

Electronic Supporting Information

Facile construction of densely functionalized 4H-chromenes via three-component reactions by L-proline

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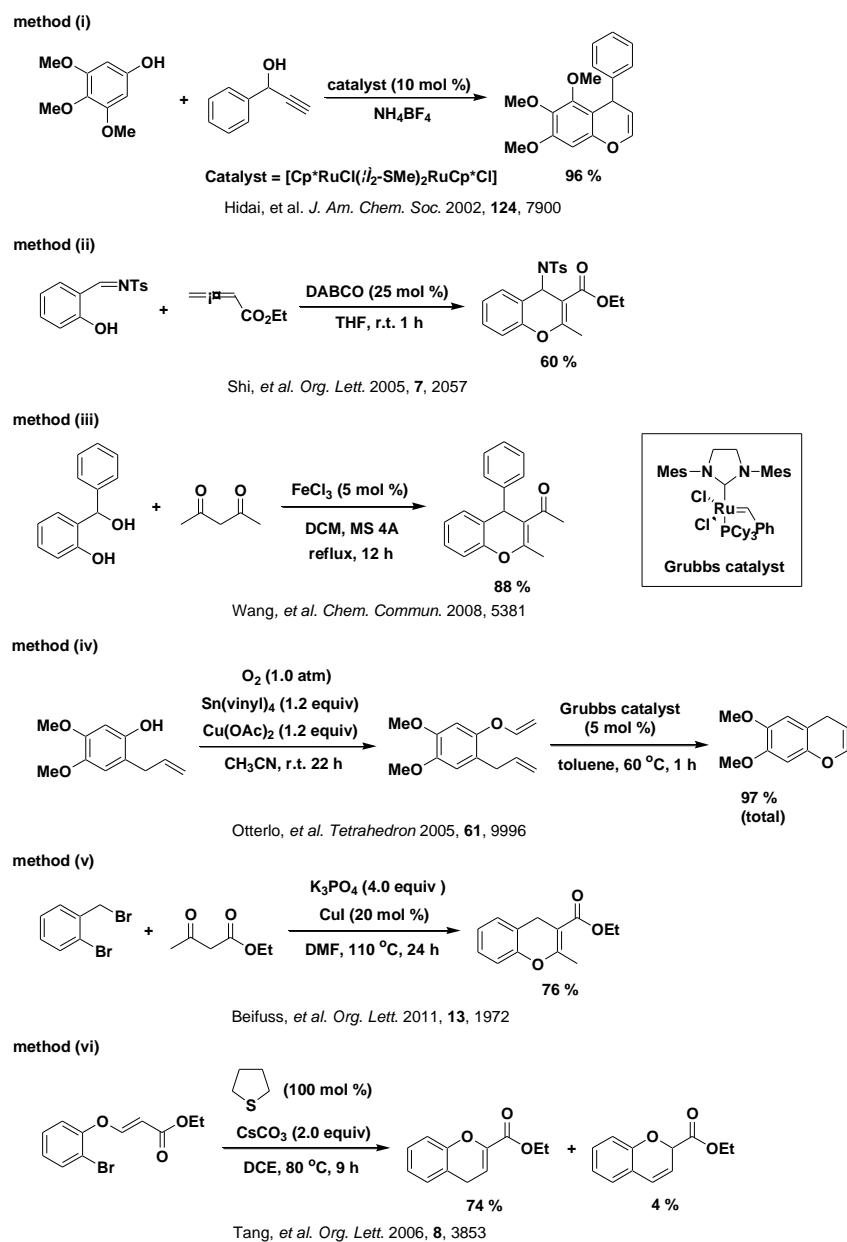
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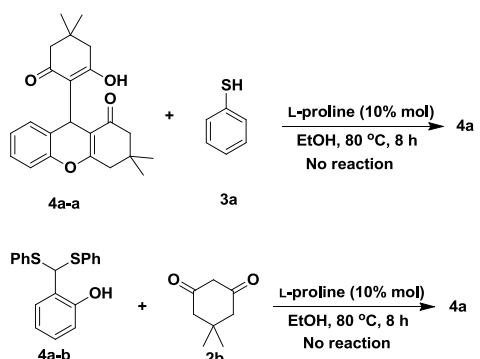
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Scheme S1. Various methods have been developed for synthesizing 4*H*-chromenes



Scheme S2. Synthesizing 4a from the side-products of the model reaction.

9-(2-Hydroxy-4,4-dimethyl-6-oxocyclohex-1-en-1-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one

(4a-a)¹

White solid, mp = 209-211 oC; ¹H NMR (CDCl₃): 1.01 (d, J = 14.8 Hz, 9H), 1.12 (s, 3H), 1.93 (d, J = 16.8 Hz, 1H), 2.00 (d, J = 16.8 Hz, 1H), 2.28-2.42 (m, 4H), 2.57 (d, J = 17.6 Hz, 1H), 2.59 (d, 17.6 Hz, 1H), 4.66 (s, 1H), 6.99-7.02 (m, 3H), 7.13-7.17 (m, 1H), 10.49 (s, 1H); ¹³C NMR: 26.4, 27.2, 27.7, 29.1, 29.8, 30.9, 32.3, 41.5, 43.1, 49.9, 50.6, 111.0, 115.7, 118.3, 124.3, 124.5, 127.5, 127.9, 151.0, 169.1, 170.7, 196.6, 202.9.

2-(Bis(phenylthio)methyl)phenol (4a-b)²

Brown liquid; ¹H NMR (CDCl₃): 5.87 (s, 1H), 6.52 (s, 1H), 6.85 (t, J = 7.6 Hz, 1H), 6.89 (d, J = 8.0 Hz, 1H), 7.19 (dt, J_a = 1.6 Hz, J_b = 8.0 Hz, 1H), 7.26 (dd, J_a = 1.6 Hz, J_b = 8.0 Hz, 1H), 7.30 (m, 6H), 7.45-7.50 (m, 4H); ¹³C NMR: 56.4, 117.1, 120.8, 124.3, 128.1, 129.0, 129.6, 129.7, 132.6, 133.7, 153.7; HRMS m/z (ESI) calcd for C₂₀H₁₈NaO₂S [M + Na]⁺ 345.0925 found 345.0922.

3,3-Dimethyl-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4a)

brown liquid; ¹H NMR (CDCl₃): 0.97 (s, 3H), 1.06 (s, 3H), 2.15-2.32 (m, 4H), 5.21 (s, 1H), 6.70 (dd, J_a = 0.8 Hz, J_b = 8.0 Hz, 1H), 6.96 (dd, J_a = 0.8 Hz, J_b = 8.0 Hz, 2H), 6.99-7.09 (m, 4H), 7.13-7.20 (m, 2H); ¹³C NMR: 28.4, 28.5, 32.1, 40.8, 41.3, 50.9, 109.8, 116.1, 122.7, 125.0, 128.1, 128.2, 128.7, 129.5, 131.8, 136.4, 150.6, 166.3, 195.8; IR (cm⁻¹): 3046, 2959, 2935, 2869, 1661, 1638, 1578, 1480, 1458, 1437, 1382, 1232, 1176, 1139, 1098, 1021, 801, 757, 746, 692; HRMS m/z (ESI) calcd for C₂₁H₂₀NaO₂S [M + Na]⁺ 359.1082 found 359.1080.

9-((4-Isopropylphenyl)thio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4b)

brown liquid; ¹H NMR (CDCl₃): 1.05 (s, 3H), 1.14 (s, 3H), 1.19 (s, 3H), 1.21 (s, 3H), 2.23-2.39 (m, 4H), 5.28 (s, 1H), 6.78 (d, J = 8.4 Hz, 1H), 6.98 (t, J = 8.4 Hz, 4H), 7.08 (t, J = 7.6 Hz, 1H), 7.15 (t, J = 7.6 Hz, 1H), 7.23 (d, J = 7.6 Hz, 1H); ¹³H NMR: 23.9, 28.4, 28.6, 32.0, 33.8, 40.7, 41.3, 50.9, 109.8, 116.0, 122.9, 124.9, 126.3, 128.0, 128.7, 129.5, 136.4, 149.9, 150.6, 166.2, 195.8; IR (cm⁻¹): 3068, 3039, 3018, 2959, 2870, 1666, 1644, 1581, 1485, 1460, 1383, 1235, 1177, 1143, 1015, 922, 830, 752, 731, 662; HRMS m/z (ESI) calcd for C₂₄H₂₆NaO₂S [M + Na]⁺ 401.1551 found 401.1548.

3,3-Dimethyl-9-(o-tolylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4c)

brown liquid; ¹H NMR (CDCl₃): 1.03 (s, 3H), 1.12 (s, 1.12), 2.25-2.41 (m, 4H), 3.62 (s, 3H), 5.41 (s, 1H), 6.73-6.76 (m, 2H), 6.85 (d, J = 8.0 Hz, 1H), 7.00 (t, J = 7.2 Hz, 1H), 7.07-7.14 (m, 3H), 7.26 (t, J = 8.0 Hz, 1H); ¹³C NMR: 28.0, 28.4, 31.8, 39.2, 41.2, 50.5, 55.3, 109.9, 110.3, 115.6, 119.9, 120.0, 122.7, 124.3, 127.6, 129.2, 130.5, 138.3, 150.3, 160.5, 166.2, 195.5; IR (cm⁻¹): 3062, 3005, 2958, 2936, 2871, 2834, 1664, 1643, 1580, 1475, 1462, 1430, 1383, 1273, 1238, 1178, 1143, 1024, 911, 752, 731, 662; HRMS m/z (ESI) calcd for C₂₂H₂₂NaO₂S [M + Na]⁺ 373.1238 found 373.1235.

