

Supporting Information for
A Highly Selective Cascade Approach to Diverse Aromatic Ring
Systems from Simple Aromatic Aldehydes and Propiolates

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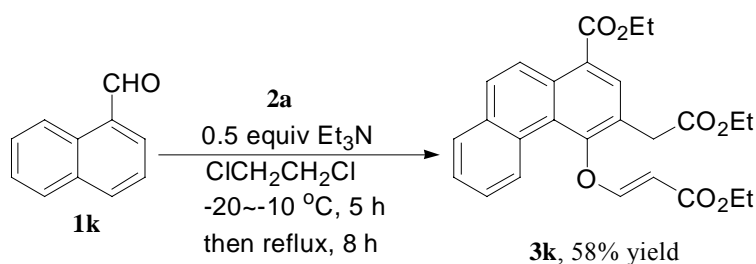
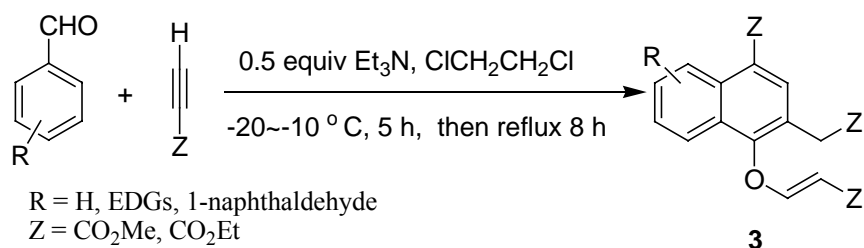
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I. General Considerations

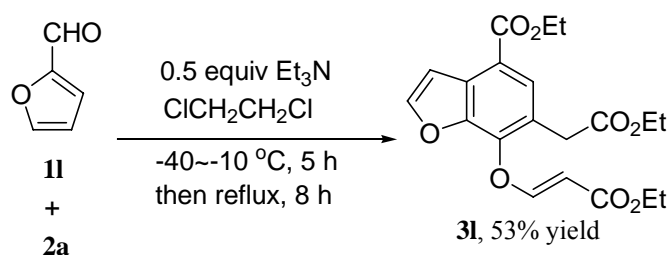
Column chromatography was carried out on silica gel (10-40 mesh) with mixed solvents (hexane-ethyl acetate). CH_2Cl_2 , $\text{ClCH}_2\text{CH}_2\text{Cl}$ and triethyl amine (TEA) were distilled from CaH_2 . Infrared spectra were obtained on a FTIR spectrometer. NMR spectra were recorded for ^1H NMR at 500 MHz otherwise noted, for ^{13}C NMR at 125 MHz at 293 K otherwise noted. Chemical shifts are reported relative to residue peaks of CDCl_3 (7.27 ppm for ^1H and 77.27 ppm for ^{13}C). The following abbreviations are used to describe peak patterns where appropriate: b = broad, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. Coupling constants are reported in Hertz (Hz). Low-resolution MS and HRMS were obtained using ESI ionization. Melting points were measured with micro melting point apparatus.

II. Procedures for the Reactions

General Procedure for Et₃N-catalyzed Cascade Approach to **3**.

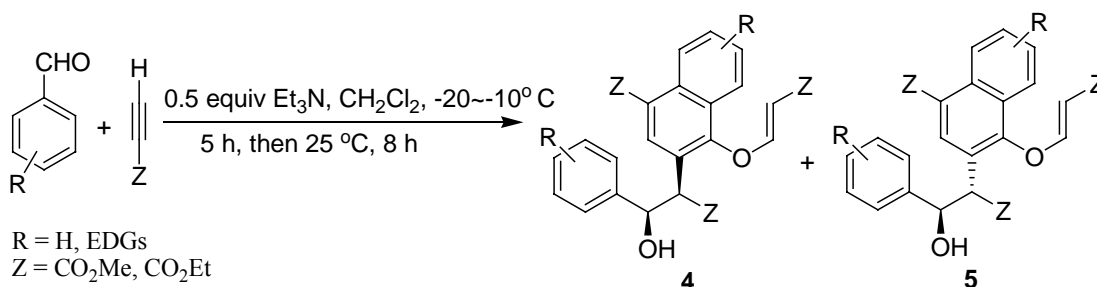


To a solution of benzaldehyde or 1-naphthaldehyde (2 mmol) and propiolate (3 mmol) in ClCH₂CH₂Cl (10 ml) was added dropwise TEA (1.5 mmol) in ClCH₂CH₂Cl (5 ml) under N₂ at -20°C during about 30 min. The mixture was stirred at -20 ~ -10 °C for 5 h and then refluxed for 8 h. After completion of the reaction, the mixture was washed with brine for two times and the organic layer was dried over anhydrous sodium sulfate. The solvent was removed and the residue was purified by column chromatography on silica gel with hexane-ethyl acetate (1:5 or 1:3) to afford the corresponding products **3**.

