Supporting Information
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Synthesis of Stilbene-quinone Hybrids Through Heck Reactions In PEG-400

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Supporting Information

General experimental section ................................................................. S4-S11
Spectral data for compounds ............................................................... S12-S91
3a  $^1$H, $^{13}$C, APT, COSY, LRMS .................................................... S12-S17
3b  $^1$H, APT, COSY, HSQC, HRMS .................................................... S18-S23
3c  $^1$H, APT, HRMS ........................................................................ S24-S27
3d  $^1$H, APT, HRMS ........................................................................ S28-S31
3e  $^1$H, APT, HRMS ........................................................................ S32-S35
3f  $^1$H, APT, HRMS ........................................................................ S36-S39
3g  $^1$H, APT, COSY, HSQC, HRMS .................................................... S40-S45
3h  $^1$H, APT, HRMS ........................................................................ S46-S49
3i  $^1$H, APT, COSY, HRMS ............................................................. S50-S54
3j  $^1$H, APT, HRMS ........................................................................ S55-S58
3k  $^1$H, APT, HRMS ........................................................................ S59-S62
<table>
<thead>
<tr>
<th>3l</th>
<th>$^1$H, APT, HRMS ................................................................................................................</th>
<th>S63-S66</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S67-S68</td>
</tr>
<tr>
<td>5c</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S69-S70</td>
</tr>
<tr>
<td>5d</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S71-S72</td>
</tr>
<tr>
<td>5e</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S73-S74</td>
</tr>
<tr>
<td>5f</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S75-S76</td>
</tr>
<tr>
<td>5g</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S77-S78</td>
</tr>
<tr>
<td>5h</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S79-S80</td>
</tr>
<tr>
<td>5i</td>
<td>$^1$H ..................................................................................................................................</td>
<td>S81-S82</td>
</tr>
<tr>
<td>7</td>
<td>$^1$H, COSY, HRMS ...............................................................................................................</td>
<td>S83-S86</td>
</tr>
<tr>
<td>8</td>
<td>$^1$H, APT, COSY, HRMS ......................................................................................................</td>
<td>S87-S91</td>
</tr>
</tbody>
</table>
General Experimental Section. $^1$H and $^{13}$C NMR spectra were recorded in CDCl$_3$, Acetone-$d_6$, CD$_3$OD, DMSO-$d_6$ at 400 MHz with a Varian MR-400 NMR spectrometer using TMS as internal standard. Low-resolution electron impact (GC-EI) mass spectra were obtained at 70 eV with a Shimadzu QP-5000 instrument, and HRMS (GC-EI) were recorded with a Finnigan MAT 95S instrument. Analytical TLC was performed with Schleicher & Schuell F1400/LS silica gel plates, and the spots were visualized under UV light ($\lambda = 254$ nm). For flash chromatography, Merck silica gel 60 (0.040–0.063 mm) was employed.

General procedure for the synthesis of stilbene-quinones (3a-l):

A mixture of 3-iodolawsone (4) (1 mmol), styrene (5) (1 mmol), sodium hydroxide (3 mmol) and palladium acetate (10 mol%) in PEG-400 (8 g) was stirred for 15 min at 90 °C. The reaction was monitored by TLC. After this time, the reaction mixture was extracted with ethyl acetate (50 mL) and filtered by celite. Then, phosphoric acid 25% (50mL) was added. The organic layer was washed with brine (3 X 50 mL), dried (Na$_2$SO$_4$) and concentrated in vacuum. The resulting oil was purified by chromatography column (ethylacetate/n-hexane 5:95), furnishing pure products.

(E)-2-hydroxy-3-styrylnaphthalene-1,4-dione (3a): red amorphous solid, mp 160-161 °C.$^{17}$ 223.5 mg, 81% from 1 mmol of 5a. LRMS: m/z found: 276. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.06 (d, $J = 7.7$ Hz, 1H), 7.97 (d, $J = 7.5$ Hz, 1H), 7.92 (s, 1H), 7.85 (d, $J = 16.7$ Hz, 1H), 7.65 (td, $J = 7.6$, 1.2 Hz, 1H), 7.58 (td, $J = 7.5$, 1.2 Hz, 1H), 7.49 (d, $J = 7.4$ Hz, 2H), 7.28 (d, $J = 16.8$ Hz, 1H), 7.32 – 7.24 (m, 2H), 7.19 (m, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 184.12, 180.94, 151.68, 139.26, 137.75, 134.95, 133.18, 132.67, 129.52, 128.70, 128.69, 128.65, 127.17, 127.16, 127.12, 126.03, 118.66, 117.37.
(E)-2-hydroxy-3-(4-methoxystyryl)naphthalene-1,4-dione (3b): Purple amorphous solid, mp 125-126 °C.\textsuperscript{14} 70.3 mg, 23% from 1 mmol of 5b. HRMS: [M + Na]\textsuperscript{+} m/z calculated for C\textsubscript{19}H\textsubscript{14}O\textsubscript{4}Na 329.0790, [M + Na]\textsuperscript{+} m/z found: 329.0781. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta\) 8.16 (dd, \(J = 7.6, 1.0\) Hz, 1H), 8.09 (dd, \(J = 7.5, 1.1\) Hz, 1H), 7.94 (d, \(J = 16.7\) Hz, 1H), 7.76 (td, \(J = 7.5, 1.5\) Hz, 1H), 7.70 (td, \(J = 7.5, 1.4\) Hz, 1H), 7.56 (d, \(J = 8.5\) Hz, 2H), 7.27 (d, \(J = 16.7\) Hz, 1H), 6.92 (d, \(J = 8.8\) Hz, 2H), 3.85 (s, 3H); \textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) \(\delta\) 184.35, 180.85, 160.18, 151.16, 139.05, 134.81, 133.16, 132.71, 130.65, 128.62, 128.61, 128.60, 127.08, 125.96, 119.15, 115.25, 114.16, 114.15, 55.33.

(E)-2-hydroxy-3-(4-hydroxystyryl)naphthalene-1,4-dione (3c): Purple amorphous solid, mp 189-190 °C. 58.4 mg, 20% from 1 mmol of 5c. HRMS: [M + Na]\textsuperscript{+} m/z calculated for C\textsubscript{18}H\textsubscript{12}O\textsubscript{4}Na 315.062780, [M + Na]\textsuperscript{+} m/z found: 315.0624. \textsuperscript{1}H NMR (400 MHz, Acetone-d\textsubscript{6}) \(\delta\) 8.17-8.02 (m, 2H), 7.97 (d, \(J = 16.7\) Hz, 1H), 7.91-7.78 (m, 2H), 7.50 (d, \(J = 8.5\) Hz, 2H), 7.28 (d, \(J = 16.6\) Hz, 1H), 6.90 (d, \(J = 8.6\) Hz, 2H); \textsuperscript{13}C NMR (101 MHz, Acetone-d\textsubscript{6}) \(\delta\) 184.15, 180.45, 158.10, 152.83, 137.88, 134.61, 134.49, 133.22, 133.07, 132.60, 130.29, 129.80, 128.35, 126.35, 125.47, 118.77, 115.68, 114.96.