9-((2-Methoxyphenyl)thio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4d)

brown liquid; ¹H NMR (CDCl₃): 1.06 (s, 3H), 1.15 (s, 3H), 2.12 (s, 3H), 2.29-2.48 (m, 4H), 5.27 (s, 1H), 6.84 (dd, J_a = 1.6 Hz, J_b = 7.8 Hz, 1H), 6.91 (d, J = 8.0 Hz, 1H), 6.98 (dt, J_a = 0.8 Hz, J_b = 7.8 Hz, 1H), 7.03 (t, J = 7.2 Hz, 1H), 7.11-7.21 (, 4H); ¹³H NMR: 20.6, 28.3, 32.1, 40.5, 41.4, 50.5, 109, 116.0, 123.0, 124.6, 125.7, 127.9, 128.8, 129.9, 131.7, 137.4, 143.1, 150.3, 166.9, 195.5; IR (cm⁻¹): 3054, 3010, 2951, 2912, 2870, 1664, 1642, 1580, 1486, 1466, 1383, 1237, 1179, 1125, 1011, 866, 753, 700; HRMS m/z (ESI) calcd for C₂₂H₂₂NaO₃S [M + Na]⁺ 389.1187 found 389.1182.

9-((3,5-Dimethylphenyl)thio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4e)

brown liquid; ¹H NMR (CDCl₃): 1.06 (s, 3H), 1.16 (s, 3H), 2.15 (s, 6H), 2.25-2.30 (m, 2H), 2.32 (d, J = 16.0 Hz, 1H), 2.38 (d, J = 16.0 Hz, 1H), 5.27 (s, 1H), 6.62 (s, 2H), 6.80 (dd, J_a = 8.0 Hz, J_b = 1.2 Hz, 1H), 7.10-7.18 (m,

¹ P. Zhang, Y. Yu, Z. Zhang, *Synth. Commun.* **2008**, *38*, 4474- 4479.

² E. J. Guthrie, J. Macritchie, R. C. Hartley, *Tetrahedron Lett.* **2000**, *41*, 4987- 4990.

2H), 7.27 (dd, J_a = 1.2 Hz, J_b = 8.0 Hz, 1H); ^{13}C NMR: 21.0, 28.4, 28.6, 31.9, 40.6, 41.3, 50.8, 109.7, 115.8, 122.8, 124.9, 127.9, 129.6, 130.3, 130.9, 134.1, 137.6, 150.9, 166.1, 195.8; IR (cm^{-1}): 3035, 2957, 2927, 2870, 1666, 1644, 1580, 1484, 1460, 1382, 1235, 1176, 1143, 1013, 852, 752, 694, 662; HRMS m/z (ESI) calcd for $\text{C}_{23}\text{H}_{24}\text{NaO}_2\text{S}$ [M + Na]⁺ 387.1395 found 387.1390.

9-((2,4-Dimethylphenylthio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4f)

brown liquid; ^1H NMR (CDCl_3): 1.09 (s, 3H), 1.17 (s, 3H), 2.10 (s, 3H), 2.30 s, 3H), 2.31-2.50 (m, 4H), 5.23 (s, 1H), 6.87 (d, J = 7.6 Hz, 2H), 6.93-7.02 (m, 3H), 7.09 (d, J = 7.6 Hz, 1H), 7.19 (dt, J_a = 1.2 Hz, J_b = 8.4 Hz, 1H); ^{13}C NMR: 21.0, 28.4, 28.6, 31.9, 40.6, 41.3, 50.8, 109.7, 115.8, 122.8, 124.9, 127.9, 129.6, 130.3, 131.0, 134.1, 137.6, 150.9, 166.1, 195.8; IR (cm^{-1}): 3073, 3035, 3003, 2949, 2890, 2869, 1669, 1645, 1578, 1482, 1458, 1384, 1234, 1179, 1141, 1011, 818, 753, 661; HRMS m/z (ESI) calcd for $\text{C}_{23}\text{H}_{24}\text{NaO}_2\text{S}$ [M + Na]⁺ 387.1395 found 387.1391.

9-((4-Chlorophenylthio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4g)

brown liquid; ^1H NMR (CDCl_3): 1.07 (s, 3H), 1.15 (s, 3H), 2.28-2.40 (m, 4H), 5.28 (s, 1H), 6.83 (d, J = 8.0 Hz, 1H), 6.97 (d, J = 8.0 Hz, 2H), 7.09-7.13 (m, 3H), 7.17 (dt, J_a = 1.6 Hz, J_b = 7.6 Hz, 1H), 7.23 (dd, J_a = 1.6 Hz, J_b = 7.6 Hz, 1H); ^{13}C NMR: 28.4, 28.5, 32.0, 41.0, 41.3, 50.8, 109.6, 116.2, 122.3, 125.1, 128.3, 128.4, 129.5, 130.5, 135.2, 137.5, 150.7, 166.3, 195.7; IR (cm^{-1}): 3062, 2958, 2871, 1665, 1643, 1579, 1473, 1383, 1236, 1176, 1092, 1013, 910, 825, 753, 732, 662; HRMS m/z (ESI) calcd for $\text{C}_{21}\text{H}_{19}\text{ClNaO}_2\text{S}$ [M + Na]⁺ 393.0692 found 393.0690.

9-(Benzylthio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4h)

brown liquid; ^1H NMR (CDCl_3): 1.08 (s, 3H), 1.18 (s, 3H), 2.18-2.35 (m, 4H), 3.56 (d, J = 13.6 Hz, 1H), 3.65 (d, J = 13.6 Hz, 1H), 5.07 (s, 1H), 7.03 (d, J = 8.0 Hz, 1H), 7.12-7.16 (m, 1H), 7.17-7.29 (m, 7H); ^{13}C NMR: 28.0, 28.7, 31.9, 34.8, 35.4, 41.3, 50.7, 110.8, 116.2, 122.3, 125.3, 126.7, 128.2, 128.3, 128.9, 129.9, 138.4, 150.8, 165.5, 196.4; IR (cm^{-1}): 3060, 3028, 2957, 2870, 1665, 1644, 1581, 1486, 1456, 1380, 1234, 1176, 1143, 1029, 921, 754, 705, 663; HRMS m/z (ESI) calcd for $\text{C}_{22}\text{H}_{22}\text{NaO}_2\text{S}$ [M + Na]⁺ 373.1238 found 373.1234.

9-(Cyclohexylthio)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (4i)

brown liquid; ^1H NMR (CDCl_3): 1.11 (s, 3H), 1.16 (s, 3H), 1.19-1.38 (m, 6H), 1.47-1.53 (m, 1H), 1.64-1.69 (m, 3H), 1.90-1.92 (m, 1H), 2.29 (d, J = 16.4 Hz, 1H), 2.57 (d, J = 16.4 Hz, 1H), 2.47 (d, J = 16.8 Hz, 1H), 2.54 (d, J = 16.8 Hz, 1H), 2.67-2.72 (m, 1H), 5.07 (s, 1H), 7.02 (d, J = 8.4 Hz, 1H), 7.14 (t, J = 7.2 Hz, 1H), 7.20 (t, J = 7.6 Hz, 1H), 7.34 (d, J = 7.6 Hz, 1H); ^{13}C NMR: 25.7, 26.0, 26.2, 27.2, 29.3, 32.0, 33.9, 34.1, 34.5, 41.5, 43.4, 50.7, 111.8, 116.4, 123.7, 125.1, 127.9, 129.4, 150.6, 155.9, 196.2; IR (cm^{-1}): 3040, 2928, 2851, 1664, 1644, 1581, 1484, 1459, 1380, 1234, 1177, 1143, 1028, 1011, 755, 732; HRMS m/z (ESI) calcd for $\text{C}_{21}\text{H}_{26}\text{NaO}_2\text{S}$ [M + Na]⁺ 365.1551 found 365.1549.

3,3-Dimethyl-9-(thiophen-2-ylmethyl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4j)

brown liquid; ^1H NMR (CDCl_3): 1.08 (s, 3H), 1.13 (s, 3H), 2.27 (d, J = 16.0 Hz, 1H), 2.33 (d, J = 16.0 Hz, 1H), 2.41 (d, J = 17.2 Hz, 1H), 2.50 (d, J = 17.2 Hz, 1H), 3.57 (d, J = 14.8 Hz, 1H), 3.79 (d, J = 14.8 Hz, 1H), 5.05 (s, 1H), 6.14 (d, J = 3.2 Hz, 1H), 6.26 (dd, J_a = 1.6 Hz, J_b = 3.2 Hz, 1H), 7.00 (d, J = 8.0 Hz, 1H), 7.10 (t, J = 8.0 Hz, 1H), 7.14-7.20 (m, 2H), 7.30 (dd, J_a = 0.8 Hz, J_b = 2.0 Hz, 1H); ^{13}C NMR: 27.5, 27.6, 28.7, 31.8, 35.1, 41.2, 50.5, 107.3, 110.3, 110.7, 116.0, 122.1, 125.1, 128.0, 129.6, 141.7, 150.4, 151.5, 165.5, 196.1; IR (cm^{-1}): 3116, 2958, 2871, 1644, 1581, 1485, 1460, 1380, 1235, 1177, 1146, 1011, 933, 911, 755, 734, 663; HRMS m/z (ESI) calcd for $\text{C}_{20}\text{H}_{20}\text{NaO}_2\text{S}$ [M + Na]⁺ 347.1082 found 347.1078.

