimidine-4,6-dione (3h)

¹H NMR Spectrum of 5-(6-Fluoro-4-oxo-4H-chromen-3-yl)-2,8-dithioxo-2,3,5,7,8,9-hexahydro-1H-pyrano[2,3-*d*;6,5-*d'*]dipyrimidine-4,6-dione (3h)

¹³C NMR Spectrum of 5-(6-Fluoro-4-oxo-4*H*-chromen-3-yl)-2,8-dithioxo-2,3,5,7,8,9-hexahydro-1*H*-pyrano[2,3-*d*;6,5-*d'*]dipyrimidine-4,6-dione (3h)

IR Spectrum of 9-(6-Fluoro-4-oxo-4H-chromen-3-yl)-3,6-dimethyl-9H-2,7,10-trioxa-anthracene-1,8-dione (3i)

^1H NMR Spectrum of 9-(6-Fluoro-4-oxo-4H-chromen-3-yl)-3,6-dimethyl-9H-2,7,10-trioxa-anthracene-1,8-dione (**3i**)

C NMR Spectrum of 9-(6-Fluoro-4-oxo-4*H*-chromen-3yl)-3,6-dimethyl-9*H*-2,7,10-trioxa-anthracene-1,8-dione (3i)

IR Spectrum of 7-(6-Fluoro-4-oxo-4H-chromen-3yl)-7,9-dihydro-5H-14-oxa-5,9-diaza-dibenzo[a,j]anthracene-6,8-dione (3j)

¹H NMR Spectrum of 7-(6-Fluoro-4-oxo-4*H*-chromen-3-yl)-7,9-dihydro-5*H*-14-oxa-5,9-diaza-dibenzo[*a,j*]anthracene-6,8-dione (3j)

¹³C NMR Spectrum of 7-(6-Fluoro-4-oxo-4H-chromen-3-yl)-7,9-dihydro-5H-14-oxa-5,9-diaza-dibenzo[a,j]anthracene-6,8-dione (3j)

IR Spectrum of 5-(4-Oxo-4*H*-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4k)

¹H NMR Spectrum of 5-(4-Oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4k)

¹³C NMR Spectrum of 5-(4-Oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4k)

IR Spectrum of 2-(4-Oxo-4H-chromen-3-ylmethylene)-indan-1,3-dione (4l)

^1H NMR Spectrum of 2-(4-Oxo-4*H*-chromen-3-ylmethylene)-indan-1,3-dione (4l)

¹H NMR Spectrum of 2-(4-Oxo-4H-chromen-3-ylmethylene)-indan-1,3-dione (4l)

IR Spectrum of 5-(6-Fluoro-4-oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4m)

¹H NMR Spectrum of 5-(6-Fluoro-4-oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4m)

¹³C NMR Spectrum of 5-(6-Fluoro-4-oxo-4H-chromen-3-ylmethylene)-pyrimidine-2,4,6-trione (4m)

IR Spectrum of 2-(6-Fluoro-4-oxo-4H-chromen-3-ylmethylene)-indan-1,3-dione(4n)

¹H NMR Spectrum of 2-(6-Fluoro-4-oxo-4*H*-chromen-3ylmethylene)-indan-1,3-dione(4n)