(E)-2-hydroxy-3-(4-hydroxy-3-methoxystyryl)naphthalene-1,4-dione (3d): Reddish-purple amorphous solid, mp 186-187 °C. 23.7 mg, 7% from 1 mmol of 5d. HRMS: [M + Na]\textsuperscript{+} m/z calculated for C\textsubscript{19}H\textsubscript{14}O\textsubscript{5}Na 345.073344, [M + Na]\textsuperscript{+} m/z found: 345.0741. \textsuperscript{1}H NMR (400 MHz, Acetone-d\textsubscript{6}) \(\delta\) 8.10-8.02 (m, 2H), 7.96 (d, \(J = 16.6\) Hz, 1H), 7.89-7.80 (m, 2H), 7.28 (d, \(J = 16.6\) Hz, 1H), 7.25 (d, \(J = 1.9\) Hz, 1H), 7.10 (dd, \(J = 8.2, 1.6\) Hz, 1H), 6.88 (d, \(J = 8.2\) Hz, 1H), 3.95 (s, 3H); \textsuperscript{13}C NMR (101 MHz, Acetone-d\textsubscript{6}) \(\delta\) 184.58, 181.43, 158.38, 152.84, 147.79, 147.56, 138.09, 134.73, 133.06, 132.45, 130.17, 126.35, 125.92, 125.00, 120.91, 118.65, 115.06, 110.73, 55.25.
(E)-2-hydroxy-3-(3-hydroxy-4-methoxystyryl)naphthalene-1,4-dione (3e): Reddish-purple solid, mp 178-179 °C. 65.1 mg, 20% from 1 mmol of 5e. HRMS: [M - H] m/z calculated for C_{19}H_{13}O_{5} 321.0768, [M - H] m/z found: 321.0782. \(^1\)H NMR (400 MHz, CD_{3}OD) δ 8.15-7.98 (m, 2H), 7.85 (d, J = 16.7 Hz, 1H), 7.82-7.70 (m, 2H), 7.06 (d, J = 2.0 Hz, 1H), 6.98 (dd, J = 8.3, 2.0 Hz, 1H), 6.92 (d, J = 8.3 Hz, 1H), 3.88 (s, 3H). \(^1^3\)C NMR (101 MHz, DMSO-d_{6}) δ 184.99, 181.59, 159.89, 154.45, 148.82, 147.20, 134.78, 133.52, 127.15, 126.83, 126.28, 125.76, 119.65, 111.39, 72.75, 70.18, 60.66, 56.07, 55.98.

(E)-2-(2-(benzo[d][1,3]dioxol-5-yl)vinyl)-3-hydroxynaphthalene-1,4-dione (3f): Dark purple solid, mp 203-204 °C. 53.4 mg, 17% from 1 mmol of 5f. HRMS: [M - H] m/z calculated for C_{19}H_{11}O_{5} 319.0612, [M - H] m/z found: 319.0622. \(^1\)H NMR (400 MHz, CD_{3}OD) δ 8.10 (dd, J = 7.5, 1.2 Hz, 1H), 8.06 (dd, J = 7.6, 1.3 Hz, 1H), 7.90 (d, J = 16.6 Hz, 1H), 7.81-7.71 (m, 2H), 7.25 (d, J = 16.7 Hz, 1H), 7.12 (d, J = 1.6 Hz, 1H), 6.99 (dd, J = 8.0, 1.7 Hz, 1H), 6.82 (d, J = 8.0 Hz, 1H), 5.97 (s, 2H). \(^1^3\)C NMR (101 MHz, DMSO-d_{6}) δ 184.47, 180.89, 155.05, 148.48, 148.01, 136.46, 134.92, 133.74, 132.74, 132.43, 130.66, 126.47, 125.92, 122.45, 118.57, 117.09, 109.01, 105.65, 101.69.

(E)-2-(2,3-dimethoxystyryl)-3-hydroxynaphthalene-1,4-dione (3g): Red solid, mp 151-152 °C. 106.1 mg, 32% from 1 mmol of 5g. HRMS: [M - H] m/z calculated for C_{20}H_{15}O_{5} 335.0925, [M - H] m/z found: 335.0912. \(^1\)H NMR (400 MHz, CDCl_{3}) δ 8.27 (d, J = 16.9 Hz, 1H), 8.18 (dd, J = 7.6, 0.9 Hz, 1H), 8.11 (t, J = 7.9 Hz, 1H), 8.00 (s, 1H), 7.76 (dd, J = 7.6, 1.4 Hz, 1H), 7.71 (td, J = 7.6, 1.3 Hz, 1H), 7.40 (d, J = 16.9 Hz, 1H),
7.36 (dd, $J = 8.0, 0.8$ Hz, 1H), 7.09 (t, $J = 8.0$ Hz, 1H), 6.89 (dd, $J = 8.1, 1.1$ Hz, 1H), 3.89 (s, 6H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 184.14, 181.03, 153.04, 151.70, 147.50, 134.94, 133.67, 133.17, 132.68, 132.03, 129.55, 127.13, 126.03, 124.13, 118.98, 118.42, 112.34, 110.66, 61.26, 55.84.

(E)-2-hydroxy-3-(4-nitrostyryl)naphthalene-1,4-dione (3h): The chromatography column of this compound was eluted with ethylacetate/n-hexane 30:70. Reddish-Orange solid, mp 153-154 °C. 163.8 mg, 98% from 0.52 mmols of 5h. HRMS: [M - H] $m/z$ calculated for C$_{18}$H$_{10}$NO$_5$ 320.056446, [M - H] $m/z$ found: 320.0576. $^1$H NMR (400 MHz, Acetone-$d_6$) $\delta$ 8.15-8.10 (m, 3H), 8.08 (dd, $J = 7.4, 1.1$ Hz, 2H), 8.04 (dd, $J = 7.3, 1.3$ Hz, 2H), 7.89-7.84 (m, 3H). $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$ 184.18, 181.67, 162.75, 156.80, 146.89, 144.85, 134.90, 133.91, 133.65, 130.71, 130.15, 127.83, 127.18, 126.89, 126.36, 125.82, 124.57, 111.41.