5-Methoxy-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4k)

brown liquid; ^1H NMR (CDCl_3): 1.05 (s, 3H), 1.14 (s, 3H), 2.29-2.45 (m, 4H), 3.78 (s, 3H), 5.28 (s, 1H), 6.74 (dd, J_a = 1.2 Hz, J_b = 8.4 Hz, 1H), 6.82 (dd, J_a = 1.2 Hz, J_b = 8.0 Hz, 1H), 7.02 (t, J = 8.0 Hz, 1H), 7.08 (dd, J_a = 1.2 Hz, J_b = 8.0 Hz, 2H), 7.14 (t, J = 8.0 Hz, 2H), 7.26 (t, J = 7.2 Hz, 1H); ^{13}C NMR: 28.4, 28.5, 32.0, 41.0, 41.3, 50.8, 109.6, 116.2, 122.3, 125.1, 128.3, 128.4, 129.5, 130.5, 135.2, 137.5, 150.7, 166.3, 195.7; IR (cm^{-1}): 3055, 3003,

2958, 2871, 2838, 1663, 1645, 1612, 1583, 1483, 1439, 1384, 1274, 1228, 1186, 1124, 1093, 913, 736, 694; HRMS m/z (ESI) calcd for $C_{22}H_{22}NaO_3S$ [M + Na]⁺ 389.1187 found 389.1180.

5-Ethoxy-3,3-dimethyl-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4l)

brown liquid; ¹H NMR ($CDCl_3$): 1.06 (s, 3H), 1.15 (s, 3H), 1.37 (t, $J = 6.8$ Hz, 3H), 2.30-2.47 (m, 4H), 4.01 (q, $J = 6.8$ Hz, 2H), 5.29 (s, 1H), 6.74 (dd, $J_a = 1.2$ Hz, $J_b = 8.0$ Hz, 1H), 6.78 (dd, $J_a = 0.8$ Hz, $J_b = 7.6$ Hz, 1H), 7.00 (t, $J = 7.6$ Hz, 1H), 7.10 (dd, $J_a = 1.2$ Hz, $J_b = 8.0$ Hz, 2H), 7.15 (t, $J = 8.0$ Hz, 2H), 7.26 (m, 1H); ¹³C NMR: 14.7, 28.4, 28.5, 32.1, 41.0, 41.3, 50.9, 64.9, 109.7, 112.3, 121.0, 123.7, 124.6, 128.3, 128.7, 132.2, 136.1, 140.9, 146.7, 166.2, 196.0; IR (cm^{-1}): 3056, 2958, 2935, 2872, 1664, 1645, 1612, 1582, 1473, 1384, 1275, 1227, 1191, 1117, 1084, 736, 694; HRMS m/z (ESI) calcd for $C_{23}H_{24}NaO_3S$ [M + Na]⁺ 403.1344 found 403.1340.

7-Bromo-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4m)

brown liquid; ¹H NMR ($CDCl_3$): 1.06 (s, 3H), 1.15 (s, 3H), 2.23-2.41 (m, 4H), 5.21 (s, 1H), 6.68 (d, $J = 8.8$ Hz, 1H), 7.07 (d, $J = 7.2$ Hz, 2H), 7.18 (t, $J = 7.6$ Hz, 2H), 7.25 (dd, $J_a = 2.0$ Hz, $J_b = 8.8$ Hz, 1H), 7.28-7.32 (m, 2H); ¹³C NMR: 28.4, 28.5, 32.1, 40.4, 41.2, 50.8, 109.4, 117.1, 117.8, 124.7, 128.4, 129.1, 131.0, 131.3, 132.0, 136.5, 149.6, 166.0, 195.6; IR (cm^{-1}): 3057, 2958, 2870, 1666, 1644, 1573, 1474, 1438, 1414, 1380, 1233, 1175, 1144, 1024, 910, 816, 739, 694; HRMS m/z (ESI) calcd for $C_{21}H_{19}BrNaO_2S$ [M + Na]⁺ 437.0187 found 437.0185.

9-(Phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4n)

brown liquid; ¹H NMR ($CDCl_3$): 1.98-2.05 (m, 2H), 2.34-2.45 (m, 3H), 2.56 (dt, $J_a = 5.2$ Hz, $J_b = 16.8$ Hz, 1H), 5.31 (s, 1H), 6.74 (d, $J = 9.2$ Hz, 1H), 6.99 (d, $J = 9.2$ Hz, 2H), 7.12-7.16 (m, 4H), 7.27-7.34 (m, 2H); ¹³C NMR: 20.2, 27.5, 36.8, 40.5, 110.5, 115.8, 122.6, 125.1, 128.1, 128.2, 129.0, 129.6, 131.3, 136.9, 150.5, 167.9, 196.0; IR (cm^{-1}): 3057, 2949, 2888, 1664, 1639, 1580, 1483, 1458, 1382, 1238, 1173, 1134, 994, 748, 694; HRMS m/z (ESI) calcd for $C_{19}H_{16}NaO_2S$ [M + Na]⁺ 331.0769 found 331.0761.

3-Methyl-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4o)

brown liquid; ¹H NMR ($CDCl_3$): 1.10 (dd, $J_a = 4.8$ Hz, $J_b = 6.4$ Hz, 3H), 2.03-2.19 (m, 2H), 2.23-2.29 (m, 1H), 2.33-2.41 (m, 1H), 2.56-2.61 (m, 1H), 5.29 (s, 1H), 6.73-6.76 (m, 1H), 6.97-7.00 (m, 2H), 7.11-7.16 (m, 4H), 7.27-7.33 (m, 2H); ¹³C NMR: 20.9, 21.1, 27.7, 28.6, 35.6, 35.7, 40.5, 40.9, 45.1, 45.4, 110.2, 115.9, 122.4, 122.7, 125.0, 125.1, 128.1, 128.2, 128.3, 128.4, 128.9, 129.6, 131.3, 136.8, 136.9, 150.6, 167.1, 167.5, 195.9; IR (cm^{-1}): 3056, 2957, 2926, 2873, 1661, 1640, 1580, 1483, 1458, 1385, 1234, 1174, 1136, 1016, 745, 695; HRMS m/z (ESI) calcd for $C_{20}H_{18}NaO_2S$ [M + Na]⁺ 345.0925 found 345.0922.

3-Isopropyl-9-(phenylthio)-2,3,4,9-tetrahydro-1H-xanthen-1-one (4p)

brown liquid; ¹H NMR ($CDCl_3$): 0.93-0.97 (m, 6H), 1.61 (sext, $J = 6.8$ Hz, 1H), 1.86-1.95 (m, 1H), 2.10-2.23 (m, 2H), 2.31-2.37 (m, 1H), 2.60-2.65 (m, 1H), 5.29 (s, 0.57H), 5.30 (s, 0.42H), 6.74-6.77 (m, 1H), 6.95-7.02 (m, 2H), 7.12-7.16 (m, 4H), 7.28-7.32 (m, 2H); ¹³C NMR: 19.5, 19.6, 19.7, 31.4, 31.5, 31.7, 31.9, 38.9, 39.9, 40.5, 40.8, 40.9, 41.4, 110.1, 115.9, 122.7, 125.1, 125.2, 128.1, 128.2, 128.9, 129.6, 129.7, 131.4, 136.9, 137.0, 150.6, 168.1, 196.2; IR (cm^{-1}): 3058, 2960, 2873, 1722, 1664, 1643, 1581, 1483, 1461, 1386, 1229, 1175, 1141, 1028, 908, 748, 695; HRMS m/z (ESI) calcd for $C_{22}H_{22}NaO_2S$ [M + Na]⁺ 373.1238 found 373.1235.

5-Methoxy-3,3-dimethyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6a)

white solid, mp = 233-235 °C; ¹H NMR ($DMSO-d_6$): 0.95 (s, 3H), 1.08 (s, 3H), 2.19 (d, $J = 16.4$ Hz, 1H), 2.30 (d, $J = 16.4$ Hz, 1H), 2.63-2.65 (m, 2H), 3.80 (s, 3H), 5.41 (s, 1H), 6.20 (d, $J = 5.6$ Hz, 1H), 6.79 (d, $J = 6.8$ Hz, 2H), 6.88 (d, $J = 7.6$ Hz, 1H), 6.99 (d, $J = 7.6$ Hz, 1H), 7.28-7.32 (m, 2H), 7.46 (t, $J = 7.6$ Hz, 1H), 7.59 (d, $J = 7.6$ Hz, 2H), 8.13 (d, $J = 6.4$ Hz, 2H), 11.20 (s, 1H); ¹³C NMR: 27.3, 28.6, 29.1, 32.0, 41.1, 50.9, 56.1, 110.3, 111.3, 111.8, 116.1, 118.7, 119.1, 120.8, 121.5, 124.8, 126.3, 126.8, 128.1, 128.3, 128.5, 129.1, 129.6, 133.7, 134.6, 136.4, 138.2, 147.5, 164.9, 197.4; IR (cm^{-1}): 3441, 3411, 3325, 3056, 2953, 2932, 2873, 1636, 1612, 1584, 1481, 1456, 1374, 1273, 1222, 1187, 1115, 1091, 928, 765, 738, 700; HRMS m/z (ESI) calcd for $C_{30}H_{27}NNaO_3$ [M + Na]⁺ 472.1889 found 472.1885.

5-Ethoxy-3,3-dimethyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6b)

white solid, mp = 259–261 °C; ^1H NMR (DMSO- d_6): 0.96 (s, 3H), 1.08 (s, 3H), 1.37 (t, J = 7.2 Hz, 3H), 2.09 (d, J = 16.0 Hz, 1H), 2.30 (d, J = 16.0 Hz, 1H), 2.68 (s, 2H), 4.09–4.13 (m, 2H), 5.40 (s, 1H), 6.18 (d, J = 5.6 Hz, 1H), 6.79 (d, J = 6.8 Hz, 2H), 6.88 (d, J = 7.6 Hz, 1H), 6.99 (d, J = 7.6 Hz, 1H), 7.28–7.32 (m, 2H), 7.46 (t, J = 7.6 Hz, 1H), 7.59 (d, J = 7.6 Hz, 2H), 8.13 (d, J = 6.4 Hz, 2H), 11.20 (s, 1H); ^{13}C NMR: 15.1, 27.2, 28.6, 29.1, 32.0, 41.2, 50.9, 64.5, 111.3, 111.5, 111.8, 116.2, 118.7, 119.1, 120.8, 121.5, 124.8, 126.4, 126.8, 128.1, 128.3, 128.5, 129.1, 129.6, 133.5, 133.7, 134.6, 136.4, 138.5, 146.8, 164.9, 197.4; IR (cm $^{-1}$): 3411, 3314, 3059, 2970, 2928, 2888, 1631, 1610, 1581, 1466, 1376, 1274, 1227, 1189, 1113, 1079, 771, 741, 701; HRMS m/z (ESI) calcd for C₃₁H₂₉NNaO₃ [M + Na] $^+$ 486.2045 found 486.2040.

7-Bromo-3,3-dimethyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6c)

white solid, mp = 286–288 °C; ^1H NMR (DMSO- d_6): 0.93 (s, 3H), 1.06 (s, 3H), 2.68 (d, J = 16.0 Hz, 1H), 2.29 (d, J = 16.0 Hz, 1H), 2.69 (d, J = 17.6 Hz, 1H), 2.66 (d, J = 17.6 Hz, 1H), 5.42 (s, 1H), 6.69 (s, 1H), 6.89 (t, J = 7.6 Hz, 1H), 7.03 (t, J = 7.6 Hz, 1H), 7.10 (d, J = 8.8 Hz, 1H), 7.25–7.33 (m, 3H), 7.48 (t, J = 7.6 Hz, 1H), 7.60 (t, J = 7.6 Hz, 2H), 8.07 (s, 2H), 11.30 (s, 1H); ^{13}C NMR: 27.3, 28.6, 29.0, 31.9, 40.9, 50.8, 111.2, 112.0, 115.8, 116.5, 118.5, 119.0, 119.3, 121.7, 126.7, 128.2, 128.3, 129.2, 129.6, 130.9, 132.0, 133.4, 134.8, 136.4, 148.0, 164.7, 197.1; IR (cm $^{-1}$): 3343, 3058, 2962, 2930, 2872, 1628, 1573, 1477, 1452, 1374, 1233, 1175, 1012, 815, 773, 734, 702, 628; HRMS m/z (ESI) calcd for C₂₉H₂₄BrNNaO₂ [M + Na] $^+$ 520.0888 found 520.0880.

9,9-Dimethyl-12-(2-phenyl-1H-indol-3-yl)-9,10-dihydro-8H-benzo[a]xanthene-11(12H)-one (6d)

white solid, mp = 303–305 °C; ^1H NMR (DMSO- d_6): 0.93 (s, 3H), 1.11 (s, 3H), 2.19 (d, J = 16.0 Hz, 1H), 2.43 (d, J = 16.0 Hz, 1H), 2.71 (d, J = 17.6 Hz, 1H), 2.81 (d, J = 17.6 Hz, 1H), 5.94 (s, 1H), 6.84 (quint, J = 7.6 Hz, 2H), 6.95 (t, J = 8.4 Hz, 1H), 7.11 (d, J = 8.4 Hz, 1H), 7.23 (t, J = 8.0 Hz, 2H), 7.33–7.38 (m, 2H), 7.59 (t, J = 7.2 Hz, 1H), 7.70–7.56 (m, 4H), 8.41 (s, 2H), 11.23 (s, 1H); ^{13}C NMR: 26.3, 26.9, 29.4, 32.1, 41.1, 51.1, 111.8, 112.0, 114.8, 117.4, 117.6, 118.6, 119.2, 121.4, 124.1, 124.9, 126.3, 126.9, 128.5, 128.8, 129.0, 129.2, 129.9, 131.3, 131.4, 134.4, 136.3, 146.7, 165.0, 197.9; IR (cm $^{-1}$): 3420, 3235, 3217, 3064, 2955, 2928, 2869, 1640, 1619, 1595, 1451, 1372, 1226, 1173, 1148, 1028, 808, 766, 738, 699; HRMS m/z (ESI) calcd for C₃₃H₂₇NNaO₂ [M + Na] $^+$ 492.1939 found 492.1935.

3,3-Dimethyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6e)

white solid, mp = 258–260 °C; ^1H NMR (DMSO- d_6): 0.93 (s, 3H), 1.07 (s, 3H), 2.07 (d, J = 16.0 Hz, 1H), 2.29 (d, J = 16.0 Hz, 1H), 2.60 (d, J = 17.6 Hz, 1H), 2.68 (d, J = 17.6 Hz, 1H), 5.42 (s, 1H), 6.64 (d, J = 7.6 Hz, 1H), 6.83–6.91 (m, 2H), 6.99 (t, J = 7.6 Hz, 1H), 7.09 (d, J = 4.0 Hz, 2H), 7.24–7.29 (m, 2H), 7.46 (t, J = 7.6 Hz, 1H), 7.58 (t, J = 7.6 Hz, 2H), 8.10 (d, J = 5.6 Hz, 1H), 11.20 (s, 1H); ^{13}C NMR: 26.8, 28.1, 28.7, 31.4, 40.6, 50.4, 111.0, 111.3, 115.8, 116.0, 118.2, 118.6, 121.0, 124.7, 125.1, 127.5, 127.7, 128.6, 129.2, 129.3, 133.2, 134.1, 135.9, 148.2, 164.5, 196.8; IR (cm $^{-1}$): 3324, 3044, 2959, 2932, 2874, 1627, 1484, 1452, 1377, 1229, 1180, 754, 702; HRMS m/z (ESI) calcd for C₂₉H₂₅NNaO₂ [M + Na] $^+$ 442.1783 found 442.1775.

3,3-Dimethyl-9-(1-methyl-2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6f)

white solid, mp = 300–302 °C; ^1H NMR (DMSO- d_6): 0.93 (s, 3H), 1.04 (s, 3H), 2.06 (d, J = 16.0 Hz, 1H), 2.25 (d, J = 16.0 Hz, 1H), 2.53 (d, J = 17.6 Hz, 1H), 2.61 (d, J = 17.6 Hz, 1H), 3.49 (s, 3H), 5.09 (s, 1H), 6.74 (d, J = 7.2 Hz, 1H), 6.89–6.92 (m, 2H), 7.06–7.13 (m, 3H), 7.32 (d, J = 7.2 Hz, 1H), 7.39 (d, J = 8.0 Hz, 1H), 7.54 (t, J = 7.2 Hz, 1H), 7.62 (t, J = 7.2 Hz, 2H), 7.81 (br, 2H); ^{13}C NMR: 27.5, 28.8, 29.0, 30.9, 31.9, 41.0, 50.8, 110.4, 111.5, 116.5, 118.7, 119.4, 121.6, 125.2, 125.5, 128.0, 128.8, 129.7, 131.5, 131.9, 137.1, 137.3, 148.8, 164.8, 197.0; IR (cm $^{-1}$): 3063, 2958, 2868, 1646, 1582, 1484, 1469, 1375, 1227, 1182, 1032, 1016, 756, 745, 707; HRMS m/z (ESI) calcd for C₃₀H₂₇NNaO₂ [M + Na] $^+$ 456.1939 found 456.1935.

9-(1-Ethyl-2-phenyl-1H-indol-3-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (6g)

white solid, mp = 214–216 °C; ^1H NMR (DMSO- d_6): 0.94 (s, 3H), 1.03 (s, 3H), 1.09 (t, J = 6.8 Hz, 3H), 2.07 (d, J

= 16.0 Hz, 1H), 2.23 (d, J = 16.0 Hz, 1H), 2.52 (d, J = 17.6 Hz, 1H), 2.57 (d, J = 17.6 Hz, 1H), 3.94 (dt, J_a = 6.8 Hz, J_b = 14.4 Hz, 2H), 5.01 (s, 1H), 6.82 (d, J = 7.2 Hz, 1H), 6.93 (dt, J_a = 7.2 Hz, J_b = 1.6 Hz, 2H), 7.05-7.13 (m, 3H), 7.35 (d, J = 7.2 Hz, 1H), 7.41 (d, J = 8.0 Hz, 1H), 7.52-7.98 (m, 5H); ^{13}C NMR: 15.6, 27.7, 28.7, 28.9, 31.9, 38.4, 41.0, 50.8, 110.4, 111.5, 116.5, 117.2, 118.8, 119.4, 121.5, 125.5, 127.9, 128.9, 129.8, 132.1, 135.8, 136.8, 148.8, 164.7, 196.9; IR (cm^{-1}): 3251, 3180, 2958, 2874, 1641, 1594, 1458, 1376, 1223, 1174, 1140, 1013, 942, 825, 743; HRMS m/z (ESI) calcd for $\text{C}_{31}\text{H}_{29}\text{NNaO}_2$ [M + Na]⁺ 470.2096 found 470.2092.