(E)-2-hydroxy-3-(2-nitrostyryl)naphthalene-1,4-dione (3i): The chromatography column of this compound was eluted with ethylacetate/n-hexane 30:70. Reddish-Orange solid, mp 235 °C. 14279 mg, 87% from 1 mmol of 5i. HRMS: [M + Na]$^+$ $m/z$ calculated for C$_{18}$H$_{11}$NO$_5$Na: 344.052943, [M + Na]$^+$ $m/z$ found: 344.0537. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.38 (d, $J = 16.5$ Hz, 1H), 8.20 (d, $J = 16.5$ Hz, 1H), 8.13 (d, $J = 7.5$ Hz, 1H), 8.09 (s, 1H), 7.98 (d, $J = 7.5$ Hz, 1H), 7.86 - 7.78 (m, 2H), 7.74 (t, $J = 7.5$ Hz, 1H), 7.65 (t, $J = 7.5$ Hz, 1H), 7.45 (t, $J = 7.8$ Hz, 1H), 7.37 (d, $J = 16.5$ Hz, 1H). $^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ 188.87, 185.79, 161.53, 153.21, 139.88, 138.70, 138.57, 137.49, 137.12, 135.44, 134.50, 134.06, 132.68, 131.32, 130.84, 129.55, 128.62, 122.02.

(E)-2-hydroxy-3-(3-nitrostyryl)naphthalene-1,4-dione (3j): The chromatography column of this compound was eluted with ethylacetate/n-hexane 30:70. Reddish-Orange solid, mp 222 °C. 448,4 mg, 81% from 1 mmol of 5j. HRMS: [M + Na]$^+$ $m/z$ calculated for C$_{18}$H$_{11}$NO$_5$Na:
344.052943, [M + Na]+ m/z found: 344.0534. 1H NMR (400 MHz, CDCl₃) δ 8.44 - 8.42 (m, 1H), 8.21 (d, J = 8.2 Hz, 1H), 8.16 - 8.12 (m, 2H), 8.07 (s, 1H), 8.00 (d, J = 16.6 Hz, 1H), 7.91 (d, J = 7.7 Hz, 1H), 7.84 - 7.78 (m, 1H), 7.76 - 7.71 (m, 1H), 7.59 - 7.53 (m, 1H), 7.51 (d, J = 16.7 Hz, 1H). 13C NMR (101 MHz, DMSO-d₆) δ 184.11, 180.96, 156.43, 148.72, 139.94, 135.08, 133.77, 133.55, 133.11, 132.34, 130.74, 130.61, 126.51, 126.03, 122.80, 121.64, 120.83, 117.41.

(E)-2-(4-chlorostyryl)-3-hydroxynaphthalene-1,4-dione (3k): The chromatography column of this compound was eluted with ethylacetate/n-hexane 5:95. Red solid, mp 190 °C. 1H NMR (400 MHz, CDCl₃) δ 8.18 (d, J = 7.6 Hz, 1H), 8.11 (d, J = 7.4 Hz, 1H), 7.99 (s, 1H), 7.92 (d, J = 16.7 Hz, 1H), 7.79 (t, J = 7.5 Hz, 1H), 7.72 (t, J = 7.5 Hz, 1H), 7.53 (d, J = 8.4 Hz, 2H), 7.37 (d, J = 16.8 Hz, 1H), 7.35 (d, J = 8.4 Hz, 2H). 13C NMR (101 MHz, DMSO-d₆) δ 184.30, 180.90, 155.61, 137.05, 134.99, 134.97, 133.75, 132.96, 132.33, 130.59, 129.26, 129.24, 128.56, 128.54, 126.49, 125.97, 119.60, 117.98.

(E)-2-hydroxy-3-(4-(trifluoromethyl)styrylnaphthalene-1,4-dione (3l): The chromatography column of this compound was eluted with ethylacetate/n-hexane 10:90. Reddish-Orange solid, mp 223 °C. 278.1 mg, 81% from 1 mmol of 5l. HRMS: [M + Na]+ m/z calculated for C₁₈H₁₁ClO₃Na 333.02893, [M + Na]+ m/z found: 333.0286.
Synthesis of 3-iodolawsone (4): To a mixture of lawsone (8.7 g, 50 mmol) and K₂CO₃ (21 g, 150 mmol) in water (50 mL), was added the morpholine-iodide complex (21.2 g, 62.5 mmol), in small portions every 15 minutes during 2 hours. The reaction was stirred in room temperature for an additional hour, and then filtered to remove any solids. The filtrate was cooled in an ice bath and acidified with 25% H₃PO₄ until a pH of approximately 2. The precipitated was filtered, washed with cold water and recrystallized from glacial acetic acid to afford pure 4, as yellow crystals (10.85 g, 36 mmol, 72% yield), mp 177°C.¹⁵

¹H NMR (400 MHz, CDCl₃) δ 8.22 (dd, J = 7.3, 1.3 Hz, 1H), 8.15 (dd, J = 7.3, 1.3 Hz, 1H), 8.01 (s, 1H), 7.77 (m, 2H).

General procedure for the Wittig reaction. Example: 4-hydroxystyrene (5c). A mixture of methyl triphenylphosphonium bromide (1.1 g; 3 mmol) in THF (4 mL) was treated with potassium tert-butoxide (562 mg, 5 mmol). After stirring for 10 min at room temperature, a solution of 4-hydroxybenzaldehyde (6c; 244 mg; 2 mmol) in THF (2 mL) was added in drops to the above suspension, and the resulting mixture was stirred at room temperature for 60 min., which was monitored by TLC. The resulting solution was quenched with saturated NH₄Cl solution (10 mL), and concentrated in vacuum to remove THF. The concentrated mixture was extracted with CH₂Cl₂ (40 mL). The organic layer was washed with brine (3 X 40 mL) and dried over Na₂SO₄ anhydrous, filtered, evaporated, and the residue was purified by chromatography column (ethylacetate/n-hexane 5:95) to give pure 5c, 200.7 mg (1.97 mmol) 98% yield, as a light yellow solid, mp 65 °C.²⁰ ¹H NMR (400 MHz, CDCl₃) δ 7.30 (d, J = 8.5 Hz, 2H), 6.79 (d, J = 8.6 Hz, 2H), 6.65 (dd, J = 17.6, 10.9 Hz, 1H), 5.60 (d, J = 17.6 Hz, 1H), 5.12 (d, J = 10.9 Hz, 1H), 4.94 (s, 1H).

3-methoxy-4-hydroxystyrene (5d): Light yellow oil,²⁰ 705.6 mg, 94% from 5 mmols of 6d using 7.5 mmols of triphenylphosphonium iodide.

¹H NMR (400 MHz, CDCl₃) δ 6.95-6.90 (m, 2H), 6.87 (d, J = 8.1 Hz, 1H), 6.64 (dd, J = 17.5, 10.9 Hz, 1H), 5.62 (s, 1H), 5.59 (dd, J = 17.5, 0.8
Hz, 1H), 5.13 (dd, J = 10.9, 0.8 Hz, 1H), 3.92 (s, 3H).

3-hydroxy-4-methoxystyrene (5e): White amorphous solid, mp 58 °C,\textsuperscript{21} 573.3 mg, 76% from 5 mmols of 6e using 7.5 mmols of triphenylphosphonium bromide.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.05 (d, J = 2.1 Hz, 1H), 6.87 (dd, J = 8.3, 2.1 Hz, 1H), 6.80 (d, J = 8.3 Hz, 1H), 6.61 (dd, J = 17.6, 10.8 Hz, 1H), 5.60 (d, J = 18.3 Hz, 1H), 5.60 (s, 1H), 5.13 (d, J = 10.2 Hz, 1H), 3.89 (s, 3H).

5-vinylbenzo[d][1,3]dioxole (5f): Colorless oil,\textsuperscript{22} 260.7 mg, 56% from 3 mmols of 6f using 4.5 mmols of triphenylphosphonium iodide.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.96 (d, J = 1.6 Hz, 1H), 6.83 (dd, J = 8.0, 1.5 Hz, 1H), 6.75 (d, J = 8.0 Hz, 1H), 6.62 (dd, J = 17.5, 10.8 Hz, 1H), 5.95 (s, 2H), 5.57 (d, J = 17.5 Hz, 1H), 5.12 (d, J = 10.8 Hz, 1H).

2,3-dimethoxystyrene (5g): Light yellow oil,\textsuperscript{23} 392.5 mg, 81% from 3 mmols of 6g using 4.5 mmols of triphenylphosphonium iodide.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.13 (dd, J = 7.9, 1.3 Hz, 1H), 7.05 (dd, J = 17.5, 11.3 Hz, 1H), 7.03-7.00 (m, 1H), 6.83 (dd, J = 8.1, 1.4 Hz, 1H), 5.76 (dd, J = 17.8, 1.4 Hz, 1H), 5.30 (dd, J = 11.1, 1.4 Hz, 1H), 3.86 (s, 3H), 3.81 (s, 3H).

4-nitrostyrene (5h): This reaction was performed at -78°C. Clear oil,\textsuperscript{24} 98 mg, 13% from 5 mmols of 6h using 7.5 mmols of triphenylphosphonium bromide.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.20 (d, J = 8.8 Hz, 2H), 7.54 (d, J = 8.6 Hz, 2H), 6.79 (dd, J = 17.6, 10.9 Hz, 1H), 5.94 (d, J = 17.6 Hz, 1H), 5.51 (d, J = 10.9 Hz, 1H).

2-nitrostyrene (5i): This reaction was performed at -78°C. Yellowish oil,\textsuperscript{25} 491.3 mg, 32% from 10 mmols of 6i using 15 mmols of triphenylphosphonium iodide.
triphenylphosphonium bromide. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.93 (d, $J = 8.2$ Hz, 1H), 7.62 (t, $J = 7.9$ Hz, 1H), 7.57 (d, $J = 7.3$ Hz, 1H), 7.41 (t, $J = 8.2$ Hz, 1H), 7.18 (dd, $J = 17.3$, 11.0 Hz, 1H), 5.75 (d, $J = 17.3$ Hz, 1H), 5.49 (dd, $J = 11.0$, 0.5 Hz, 1H).

2-phenyl-10H-naphtho[2,3-b]furan-4,9-dione (7): This compound was obtained as a side product from reaction between 4 and 5a. Orange solid, mp 236-237 °C.$^{18}$ HRMS: [M + Na]$^+$ $m/z$ calculated for C$_{18}$H$_{10}$O$_3$Na 297.0522, [M + Na]$^+$ $m/z$ found: 297.0528. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.25 (dd, $J = 7.1$, 1.8 Hz, 1H), 8.20 (dd, $J = 7.0$, 1.9 Hz, 1H), 7.90 (dd, $J = 8.2$, 1.4 Hz, 2H), 7.80-7.72 (m, 2H), 7.53-7.43 (m, 3H), 7.20 (s, 1H).

2-phenyl-10H-naphtho[1,2-b]furan-4,5-dione (8): This compound was obtained as a side product from reaction between 4 and 5a. Reddish-purple solid, mp 193-194 °C.$^{18}$ HRMS: [M + Na]$^+$ $m/z$ calculated for C$_{18}$H$_{10}$O$_3$Na 297.0522, [M + Na]$^+$ $m/z$ found: 297.0524. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.06 (d, $J = 7.7$ Hz, 1H), 7.78 (d, $J = 7.7$ Hz, 1H), 7.73 (dd, $J = 7.0$, 1.1 Hz, 2H), 7.67 (td, $J = 7.6$, 1.2 Hz, 1H), 7.49-7.42 (m, 3H), 7.41-7.35 (m, 1H), 7.01 (s, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 180.32, 174.41, 159.70, 156.69, 135.40, 130.61, 130.56, 130.19, 129.21, 128.99, 128.82, 128.59, 128.38, 124.40, 124.36, 123.26, 122.24, 102.79.
LRMS: $m/z$ found: 276. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.06 (d, $J = 7.7$ Hz, 1H), 7.97 (d, $J = 7.5$ Hz, 1H), 7.92 (s, 1H), 7.85 (d, $J = 16.7$ Hz, 1H), 7.65 (td, $J = 7.6$, 1.2 Hz, 1H), 7.58 (td, $J = 7.5$, 1.2 Hz, 1H), 7.49 (d, $J = 7.4$ Hz, 2H), 7.28 (d, $J = 16.8$ Hz, 1H), 7.32 – 7.24 (m, 2H), 7.19 (m, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 184.12, 180.94, 151.68, 139.26, 137.75, 134.95, 133.18, 132.67, 129.52, 128.70, 128.69, 128.65, 127.17, 127.16, 127.12, 126.03, 118.66, 117.37.
Figure S1. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3a.
Figure S2. $^{13}$C NMR spectrum (101 MHz, CDCl$_3$) of compound 3a.
Figure S3. APT spectrum of compound 3a.
Figure S4. COSY H,H spectrum of compound 3a.
Figure S5. LRMS spectrum of compound 3a.
HRMS: [M + Na]⁺ m/z found: 329.0781. ¹H NMR (400 MHz, CDCl₃) δ 8.16 (dd, J = 7.6, 1.0 Hz, 1H), 8.09 (dd, J = 7.5, 1.1 Hz, 1H), 7.94 (d, J = 16.7 Hz, 1H), 7.76 (td, J = 7.5, 1.5 Hz, 1H), 7.70 (td, J = 7.5, 1.4 Hz, 1H), 7.56 (d, J = 8.5 Hz, 2H), 7.27 (d, J = 16.7 Hz, 1H), 6.92 (d, J = 8.8 Hz, 2H), 3.85 (s, 3H); ¹³C NMR (101 MHz, CDCl₃) δ 184.35, 180.85, 160.18, 151.16, 139.05, 134.81, 133.16, 132.71, 130.65, 129.62, 128.61, 128.60, 127.08, 125.96, 119.15, 115.25, 114.16, 114.15, 55.33.
Figure S6. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3b.
Figure S7. APT spectrum of compound 3b.
**Figure S8.** COSY H,H spectrum of compound 3b.
Figure S9. HSQC spectrum of compound 3b.
Figure S10. HRMS spectrum of compound 3b: [M + Na]^+ m/z found: 329.0781.
Product 3c