9-(1H-indol-3-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (6h)

white solid, mp = 220-221 °C; ^1H NMR (DMSO-*d*₆): 0.93 (s, 3H), 1.05 (s, 3H), 2.08 (d, J = 16.0 Hz, 1H), 2.27 (d, J = 16.0 Hz, 1H), 2.65 (s, 2H), 3.82 (s, 3H), 5.16 (s, 1H), 6.80 (d, J = 1.2 Hz, 1H), 6.86-7.01 (m, 4H), 7.25 (d, J = 2.4 Hz, 1H), 7.28 (d, J = 8.0 Hz, 1H), 7.43 (d, J = 8.0 Hz, 1H), 10.82 (s, 1H); ^{13}C NMR: 18.4, 26.7, 28.5, 28.7, 31.6, 40.5, 50.2, 55.6, 56.0, 109.8, 111.4, 111.8, 118.2, 118.4, 119.5, 120.7, 120.8, 122.5, 124.3, 125.2, 126.5, 136.3, 138.3, 147.2, 164.0, 196.1; IR (cm^{-1}): 3404, 3324, 3058, 2958, 2939, 2870, 1639, 1612, 1582, 1481, 1456, 1378, 1337, 1275, 1229, 1186, 1089, 928, 766, 740; HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{23}\text{NNaO}_3$ [M + Na]⁺ 396.1576 found 396.1569.

5-Methoxy-3,3-dimethyl-9-(2-methyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6i)

white solid, mp = 243-245 °C; ^1H NMR (DMSO-*d*₆): 0.84 (s, 3H), 1.04 (s, 3H), 2.02 (d, J = 16.0 Hz, 1H), 2.23 (d, J = 16.0 Hz, 1H), 2.50 (s, 3H), 2.58 (d, J = 17.6 Hz, 1H), 2.64 (d, J = 17.6 Hz, 1H), 3.83 (s, 3H), 5.10 (s, 1H), 6.60 (d, J = 2.8 Hz, 1H), 6.76-6.84 (m, 2H), 6.86-6.92 (m, 2H), 7.10 (d, J = 8.0 Hz, 1H), 7.17 (d, J = 8.0 Hz, 1H), 10.73 (s, 1H); ^{13}C NMR: 11.4, 26.4, 27.6, 28.7, 31.5, 40.4, 50.1, 55.5, 109.7, 110.4, 111.4, 117.0, 118.0, 119.5, 121.0, 124.3, 125.9, 126.3, 131.4, 134.9, 138.4, 147.0, 163.3, 196.1; IR (cm^{-1}): 3344, 3056, 2955, 2928, 2869, 1637, 1613, 1582, 1483, 1461, 1377, 1275, 1227, 1184, 1089, 738, 642; HRMS m/z (ESI) calcd for $\text{C}_{25}\text{H}_{25}\text{NNaO}_3$ [M + Na]⁺ 410.1732 found 410.1730

5-Methoxy-3,3-dimethyl-9-(6-methyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6j)

white solid, mp = 240-242 °C; ^1H NMR (DMSO-*d*₆): 0.92 (s, 3H), 1.05 (s, 3H), 2.07 (d, J = 16.0 Hz, 1H), 2.25 (d, J = 16.0 Hz, 1H), 2.31 (s, 3H), 2.61 (d, J = 17.2 Hz, 1H), 2.65 (d, J = 17.2 Hz, 1H), 3.81 (s, 3H), 5.11 (s, 1H), 6.72 (dd, J_a = 0.8 Hz, J_b = 8.0 Hz, 1H), 6.77 (d, J = 8.0 Hz, 1H), 6.84 (dd, J_a = 1.2 Hz, J_b = 8.0 Hz, 1H), 6.90-6.94 (m, 1H), 7.03-7.05 (m, 2H), 7.28 (d, J = 8.0 Hz, 1H), 10.63 (s, 1H); ^{13}C NMR: 21.2, 26.6, 28.5, 28.7, 31.6, 40.4, 50.2, 55.6, 109.7, 111.2, 111.7, 117.9, 119.3, 120.1, 120.7, 121.7, 123.1, 124.2, 126.5, 129.6, 136.7, 138.3, 147.1, 163.9, 196.0; IR (cm^{-1}): 3311, 3049, 2951, 2864, 1637, 1581, 1480, 1455, 1376, 1330, 1274, 1230, 1183, 1088, 1061, 802, 741, 585; HRMS m/z (ESI) calcd for $\text{C}_{25}\text{H}_{25}\text{NNaO}_3$ [M + Na]⁺ 410.1732 found 410.1730.

9-(6-Fluoro-1H-indol-3-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (6k)

white solid, mp = 253-255 °C; ^1H NMR (DMSO-*d*₆): 0.92 (s, 3H), 1.05 (s, 3H), 2.09 (d, J = 16.0 Hz, 1H), 2.26 (d, J = 16.0 Hz, 1H), 2.64 (s, 2H), 3.82 (s, 3H), 5.15 (s, 1H), 6.76-6.81 (m, 2H), 6.86 (dd, J_a = 1.2 Hz, J_b = 8.4 Hz, 1H), 6.94 (t, J = 8.0 Hz, 1H), 7.05 (dd, J_a = 2.4 Hz, J_b = 10.0 Hz, 1H), 7.15 (d, J = 2.4 Hz, 1H), 7.40 (dd, J_a = 5.6 Hz, J_b = 8.8 Hz, 1H), 10.89 (s, 1H); ^{13}C NMR: 26.6, 28.3, 28.6, 31.6, 40.4, 50.1, 55.6, 97.2, 97.4, 106.7, 106.9, 109.9, 111.7, 119.1, 119.2, 119.6, 120.7, 122.0, 123.1, 123.2, 124.3, 126.2, 136.0, 136.1, 138.2, 147.2, 157.3, 159.6, 164.0, 196.0; IR (cm^{-1}): 3301, 3094, 2956, 2940, 2837, 1638, 1581, 1549, 1482, 1457, 1377, 1275, 1230, 1185, 1090, 951, 842, 831, 804, 745; HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{22}\text{FNNaO}_3$ [M + Na]⁺ 414.1481 found 414.1475.

9-(5-Bromo-1H-indol-3-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (6l)

white solid, mp = 238-240 °C; ^1H NMR (DMSO-*d*₆): 0.94 (s, 3H), 1.06 (s, 3H), 2.09 (d, J = 16.0 Hz, 1H), 2.28 (d, J = 16.0 Hz, 1H), 2.61 (d, J = 17.6 Hz, 1H), 2.67 (d, J = 17.6 Hz, 1H), 3.84 (s, 3H), 5.16 (s, 1H), 6.79 (d, J = 6.8 Hz, 1H), 6.88 (d, J = 7.2 Hz, 1H), 6.96 (t, J = 8.0 Hz, 1H), 7.11 (dd, J_a = 1.6 Hz, J_b = 8.8 Hz, 1H), 7.17 (d, J = 2.4 Hz, 1H), 7.25 (d, J = 7.2 Hz, 1H), 7.61 (d, J = 1.2 Hz, 1H), 10.05 (s, 1H); ^{13}C NMR: 26.4, 28.1, 28.7, 31.6, 40.4, 50.1, 55.6, 110.0, 111.1, 113.4, 119.6, 120.6, 120.7, 123.1, 124.3, 124.4, 126.2, 127.0, 134.8, 138.2, 147.2, 164.0,

196.0; IR (cm^{-1}): 3306, 3006, 2956, 2935, 2887, 2836, 1639, 1612, 1582, 1481, 1463, 1377, 1276, 1228, 1185, 1090, 882, 790, 764, 645; HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{22}\text{BrNNaO}_3$ [$\text{M} + \text{Na}$]⁺ 474.0681 found 474.0671.

9-(2-Phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6m)

white solid, mp = 299-302 °C; ¹H NMR (DMSO-*d*₆): 1.74-1.80 (m, 1H), 1.94-2.00 (m, 1H), 2.18-2.22 (m, 1H), 2.28-2.35 (m, 1H), 2.70 (t, J = 5.6 Hz, 1H), 5.46(s, 1H), 6.71 (d, J = 7.6 Hz, 1H), 6.87-6.92 (m, 2H), 7.02 (t, J = 7.6 Hz, 1H), 7.10 (d, J = 3.6 Hz, 2H), 7.32 (dd, J_a = 8.0 Hz, J_b = 12.0 Hz, 2H), 7.47 (t, J = 7.2 Hz, 1H), 7.58 (t, J = 7.6 Hz, 2H), 8.04 (d, J = 7.6 Hz, 2H), 11.20 (s, 1H); ¹³C NMR: 20.6, 27.7, 28.5, 37.2, 111.8, 112.5, 116.3, 116.5, 118.5, 119.3, 121.5, 125.2, 125.7, 127.1, 128.0, 128.2, 129.0, 129.6, 129.8, 133.8, 134.7, 136.4, 148.5, 166.7, 197.2; IR (cm^{-1}): 3413, 3054, 2963, 2881, 1642, 1578, 1484, 1453, 1372, 1224, 1181, 995, 766, 736, 702; HRMS m/z (ESI) calcd for $\text{C}_{27}\text{H}_{21}\text{NNaO}_2$ [$\text{M} + \text{Na}$]⁺ 414.1470 found 414.1468.