HRMS: [M + Na]⁺ \textit{m/z} calculated for C₁₈H₁₂O₄Na 315.062780, [M + Na]⁺ \textit{m/z} found: 315.0624. $^1$H NMR (400 MHz, Acetone-$d_6$) $\delta$ 8.17-8.02 (m, 2H), 7.97 (d, $J$ = 16.7 Hz, 1H), 7.91-7.78 (m, 2H), 7.50 (d, $J$ = 8.5 Hz, 2H), 7.28 (d, $J$ = 16.6 Hz, 1H), 6.90 (d, $J$ = 8.6 Hz, 2H); $^{13}$C NMR (101 MHz, Acetone-$d_6$) $\delta$ 184.15, 180.45, 158.10, 152.83, 137.88, 134.61, 134.49, 133.22, 133.07, 132.60, 130.29, 129.80, 128.35, 126.35, 125.47, 118.77, 115.68, 114.96.
Figure S11. $^1$H NMR spectrum (400 MHz, Acetone-$d_6$) of compound 3c.
Figure S12. APT spectrum of compound 3c.
**Figure S13.** HRMS spectrum of compound 3c: [M + Na]$^+$ m/z calculated for $\text{C}_{18}\text{H}_{12}\text{O}_4\text{Na}$ 315.062780, [M + Na]$^+$ m/z found: 315.0624.
Product 3d

HRMS: [M + Na]^+ m/z calculated for C_{19}H_{14}O_5Na 345.073344, [M + Na]^+ m/z found: 345.0741. ¹H NMR (400 MHz, Acetone-d₆) δ 8.10-8.02 (m, 2H), 7.96 (d, J = 16.6 Hz, 1H), 7.89-7.80 (m, 2H), 7.28 (d, J = 16.6 Hz, 1H), 7.25 (d, J = 1.9 Hz, 1H), 7.10 (dd, J = 8.2, 1.6 Hz, 1H), 6.88 (d, J = 8.2 Hz, 1H), 3.95 (s, 3H). ¹³C NMR (101 MHz, Acetone-d₆) δ 184.58, 181.43, 158.38, 152.84, 147.79, 147.56, 138.09, 134.73, 133.06, 132.45, 130.17, 126.35, 125.92, 125.00, 120.91, 118.65, 115.06, 110.73, 55.25.
Figure S14. $^1$H NMR spectrum (400 MHz, Acetone-$d_6$) of compound 3d.
Figure S15. APT spectrum of compound 3d.
Figure S16. HRMS spectrum of compound 3d. [M + Na]$^+$ m/z calculated for C$_{19}$H$_{14}$O$_5$Na 345.073344, [M + Na]$^+$ m/z found: 345.0741.
HRMS: [M - H] m/z calculated for C_{19}H_{13}O_{5} 321.0768, [M - H] m/z found: 321.0782. $^1$H NMR (400 MHz, CD$_3$OD) $\delta$ 8.15-7.98 (m, 2H), 7.85 (d, J = 16.7 Hz, 1H), 7.82-7.70 (m, 2H), 7.22 (d, J = 16.6 Hz, 1H), 7.06 (d, J = 2.0 Hz, 1H), 6.98 (dd, J = 8.3, 2.0 Hz, 1H), 6.92 (d, J = 8.3 Hz, 1H), 3.88 (s, 3H). $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$ 184.99, 181.59, 159.89, 154.45, 148.82, 147.20, 134.78, 133.52, 127.15, 126.83, 126.28, 125.76, 119.65, 111.39, 72.75, 70.18, 60.66, 56.07, 55.98.
Figure S17. $^1$H NMR spectrum (400 MHz, CD$_3$OD) of compound 3e.
Figure S18. APT spectrum of compound 3e.
**Figure S19.** HRMS spectrum of compound 3e. [M - H] m/z calculated for C\textsubscript{19}H\textsubscript{13}O\textsubscript{3} 321.0768, [M - H] m/z found: 321.0782.
HRMS: [M - H] m/z calculated for C₁₉H₁₁O₅ 319.0612, [M - H] m/z found: 319.0622. ¹H NMR (400 MHz, DMSO-dma) δ 8.01 (t, J = 7.7 Hz, 2H), 7.88 – 7.73 (m, 2H), 7.79 (d, J = 16.9 Hz, 1H), 7.17 (s, 1H), 7.15 (d, J = 16.9 Hz, 1H), 7.01 (d, J = 8.1 Hz, 1H), 6.92 (d, J = 8.0 Hz, 1H), 6.06 (s, 2H). ¹³C NMR (101 MHz, DMSO-dma) δ 184.47, 180.89, 155.05, 148.48, 148.01, 136.46, 134.92, 133.74, 132.74, 132.43, 130.66, 126.47, 125.92, 122.45, 118.57, 117.09, 109.01, 105.65, 101.69.
Figure S20. $^1$H NMR spectrum (400 MHz, DMSO-$d_6$) of compound 3f.
Figure S21. APT spectrum of compound 3f.
Figure S22. HRMS spectrum of compound 3f: HRMS: [M - H] m/z calculated for C_{19}H_{11}O_{5} 319.0612, [M - H] m/z found: 319.0622.
Product 3g

[Chemical Structure]