3-Methyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6n)

white solid, mp = 268-270 °C; ¹H NMR (DMSO-*d*₆): 1.01 (dd, J_a = 6.4 Hz, J_b = 16.8 Hz, 3H), 2.01-2.50 (m, 4H), 2.74 (d, J = 16.8 Hz, 1H), 5.45 (d, J = 11.2 Hz, 1H), 6.67-6.71 (m, 1H), 6.85-6.92 (m, 2H), 7.00-7.04 (m, 1H), 7.09 (t, J = 3.6 Hz, 2H), 7.30-7.32 (m, 2H), 7.47 (t, J = 7.2 Hz, 1H), 7.58 (t, J = 7.2 Hz, 2H), 8.07 (d, J = 6.8 Hz, 2H), 11.20 (d, J = 4.0 Hz, 1H); ¹³C NMR: 20.6, 20.8, 27.8, 28.1, 28.6, 28.7, 35.2, 35.6, 45.3, 111.8, 111.9, 112.1, 112.2, 116.3, 116.4, 116.5, 116.6, 118.5, 118.6, 119.2, 119.3, 121.5, 125.1, 125.2, 125.5, 125.7, 126.9, 127.0, 128.0, 128.1, 129.0, 129.6, 129.8, 133.8, 134.7, 134.8, 136.4, 148.6, 165.4, 166.4, 197.2; IR (cm^{-1}): 3367, 3060, 2950, 2922, 2868, 1637, 1580, 1485, 1456, 1425, 1379, 1347, 1228, 1178, 1131, 1030, 1015, 755, 741, 700; HRMS m/z (ESI) calcd for $\text{C}_{28}\text{H}_{23}\text{NNaO}_2$ [$\text{M} + \text{Na}$]⁺ 428.1626 found 428.1622.

3-Phenyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6o)

white solid, mp = 254-256 °C; ¹H NMR (DMSO-*d*₆): 2.39-2.46 (m, 1H), 2.63-2.70 (m, 1H), 2.86-2.89 (m, 1H), 3.03-3.10 (m, 1H), 3.35-3.56 (m, 1H), 5.50 (d, J = 12.8 Hz, 1H), 6.76 (dd, J_a = 7.6 Hz, J_b = 22.4 Hz, 1H), 6.85-6.98 (m, 2H), 7.00-7.07 (m, 1H), 7.10-7.14 (m, 2H), 7.20-7.37 (m, 6H), 7.43-7.50 (m, 2H), 7.57-7.61 (t, J = 7.6 Hz, 2H), 8.12 (d, J = 6.8 Hz, 2H), 11.21 (d, J = 16.0 Hz, 1H); ¹³C NMR: 28.6, 28.8, 34.7, 35.0, 38.2, 38.3, 44.3, 44.4, 111.7, 111.8, 112.2, 112.4, 116.3, 116.5, 116.6, 118.6, 118.7, 119.3, 119.5, 121.4, 121.5, 125.2, 125.3, 125.8, 127.1, 127.2, 127.3, 128.0, 128.1, 128.2, 128.3, 128.9, 129.0, 129.7, 129.8, 133.8, 134.8, 134.9, 136.3, 143.2, 143.3, 148.6, 166.2, 196.3; IR (cm^{-1}): 3399, 3057, 3027, 2953, 2887, 1639, 1580, 1485, 1455, 1382, 1356, 1223, 1186, 1031, 1011, 757, 748, 699, 520; HRMS m/z (ESI) calcd for $\text{C}_{33}\text{H}_{25}\text{NNaO}_2$ [$\text{M} + \text{Na}$]⁺ 490.1783 found 490.1780.

3-Isopropyl-9-(2-phenyl-1H-indol-3-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (6p)

white solid, mp = 225-227 °C; ¹H NMR (DMSO-*d*₆): 0.83-0.91 (m, 6H), 2.05-2.17 (m, 3H), 2.23-2.32 (m, 1H), 2.50-2.68 (m, 2H), 5.43 (d, J = 8.8 Hz, 1H), 6.72 (dd, J_a = 8.0 Hz, J_b = 14.4 Hz, 1H), 6.86-6.93 (m, 2H), 7.02 (dt, J_a = 2.8 Hz, J_b = 7.2 Hz, 1H), 7.07-7.14 (m, 2H), 7.28-7.35 (m, 2H), 7.46 (t, J = 7.2 Hz, 1H), 7.57 (t, J = 7.6 Hz, 2H), 8.00 (d, J = 7.2 Hz, 2H), 11.18 (d, J = 8.0 Hz, 1H); ¹³C NMR: 19.7, 19.8, 19.9, 28.5, 28.6, 31.1, 31.4, 31.6, 39.0, 40.9, 41.5, 111.7, 111.8, 112.0, 112.1, 116.3, 116.5, 118.5, 118.6, 119.2, 119.3, 121.5, 125.1, 125.2, 125.5, 125.8, 127.1, 128.0, 128.1, 129.0, 129.6, 129.7, 129.8, 133.8, 133.9, 134.7, 134.8, 136.3, 148.6, 165.8, 166.8, 197.2, 197.5; IR (cm^{-1}): 3418, 3215, 3187, 3054, 2958, 2930, 2894, 2870, 1640, 1582, 1486, 1454, 1379, 1352, 1228, 1020, 754, 736, 700; HRMS m/z (ESI) calcd for $\text{C}_{30}\text{H}_{27}\text{NNaO}_2$ [$\text{M} + \text{Na}$]⁺ 456.1939 found 456.1935.

9-(5-Hydroxy-3-methyl-1-phenyl-1H-pyrazol-4-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (7a)

white solid, mp = 207-209 °C; ¹H NMR (DMSO-*d*₆): 1.02 (s, 3H), 1.06 (s, 3H), 2.13-2.69 (m, 4H), 2.50-2.55 (m, 3H), 4.86 (br, 1H), 7.06-7.19 (m, 5H), 7.37 (t, J = 4.0 Hz, 2H), 7.65 (d, J = 4.0 Hz, 2H), 10.6 (s, 1H); ¹³C NMR: 28.9, 29.4, 29.7, 30.8, 32.5, 40.6, 50.3, 111.4, 117.6, 120.0, 127.6, 129.3, 133.4, 145.0, 150.6, 152.0, 1524.3, 155.3, 161.8, 162.5, 195.8; IR (cm^{-1}): 3430, 3063, 2957, 2940, 2816, 1632, 1579, 1497, 1382, 1234, 1180, 757, 685, 663; HRMS m/z (ESI) calcd for $\text{C}_{25}\text{H}_{24}\text{N}_2\text{NaO}_3$ [$\text{M} + \text{Na}$]⁺ 423.1685 found 423.1680.

6-Amino-5-(3,3-dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-xanthen-9-yl)-1,3-dimethylpyrimidine-2,4(1H,3H)-dio

ne (7b)

white solid, mp > 300 °C; ¹H NMR (DMSO-*d*₆): 0.95 (s, 3H), 1.05 (s, 3H), 2.08 (d, J = 16.4 Hz, 1H), 2.25 (d, J = 16.4 Hz, 1H), 2.55 (d, J = 17.6 Hz, 1H), 2.66 (d, J = 17.6 Hz, 1H), 3.11 (s, 3H), 3.45 (s, 3H), 4.97 (s, 1H), 6.68 (t, J = 8.4 Hz, 2H), 6.96 (dd, J_a = 8.4 Hz, J_b = 12.8 Hz, 2H), 9.18 (s, 1H), 9.48 (s, 1H); ¹³C NMR: 27.4, 28.3, 29.0, 29.7, 30.8, 32.5, 50.3, 90.1, 111.4, 117.6, 119.9, 127.6, 129.4, 133.4, 145.0, 150.6, 152.0, 155.3, 162.5, 195.9; IR (cm⁻¹): 3278, 3234, 3098, 2968, 2953, 1706, 1666, 1638, 1596, 1495, 1382, 1358, 1292, 1246, 1211, 1151, 961, 767, 749, 622; HRMS m/z (ESI) calcd for C₂₁H₂₃N₃NaO₄ [M + Na]⁺ 404.1586 found 404.1580.

9-(4-Amino-2,6-dihydroxypyrimidin-5-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (7c)

white solid, mp > 300 °C; ¹H NMR (DMSO-*d*₆): 0.96 (s, 3H), 1.04 (s, 3H), 2.06 (d, J = 16.0 Hz, 1H), 2.13 (d, J = 16.0 Hz, 1H), 2.50-2.51 (m, 2H), 4.87 (s, 1H), 6.69-6.72 (m, 2H), 6.91-6.98 (m, 2H), 8.97 (s, 1H), 9.52 (s, 1H), 10.42 (s, 1H), 11.00 (s, 1H); ¹³C NMR: 26.8, 27.0, 29.3, 32.1, 41.0, 50.8, 91.0, 110.5, 115.7, 124.4, 125.6, 127.4, 129.1, 150.5, 150.6, 151.5, 163.0, 165.7, 196.7; IR (cm⁻¹): 3482, 3282, 3165, 3011, 2947, 2869, 1721, 1632, 1527, 1443, 1378, 1233, 1195, 1177, 1124, 1020, 954, 801, 753, 649; HRMS m/z (ESI) calcd for C₁₉H₁₉N₃NaO₄ [M + Na]⁺ 376.1273 found 376.1270.

9-(6-Bromo-2-hydroxynaphthalen-1-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (7d)

white solid, mp = 238-240 °C; ¹H NMR (DMSO-*d*₆): 0.93 (s, 3H), 1.07 (s, 3H), 2.10 (d, J = 16.0 Hz, 1H), 2.33 (d, J = 16.0 Hz, 1H), 2.56 (d, J = 17.6 Hz, 1H), 2.68 (d, J = 17.6 Hz, 1H), 5.71 (s, 1H), 6.61 (dt, J_a = 0.8 Hz, J_b = 7.2 Hz, 1H), 6.71 (d, J = 8.0 Hz, 1H), 6.88 (dt, J_a = 1.6 Hz, J_b = 8.0 Hz, 1H), 7.01 (d, J = 7.2 Hz, 1H), 7.43 (d, J = 9.2 Hz, 1H), 7.57 (d, J = 9.2 Hz, 1H), 7.83 (d, J = 9.2 Hz, 1H), 8.15 (s, 1H), 8.25 (d, J = 9.2 Hz, 1H), 9.66 (s, 1H); ¹³C NMR: 26.7, 28.9, 29.4, 32.3, 40.7, 50.6, 113.1, 116.2, 118.4, 118.9, 119.6, 126.3, 127.8, 128.2, 130.0, 130.3, 130.4, 130.6, 131.5, 132.6, 148.0, 154.0, 164.5, 196.5; IR (cm⁻¹): 3444, 3211, 2959, 2941, 2870, 1629, 1597, 1484, 1384, 1224, 1194, 1150, 1032, 887, 792, 758, 673; HRMS m/z (ESI) calcd for C₂₅H₂₁BrNaO₃ [M + Na]⁺ 471.0572 found 471.0570.

3-(3,3-Dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-xanthen-9-yl)-4-hydroxynaphthalene-1,2-dione (7e)

white solid, mp = 254-256 °C; ¹H NMR (DMSO-*d*₆): 0.98 (s, 3H), 1.06 (s, 3H), 2.04 (d, J = 16.0 Hz, 1H), 2.28 (d, J = 16.0 Hz, 1H), 2.41 (d, J = 17.6 Hz, 1H), 2.62 (d, J = 17.6 Hz, 1H), 5.35 (s, 1H), 7.00-7.06 (m, 3H), 7.17-7.21 (m, 1H), 7.76 (t, J = 7.2 Hz, 1H), 7.81-7.87 (m, 1H), 7.93-8.11 (m, 2H), 11.07 (s, 1H); ¹³C NMR: 26.8, 29.4, 32.1, 41.1, 50.6, 56.5, 110.1, 116.3, 125.1, 126.0, 128.3, 129.2, 130.2, 132.1, 133.6, 135.2, 149.8, 155.3, 165.9, 181.9, 183.7, 196.4; IR (cm⁻¹): 3198, 2952, 2929, 1675, 1637, 1580, 1486, 1456, 1366, 1278, 1235, 1186, 1038, 1016, 757, 730; HRMS m/z (ESI) calcd for C₂₅H₂₀NaO₅ [M + Na]⁺ 423.1208 found 423.1205.

5-(3,3-Dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-xanthen-9-yl)pyrimidine-2,4,6(1H,3H,5H)-trione (7f)

white solid, mp = 150-152 °C; ¹H NMR (DMSO-*d*₆): 1.07 (s, 3H), 1.12 (s, 3H), 2.16 (d, J = 16.0 Hz, 1H), 2.38 (d, J = 16.0 Hz, 1H), 2.39 (d, J = 17.2 Hz, 1H), 2.59 (d, J = 17.2 Hz, 1H), 3.69 (d, J = 2.4 Hz, 1H), 4.63 (s, 1H), 7.06-7.15 (m, 3H), 7.26-7.30 (m, 1H), 10.93 (s, 1H), 11.24 (s, 1H); ¹³C NMR: 26.7, 29.7, 32.2, 33.9, 41.1, 50.6, 54.3, 109.2, 116.9, 121.8, 125.4, 128.4, 129.2, 150.3, 151.0, 167.7, 169.3, 170.0, 197.1; IR (cm⁻¹): 3447, 3188, 3079, 3038, 2961, 2872, 1732, 1708, 1647, 1615, 1577, 1438, 1394, 1349, 1235, 1183, 1133, 1047, 1031, 876, 759, 493; HRMS m/z (ESI) calcd for C₁₉H₁₈N₂NaO₅ [M + Na]⁺ 377.1113 found 377.1110.

9-(4-Hydroxy-2-oxo-2H-chromen-3-yl)-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (7g)

white solid, mp = 225-227 °C; ¹H NMR (DMSO-*d*₆): 0.98 (s, 3H), 1.04 (s, 3H), 2.08 (d, J = 16.0 Hz, 1H), 2.29 (d, J = 16.0 Hz, 1H), 2.64 (d, J = 17.6 Hz, 1H), 2.61 (d, J = 17.6 Hz, 1H), 5.47 (s, 1H), 7.00-7.10 (m, 3H), 7.18 (t, J = 7.2 Hz, 1H), 7.28 (d, J = 8.0 Hz, 1H), 7.34 (t, J = 6.8 Hz, 1H), 7.56 (t, J = 8.0 Hz, 1H), 8.01 (d, J = 5.6 Hz, 1H), 11.93 (s, 1H); ¹³C NMR: 26.2, 27.3, 28.9, 31.6, 40.5, 50.1, 115.7, 115.9, 116.0, 116.2, 123.1, 123.2, 123.7, 123.8, 123.9, 124.4, 127.7, 128.6, 131.7, 149.8, 152.0, 152.1, 159.4, 166.2, 196.3; IR (cm⁻¹): 3320, 3198, 2952, 2929, 1675, 1637, 1580, 1486, 1456, 1366, 1278, 1235, 1186, 1038, 1016, 757, 730; HRMS m/z (ESI) calcd for

$C_{24}H_20NaO_5$ [M + Na]⁺ 411.1208 found 411.1203.

3,3-Dimethyl-9-(phenylsulfonyl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (7h)

white solid, mp = 184–186 °C; ¹H NMR (DMSO-*d*₆): 1.02 (s, 3H), 1.17 (s, 3H), 2.25 (d, *J* = 16.0 Hz, 1H), 2.30 (d, *J* = 16.0 Hz, 1H), 2.52 (d, *J* = 17.6 Hz, 1H), 2.61 (d, *J* = 17.6 Hz, 1H), 5.72 (s, 1H), 7.07 (d, *J* = 8.0 Hz, 1H), 7.22 (t, *J* = 7.2 Hz, 1H), 7.35 (d, *J* = 7.6 Hz, 1H), 7.40 (t, *J* = 7.6 Hz, 1H), 7.45 (d, *J* = 7.6 Hz, 2H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.69 (t, *J* = 7.2 Hz, 1H); ¹³C NMR: 27.5, 28.8, 32.1, 41.0, 50.1, 59.3, 104.6, 115.2, 116.8, 125.4, 129.3, 129.4, 130.9, 131.4, 134.6, 136.6, 151.5, 169.4, 194.5; IR (cm⁻¹): 3079, 2961, 2926, 2874, 1658, 1634, 1581, 1486, 1463, 1446, 1381, 1303, 1238, 1173, 1145, 1078, 758, 725, 693, 623, 568, 532; HRMS m/z (ESI) calcd for $C_{21}H_{20}NaO_4S$ [M + Na]⁺ 391.0980 found 391.0978.

9-(1H-Benzo[d][1,2,3]triazol-1-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (7i)

white solid, mp = 182–184 °C; ¹H NMR (DMSO-*d*₆): 0.98 (s, 3H), 1.10 (s, 3H), 2.23 (d, *J* = 16.4 Hz, 1H), 2.37 (d, *J* = 16.4 Hz, 1H), 2.78 (d, *J* = 17.6 Hz, 1H), 2.85 (d, *J* = 17.6 Hz, 1H), 3.89 (s, 3H), 6.82 (dd, *J*_a = 2.0 Hz, *J*_b = 7.2 Hz, 1H), 7.08 (d, *J* = 2.8 Hz, 1H), 7.23 (s, 1H), 7.36–7.40 (m, 1H), 7.59 (dt, *J*_a = 0.2 Hz, *J*_b = 8.0 Hz, 1H), 7.97 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J* = 8.4 Hz, 1H); ¹³C NMR: 26.3, 28.4, 31.9, 40.4, 47.7, 49.7, 55.8, 107.6, 110.6, 112.2, 119.0, 119.8, 120.4, 123.9, 125.3, 127.3, 131.9, 139.0, 144.8, 147.5, 167.6, 195.7; IR (cm⁻¹): 3092, 3058, 2961, 2937, 2891, 2840, 1651, 1614, 1586, 1483, 1448, 1384, 1268, 1234, 1195, 1132, 1087, 756, 747; HRMS m/z (ESI) calcd for $C_{22}H_{21}N_3NaO_3$ [M + Na]⁺ 398.1481 found 398.1475.

12-(1H-benzo[d][1,2,3]triazol-1-yl)-9,9-dimethyl-9,10-dihydro-8H-benzo[a]xanthen-11(12H)-one (7j)

white solid, mp = 242–243 °C; ¹H NMR (DMSO-*d*₆): 0.84 (s, 3H), 1.07 (s, 3H), 2.14 (d, *J* = 16.4 Hz, 1H), 2.41 (d, *J* = 16.4 Hz, 1H), 2.80 (d, *J* = 17.6 Hz, 1H), 2.90 (d, *J* = 17.6 Hz, 1H), 7.34 (t, *J* = 7.2 Hz, 1H), 7.43–7.49 (m, 2H), 757–7.64 (m, 2H), 7.89–7.95 (m, 3H), 7.97–8.07 (m, 1H), 8.09–8.12 (m, 2H); ¹³C NMR: 26.6, 29.0, 32.4, 40.9, 46.3, 50.3, 108.9, 111.3, 112.2, 117.6, 119.6, 122.8, 124.3, 126.0, 128.0, 128.2, 129.3, 130.7, 131.4, 131.7, 132.4, 145.0, 148.9, 167.4, 196.2; IR (cm⁻¹): 3070, 2950, 2896, 2872, 1653, 1617, 1597, 1514, 1447, 1485, 1243, 1228, 1181, 1147, 1127, 1084, 828, 810, 749, 716, 531; HRMS m/z (ESI) calcd for $C_{25}H_{21}N_3NaO_2$ [M + Na]⁺ 418.1531 found 418.1526.