Chemical Formula: C_{20}H_{15}O_{5}
Molecular Weight: 335.34

HRMS: [M - H] m/z calculated for C_{20}H_{15}O_{5} 335.0925, [M - H] m/z found: 335.0912. \(^1\)H NMR (400 MHz, CDCl \(_3\)) \(\delta\) 8.27 (d, \(J = 16.9\) Hz, 1H), 8.18 (dd, \(J = 7.6, 0.9\) Hz, 1H), 8.11 (t, \(J = 7.9\) Hz, 1H), 8.00 (s, 1H), 7.76 (dd, \(J = 7.6, 1.4\) Hz, 1H), 7.71 (td, \(J = 7.6, 1.3\) Hz, 1H), 7.40 (d, \(J = 16.9\) Hz, 1H), 7.36 (dd, \(J = 8.0, 0.8\) Hz, 1H), 7.09 (t, \(J = 8.0\) Hz, 1H), 6.89 (dd, \(J = 8.1, 1.1\) Hz, 1H), 3.89 (s, 6H); \(^{13}\)C NMR (101 MHz, CDCl \(_3\)) \(\delta\) 184.14, 181.03, 153.04, 151.70, 147.50, 134.94, 133.67, 133.17, 132.68, 132.03, 129.55, 127.13, 126.03, 124.13, 118.98, 118.42, 112.34, 110.66, 61.26, 55.84.
$\text{H NMR (400 MHz, CDCl}_3) \delta 8.27 \text{ (d, } J = 16.9 \text{ Hz, 1H)}, 8.18 \text{ (dd, } J = 7.6, 0.9 \text{ Hz, 1H)}, 8.11 \text{ (t, } J = 7.9 \text{ Hz, 1H)}, 8.00 \text{ (s, 1H)}, 7.76 \text{ (dd, } J = 7.6, 1.4 \text{ Hz, 1H)}, 7.71 \text{ (td, } J = 7.6, 1.3 \text{ Hz, 1H)}, 7.40 \text{ (d, } J = 16.9 \text{ Hz, 1H)}, 7.36 \text{ (dd, } J = 8.0, 0.8 \text{ Hz, 1H)}, 7.09 \text{ (t, } J = 8.0 \text{ Hz, 1H)}, 6.89 \text{ (dd, } J = 8.1, 1.1 \text{ Hz, 1H}), 3.89 \text{ (s, 6H).}$

**Figure S23.** $^1\text{H NMR spectrum (400 MHz, CDCl}_3$) of compound 3g.
Figure S24. APT spectrum of compound 3g.
Figure S25. COSY H,H spectrum of compound 3g.
Figure S26. HSQC spectrum of compound 3g.
Figure S27. HRMS spectrum of compound 3g: [M - H] m/z calculated for C$_{20}$H$_{15}$O$_{5}$ 335.0925, [M - H] m/z found: 335.0912.
Product 3h

HRMS: [M - H] m/z calculated for C$_{18}$H$_{10}$NO$_{5}$ 320.056446, [M - H] m/z found: 320.0576. $^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$ 8.18 (d, $J = 8.8$ Hz, 1H), 8.03 – 7.94 (m, 3H), 7.92 – 7.86 (m, 1H), 7.89 (d, $J = 16.5$ Hz, 1H), 7.86 – 7.74 (m, 3H), 7.49 (d, $J = 16.6$ Hz, 1H). $^{13}$C NMR (101 MHz, DMSO-$d_6$) $\delta$ 184.18, 181.67, 162.75, 156.80, 146.89, 144.85, 134.90, 133.91, 133.65, 130.71, 130.15, 127.83, 127.18, 126.89, 126.36, 125.82, 124.57, 111.41.
Figure S28. $^1$H NMR spectrum (400 MHz, DMSO-$d_6$) of compound 3h.
Figure S29. APT spectrum of compound 3h.
Figure S30. HRMS spectrum of compound 3h: [M - H] m/z calculated for C$_{18}$H$_{10}$NO$_{5}$ 320.056446, [M - H] m/z found: 320.0576.
Product 3i

\[
\text{Chemical Formula: C}_{18}\text{H}_{11}\text{NO}_5
\]

Molecular Weight: 321.2836

HRMS: [M + Na]^+ m/z calculated for C\textsubscript{18}H\textsubscript{11}NO\textsubscript{5}Na: 344.052943, [M + Na]^+ m/z found: 344.0537. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta\) 8.38 (d, \(J = 16.5\) Hz, 1H), 8.20 (d, \(J = 7.2\) Hz, 1H), 8.13 (d, \(J = 7.5\) Hz, 1H), 8.09 (s, 1H), 7.98 (d, \(J = 8.1\) Hz, 1H), 7.86 – 7.78 (m, 2H), 7.74 (t, \(J = 7.5\) Hz, 1H), 7.65 (t, \(J = 7.5\) Hz, 1H), 7.45 (t, \(J = 7.8\) Hz, 1H), 7.37 (d, \(J = 16.5\) Hz, 1H). \textsuperscript{13}C NMR (126 MHz, CDCl\textsubscript{3}) \(\delta\) 188.87, 185.79, 161.53, 153.21, 139.88, 138.70, 138.57, 137.49, 137.12, 135.44, 134.50, 134.06, 132.68, 131.32, 130.84, 129.55, 128.62, 122.02.
Figure S31. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3i.
Figure S32. APT spectrum of compound 3i.

$^{13}$C NMR (126 MHz, cdcl$_3$) $\delta$ 188.87, 185.79, 161.53, 153.21, 139.88, 138.70, 138.57, 137.49, 137.12, 135.44, 134.50, 134.06, 132.68, 131.32, 130.84, 129.55, 128.62, 122.02.
Figure S33. COSY H,H spectrum of compound 3i.
Figure S34. HRMS spectrum of compound 3i: [M + Na]$^+$ m/z calculated for C$_{18}$H$_{11}$NO$_3$Na: 344.052943, [M + Na]$^+$ m/z found: 344.0537.
Product 3j

\[
\text{Chemical Formula: } \text{C}_{18}\text{H}_{11}\text{NO}_{5}
\]

Molecular Weight: 321,2836

\([\text{M + Na}]^+ m/z \) calculated for \(\text{C}_{18}\text{H}_{11}\text{NO}_{5}\text{Na} 344.052943, \,[\text{M + Na}]^+ m/z \) found: 344.0534. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta 8.44 - 8.42 \, (m, 1H), 8.21 \, (d, J = 8.2 \, Hz, 1H), 8.16 - 8.12 \, (m, 2H), 8.07 \, (s, 1H), 8.00 \, (d, J = 16.6 \, Hz, 1H), 7.91 \, (d, J = 7.7 \, Hz, 1H), 7.84 - 7.78 \, (m, 1H), 7.76 - 7.71 \, (m, 1H), 7.59 - 7.53 \, (m, 1H), 7.51 \, (d, J = 16.7 \, Hz, 1H).\(^{13}\)C NMR (101 MHz, DMSO-\(d_6\)) \(\delta 184.11, 180.96, 156.43, 148.72, 139.94, 135.08, 133.77, 133.55, 133.11, 132.34, 130.74, 130.61, 126.51, 126.03, 122.80, 121.64, 120.83, 117.41.\)
Figure S35. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3j.
Figure S36. APT spectrum of compound 3j.

$^{13}$C NMR (101 MHz, dmsO)δ 184.11, 180.96, 156.43, 148.72, 139.94, 135.08, 133.77, 133.55, 133.11, 132.34, 130.74, 130.61, 126.51, 126.03, 122.80, 121.64, 120.83, 117.41.
**Figure S37.** HRMS spectrum of compound 3j: $[\text{M + Na}]^+$ m/z calculated for C$_{18}$H$_{11}$NO$_5$Na 344.052943, $[\text{M + Na}]^+$ m/z found: 344.0534.
Product 3k

![Chemical Structure](image)

Chemical Formula: C$_{18}$H$_{11}$ClO$_3$
Molecular Weight: 310.7311

HRMS: [M + Na]$^+$ m/z calculated for C$_{18}$H$_{11}$ClO$_3$Na 333.02893, [M + Na]$^+$ m/z found: 333.0286. $^1$H NMR (400 MHz, CDCl$_3$) δ 8.18 (d, $J = 7.6$ Hz, 1H), 8.11 (d, $J = 7.4$ Hz, 1H), 7.99 (s, 1H), 7.92 (d, $J = 16.7$ Hz, 1H), 7.79 (t, $J = 7.5$ Hz, 1H), 7.72 (t, $J = 7.5$ Hz, 1H), 7.53 (d, $J = 8.4$ Hz, 2H), 7.37 (d, $J = 16.8$ Hz, 1H), 7.35 (d, $J = 8.4$ Hz, 2H). $^{13}$C NMR (101 MHz, DMSO-$d_6$) δ 184.30, 180.90, 155.61, 137.05, 134.99, 134.97, 133.75, 132.96, 132.33, 130.59, 129.26, 129.24, 128.56, 128.54, 126.49, 125.97, 119.60, 117.98.
$^1$H NMR (400 MHz, CDCl$_3$) δ 8.18 (d, $J$ = 7.6 Hz, 1H), 8.11 (d, $J$ = 7.4 Hz, 1H), 7.99 (s, 1H), 7.92 (d, $J$ = 16.7 Hz, 1H), 7.79 (t, $J$ = 7.5 Hz, 1H), 7.72 (t, $J$ = 7.5 Hz, 1H), 7.53 (d, $J$ = 8.4 Hz, 2H), 7.37 (d, $J$ = 16.8 Hz, 1H), 7.35 (d, $J$ = 8.4 Hz, 2H).

Figure S38. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3k.
Figure S39. APT spectrum of compound 3k.
Figure S40. HRMS spectrum of compound 3K: [M + Na]$^+$ m/z calculated for C$_{18}$H$_{11}$ClO$_3$ 333.028893, [M + Na]$^+$ m/z found: 333.0286.
Product 31

![Chemical Structure](image)  

Chemical Formula: \( \text{C}_{19}\text{H}_{11}\text{F}_3\text{O}_3 \)  
Molecular Weight: 344.2840

HRMS: [M + H] \( m/z \) calculated for \( \text{C}_{19}\text{H}_{12}\text{F}_3\text{O}_3 \) 345.073305, [M + H] \( m/z \) found: 345.1522.  
\(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 8.20 (d, \( J = 7.6 \) Hz, 1H), 8.12 (d, \( J = 7.3 \) Hz, 1H), 8.07 (s, 1H), 7.98 (d, \( J = 16.5 \) Hz, 1H), 7.85 – 7.72 (m, 2H), 7.70 - 7.62 (m, 4H), 7.48 (d, \( J = 16.6 \) Hz, 1H).  
\(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 171.08, 170.14, 137.26, 135.22, 133.35, 127.23, 127.17, 126.19, 126.18, 125.64, 125.61, 119.78, 70.58, 70.54, 69.15, 69.11, 63.57, 63.54, 29.68.
Figure S41. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 3l.
\(^{13}\)C NMR (101 MHz, cdcl) \(\delta\) 171.08, 170.14, 137.26, 135.22, 133.35, 127.23, 127.17, 126.19, 126.18, 125.64, 125.61, 119.78, 70.58, 70.54, 69.15, 69.31, 63.57, 63.54, 29.68.

**Figure S42.** APT spectrum of compound 3l.
Figure S43. HRMS spectrum of compound 3l: [M + H] m/z calculated for C_{19}H_{12}F_{3}O_{3} 345.073305, [M + H] m/z found: 345.1522.
Product 4

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.22 (dd, $J = 7.3$, 1.3 Hz, 1H), 8.15 (dd, $J = 7.3$, 1.3 Hz, 1H), 8.01 (s, 1H), 7.77 (m, 2H).
Figure S44. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 4.
Product 5c

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.30 (d, $J = 8.5$ Hz, 2H), 6.79 (d, $J = 8.6$ Hz, 2H), 6.65 (dd, $J = 17.6$, 10.9 Hz, 1H), 5.60 (d, $J = 17.6$ Hz, 1H), 5.12 (d, $J = 10.9$ Hz, 1H), 4.94 (s, 1H).
\[ ^1H \text{ NMR (400 MHz, CDCl}_3 \] \[ \delta \] 7.30 (d, \( J = 8.5 \text{ Hz}, 2\text{H} \)), 6.79 (d, \( J = 8.6 \text{ Hz}, 2\text{H} \)), 6.65 (dd, \( J = 17.6, 10.9 \text{ Hz}, 1\text{H} \)), 5.60 (d, \( J = 17.6 \text{ Hz}, 1\text{H} \)), 5.12 (d, \( J = 10.9 \text{ Hz}, 1\text{H} \)), 4.94 (s, 1H).