9-(2-Hydroxy-6-oxocyclohex-1-en-1-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (8a)

white solid, mp = 180–181 °C; ¹H NMR (DMSO-*d*₆): 1.78 (s, 3H), 1.83 (s, 3H), 2.65–2.37 (m, 10H), 4.57 (s, 3H), 5.86 (s, 1H), 7.35 (d, *J* = 7.6 Hz, 1H), 7.58–7.60 (m, 1H), 7.70 (t, *J* = 8.0 Hz, 1H), 11.32 (s, 1H); ¹³C NMR: 20.4, 26.3, 27.6, 29.0, 31.5, 36.6, 40.7, 50.3, 55.4, 109.5, 109.6, 119.7, 123.8, 126.2, 139.1, 146.6, 164.6, 195.7; IR (cm⁻¹): 3231, 3020, 2945, 2893, 2872, 1644, 1587, 1479, 1376, 1274, 1228, 1194, 1090, 981, 747; HRMS m/z (ESI) calcd for $C_{22}H_{24}NaO_5$ [M + Na]⁺ 391.1521 found 391.1515.

5-Methoxy-3,3-dimethyl-9-(5-methylfuran-2-yl)-2,3,4,9-tetrahydro-1H-xanthen-1-one (8b)

red solid, mp = 136–137 °C; ¹H NMR (CDCl₃): 1.12 (s, 6H), 2.13 (s, 3H), 2.30 (s, 2H), 2.59 (d, *J* = 17.6 Hz, 1H), 2.65 (d, *J* = 17.6 Hz, 1H), 3.87 (s, 3H), 5.06 (s, 1H), 5.75 (dd, *J*_a = 1.2 Hz, *J*_b = 3.2 Hz, 1H), 5.87 (d, *J* = 3.2 Hz, 1H), 6.77 (dd, *J*_a = 1.2 Hz, *J*_b = 8.0 Hz, 1H), 6.87 (dd, *J*_a = 0.8 Hz, *J*_b = 8.0 Hz, 1H), 7.00 (t, *J* = 8.0 Hz, 1H); ¹³C NMR: 13.6, 27.1, 29.4, 31.3, 32.2, 41.6, 50.8, 56.0, 105.6, 106.2, 110.0, 110.2, 121.1, 124.0, 124.5, 139.1, 147.7, 150.7, 154.8, 165.4, 196.7; IR (cm⁻¹): 3107, 3070, 2966, 2942, 1640, 1610, 1582, 1484, 1464, 1384, 1273, 1232, 1187, 1123, 1092, 1015, 952, 788, 759, 737, 564; HRMS m/z (ESI) calcd for $C_{21}H_{22}NaO_4$ [M + Na]⁺ 361.1416 found 361.1410.

Ethyl 2-(5-methoxy-3,3-dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-xanthen-9-yl)-3-oxo-3-phenylpropanoate (8c)

white solid, mp = 180–181 °C; ¹H NMR (CDCl₃): 0.99 (t, *J* = 9.6 Hz, 3H), 1.14 (s, 6H), 2.32 (d, *J* = 16.0 Hz, 1H), 2.37 (d, *J* = 16.0 Hz, 1H), 2.59 (s, 2H), 3.84 (s, 3H), 3.88–3.96 (m, 2H), 4.76 (d, *J* = 2.4 Hz, 1H), 4.86 (d, *J* = 3.2 Hz, 1H), 6.62 (d, *J* = 7.6 Hz, 1H), 6.78 (d, *J* = 8.8 Hz, 1H), 6.91 (d, *J* = 8.0 Hz, 1H), 6.94 (d, *J* = 8.0 Hz, 1H), 7.49–7.61 (m, 3H), 8.22 (d, *J* = 7.6 Hz, 2H); ¹³C NMR: 13.8, 26.7, 29.9, 32.2, 41.8, 50.9, 56.1, 59.4, 61.0, 110.4,

111.0, 121.4, 122.1, 124.2, 128.2, 128.6, 128.9, 129.0, 133.6, 136.2, 147.6, 168.0, 168.7, 194.7, 197.7; IR (cm^{-1}): 3043, 2990, 2963, 2944, 1749, 1677, 1630, 1582, 1484, 1448, 1389, 1269, 1236, 1197, 1164, 1129, 1095, 1018, 773, 730, 689, 645; HRMS m/z (ESI) calcd for $\text{C}_{27}\text{H}_{28}\text{NaO}_6$ [M + Na]⁺ 471.1784 found 471.1778.

2-(5-Methoxy-3,3-dimethyl-1-oxo-2,3,4,9-tetrahydro-1H-xanthen-9-yl)-1,3-diphenylpropane-1,3-dione (8d)
red solid, mp = 177-178 °C; ¹H NMR (CDCl₃): 0.92 (s, 3H), 1.09 (s, 3H), 2.24 (d, J = 16.0 Hz, 1H), 2.35 (d, J = 16.0 Hz, 1H), 2.53 (d, J = 17.6 Hz, 1H), 2.57 (d, J = 17.6 Hz, 1H), 3.89 (s, 3H), 4.84 (d, J = 3.6 Hz, 1H), 6.11 (d, J = 3.6 Hz, 1H), 6.42 (dd, J_a = 0.8 Hz, J_b = 7.6 Hz, 1H), 6.80 (dd, J_a = 1.2 Hz, J_b = 8.0 Hz, 1H), 6.91 (t, J = 8.0 Hz, 1H), 7.32 (t, J = 8.0 Hz, 2H), 7.45 (t, J = 7.6 Hz, 1H), 7.59-7.72 (m, 5H), 8.45 (d, J = 6.8 Hz, 2H); ¹³C NMR: 26.9, 29.1, 31.9, 33.0, 41.5, 50.7, 55.9, 58.9, 110.0, 110.7, 120.8, 122.2, 123.7, 127.8, 128.4, 129.0, 129.1, 132.7, 133.7, 135.5, 137.0, 141.0, 147.2, 168.5, 195.4, 195.6, 198.0; IR (cm^{-1}): 3058, 2960, 2940, 1686, 1644, 1584, 1486, 1444, 1389, 1267, 1232, 1207, 1093, 1005, 776, 743, 690, 647; HRMS m/z (ESI) calcd for $\text{C}_{31}\text{H}_{28}\text{NaO}_5$ [M + Na]⁺ 503.1834 found 503.1830.

9-(6-Hydroxybenzo[d][1,3]dioxol-5-yl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (8e)
white solid, mp = 204- 205 °C; ¹H NMR (CDCl₃): 1.01 (s, 3H), 1.11 (s, 3H), 2.24 (d, J = 16.4 Hz, 1H), 2.31 (d, J = 16.4 Hz, 1H), 2.51 (s, 2H), 3.85 (s, 3H), 5.21 (s, 1H), 5.86 (d, J = 1.6 Hz, 1H), 5.90 (d, J = 1.6Hz, 1H), 6.43 (q, J = 1.6 Hz, 1H), 6.56 (d, J = 5.6 Hz, 2H), 6.64-6.72 (m, 2H), 7.58 (s, 1H); ¹³C NMR: 27.6, 29.5, 31.5, 32.4, 41.9, 50.8, 56.2, 98.1, 101.7, 108.7, 109.5, 112.6, 117.6, 129.4, 121.3, 133.1, 143.0, 144.5, 145.1, 147.1, 148.5, 166.4, 198.8; IR (cm^{-1}): 3422, 3359, 3005, 2953, 2879, 1655, 1619, 1481, 1379, 1281, 1218, 1144, 1033, 930, 882, 730, 550; HRMS m/z (ESI) calcd for $\text{C}_{23}\text{H}_{22}\text{NaO}_6$ [M + Na]⁺ 417.1314 found 417.1310.

9-(4-(Dimethylamino)phenyl)-5-methoxy-3,3-dimethyl-2,3,4,9-tetrahydro-1H-xanthen-1-one (8f)
white solid, mp = ; ¹H NMR (CDCl₃): 1.02 (s, 3H), 1.09 (s, 3H), 2.19 (d, J = 16.4 Hz, 1H), 2.25 (d, J = 16.4 Hz, 1H), 2.57 (d, J = 17.6 Hz, 1H), 2.64 (d, J = 17.6 Hz, 1H), 2.83 (s, 6H), 3.88 (s, 3H), 4.90 (s, 1H), 6.57 (d, J = 8.8 Hz, 2H), 6.70 (t, J = 8.0 Hz, 2H), 6.92 (t, J = 8.0 Hz, 1H), 7.08 (d, J = 8.8 Hz, 2H); ¹³C NMR: 27.6, 29.4, 32.3, 37.0, 40.7, 41.7, 51.0, 56.2, 109.6, 112.8, 113.9, 121.7, 124.8, 127.3, 128.6, 134.6, 139.2, 147.9, 149.3, 164.0, 197.1; IR (cm^{-1}): 3089, 2957, 2889, 2839, 1647, 1611, 1583, 1518, 1481, 1375, 1272, 1225, 1189, 1117, 1089, 950, 912, 837, 785, 730, 647, 550; HRMS m/z (ESI) calcd for $\text{C}_{24}\text{H}_{27}\text{NNaO}_3$ [M + Na]⁺ 400.1889 found 400.1881.