**Figure S45.** \( ^1H \) NMR spectrum (400 MHz, CDCl\(_3\)) of compound 5c.
Product 5d

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.95-6.90 (m, 2H), 6.87 (d, $J$ = 8.1 Hz, 1H), 6.64 (dd, $J$ = 17.5, 10.9 Hz, 1H), 5.62 (s, 1H), 5.59 (dd, $J$ = 17.5, 0.8 Hz, 1H), 5.13 (dd, $J$ = 10.9, 0.8 Hz, 1H), 3.92 (s, 3H).
Figure S46. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 5d.
Product 5e

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.05 (d, $J = 2.1$ Hz, 1H), 6.87 (dd, $J = 8.3$, 2.1 Hz, 1H), 6.80 (d, $J = 8.3$ Hz, 1H), 6.61 (dd, $J = 17.6$, 10.8 Hz, 1H), 5.60 (d, $J = 18.3$ Hz, 1H), 5.60 (s, 1H), 5.13 (d, $J = 10.2$ Hz, 1H), 3.89 (s, 3H).
Figure S47. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 5e.
Product 5f

\[
\begin{align*}
{^1}H\text{ NMR (400 MHz, CDCl}_3) & \quad \delta 6.96 (d, J = 1.6 \text{ Hz, 1H}), 6.83 (dd, J = 8.0, 1.5 \text{ Hz, 1H}), 6.75 (d, J = 8.0 \text{ Hz, 1H}), 6.62 (dd, J = 17.5, 10.8 \text{ Hz, 1H}), \\
& \quad 5.95 (s, 2H), 5.57 (d, J = 17.5 \text{ Hz, 1H}), 5.12 (d, J = 10.8 \text{ Hz, 1H}).
\end{align*}
\]
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.96 (d, $J = 1.6$ Hz, 1H), 6.83 (dd, $J = 8.0$, 1.5 Hz, 1H), 6.75 (d, $J = 8.0$ Hz, 1H), 6.62 (dd, $J = 17.5$, 10.8 Hz, 1H), 5.95 (s, 2H), 5.57 (d, $J = 17.5$ Hz, 1H), 5.12 (d, $J = 10.8$ Hz, 1H).

Figure S48. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 5f.
Product 5g

\[
\text{OCH}_3
\]

\[
\text{OCH}_3
\]

\[
5g
\]

\[\text{H NMR (400 MHz, CDCl}_3\) \delta 7.13 (dd, } J = 7.9, 1.3 \text{ Hz, 1H), 7.05 (dd, } J = 17.5, 11.3 \text{ Hz, 1H), 7.03-7.00 (m, 1H), 6.83 (dd, } J = 8.1, 1.4 \text{ Hz, 1H), 5.76 (dd, } J = 17.8, 1.4 \text{ Hz, 1H), 5.30 (dd, } J = 11.1, 1.4 \text{ Hz, 1H), 3.86 (s, 3H), 3.81 (s, 3H).}\]
Figure S49. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 5g.
Product \textbf{5h}

\begin{center}
\includegraphics[width=0.2\textwidth]{5h.png}
\end{center}

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.20 (d, $J = 8.8$ Hz, 2H), 7.54 (d, $J = 8.6$ Hz, 2H), 6.79 (dd, $J = 17.6$, 10.9 Hz, 1H), 5.94 (d, $J = 17.6$ Hz, 1H), 5.51 (d, $J = 10.9$ Hz, 1H).
Figure S50. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 5h.
\textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \( \delta \) 7.93 (d, \( J = 8.2 \) Hz, 1H), 7.63 (d, \( J = 7.7 \) Hz, 1H), 7.58 (t, \( J = 7.5 \) Hz, 1H), 7.41 (t, \( J = 8.2 \) Hz, 1H), 7.18 (dd, \( J = 17.3, 11.0 \) Hz, 1H), 5.75 (d, \( J = 17.3 \) Hz, 1H), 5.49 (dd, \( J = 11.0, 0.5 \) Hz, 1H).
\(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.93 (d, \(J = 8.2\) Hz, 1H), 7.63 (d, \(J = 7.7\) Hz, 1H), 7.58 (t, \(J = 7.5\) Hz, 1H), 7.41 (t, \(J = 8.2\) Hz, 1H), 7.18 (dd, \(J = 17.3, 11.0\) Hz, 1H), 5.75 (d, \(J = 17.3\) Hz, 1H), 5.49 (dd, \(J = 11.0, 0.5\) Hz, 1H).

**Figure S51.** \(^1\)H NMR spectrum (400 MHz, CDCl\(_3\)) of compound 5i.
HRMS: [M + Na]$^+ m/z$ calculated for C$_{18}$H$_{10}$O$_3$Na 297.0522, [M + Na]$^+ m/z$ found: 297.0528. $^1$H NMR (400 MHz, CDCl$_3$). $^1$H NMR (400 MHz, cdcl3) δ 8.25 (dd, $J$ = 7.1, 1.8 Hz, 1H), 8.20 (dd, $J$ = 7.0, 1.9 Hz, 1H), 7.90 (dd, $J$ = 8.2, 1.4 Hz, 2H), 7.80-7.72 (m, 2H), 7.53-7.43 (m, 3H), 7.20 (s, 1H).
Figure S52. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 7.
Figure S53. COSY H,H spectrum of compound 7.
**Figure S54.** HRMS spectrum of compound 7: [M + Na]$^+$ m/z calculated for C$_{18}$H$_{10}$O$_3$Na 297.0522, [M + Na]$^+$ m/z found: 297.0528.
HRMS: [M + Na]$^+$ m/z calculated for C$_{18}$H$_{10}$O$_3$Na 297.0522, [M + Na]$^+$ m/z found: 297.0524. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.06 (d, $J = 7.7$ Hz, 1H), 7.78 (d, $J = 7.7$ Hz, 1H), 7.73 (dd, $J = 7.0$, 1.1 Hz, 2H), 7.67 (td, $J = 7.6$, 1.2 Hz, 1H), 7.49-7.42 (m, 3H), 7.4-7.35 (m, 1H), 7.01 (s, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 180.32, 174.41, 159.70, 156.69, 135.40, 130.61, 130.19, 129.21, 128.99, 128.82, 128.59, 128.38, 124.40, 124.36, 123.26, 122.24, 102.79.
Figure S55. $^1$H NMR spectrum (400 MHz, CDCl$_3$) of compound 8.
Figure S56. APT spectrum of compound 8.

$^{13}$C NMR (101 MHz, CDCl$_3$): 180.32, 174.41, 159.70, 156.69, 135.40, 130.61, 130.56, 130.19, 129.21, 128.99, 128.82, 128.59, 128.38, 124.40, 124.36, 123.26, 122.24, 102.79.
Figure S57. COSY H,H spectrum of compound 8.
**Figure S58.** HRMS spectrum of compound 8: \([M + Na]^+ m/z\) calculated for \(C_{18}H_{10}O_3Na\) 297.0522, \([M + Na]^+ m/z\) found: 297.0524.