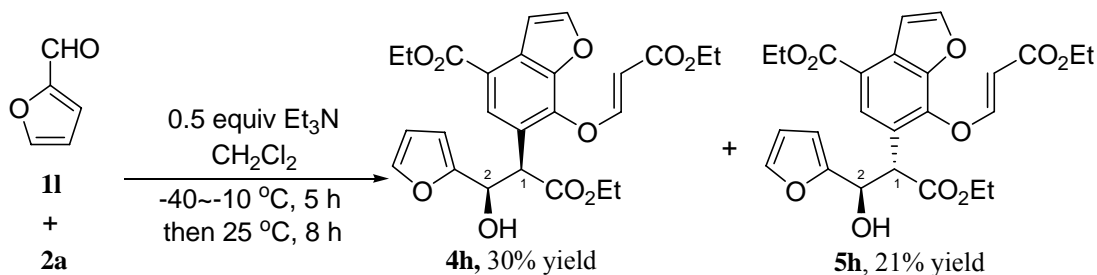


3l was obtained following the above-stated procedure only changing the temperature from -20 ~ -10 °C to -40 ~ -10 °C.

General Procedure for Et₃N-catalyzed Cascade Approach to **4** and **5**.

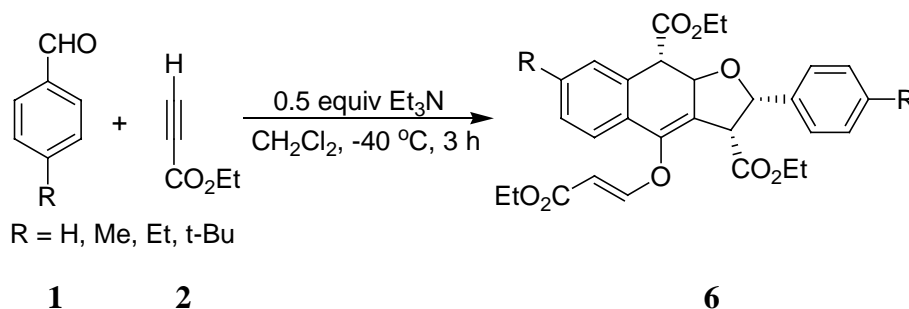


To a solution of benzaldehydes (2 mmol) and propiolates (3 mmol) in CH₂Cl₂ (10 ml) was added dropwise TEA (1.5 mmol) in CH₂Cl₂ (5 ml) for 30 min under N₂ at -20 °C. The reaction mixture was stirred at -20 ~ -10 °C for 5 h and then at 25 °C for 8 h. The mixture was washed with brine for two times and the organic layer was dried over anhydrous sodium sulfate. The solvent was removed in vacuum and the residue was purified by column chromatography on silica gel with hexane-ethyl acetate (1:5 or 1:3) to give pure products **4** and **5**.



4h and **5h** were obtained following the above-stated procedure just changing the temperature from -20 ~ -10 °C to -40 ~ -10 °C.

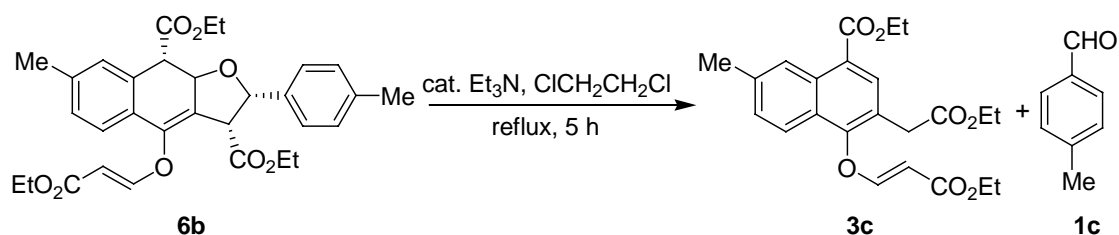
General Procedure for the Synthesis of 2,3,9,9a-tetrahydro-naphtho[2,3-b] furans **6**.



To a mixture of benzaldehyde (2 mmol) and ethyl propiolate (3 mmol) in CH₂Cl₂ (10 ml) was added dropwise TEA (1.5 mmol) in CH₂Cl₂ (5 ml) under N₂ at -40 °C. The reaction

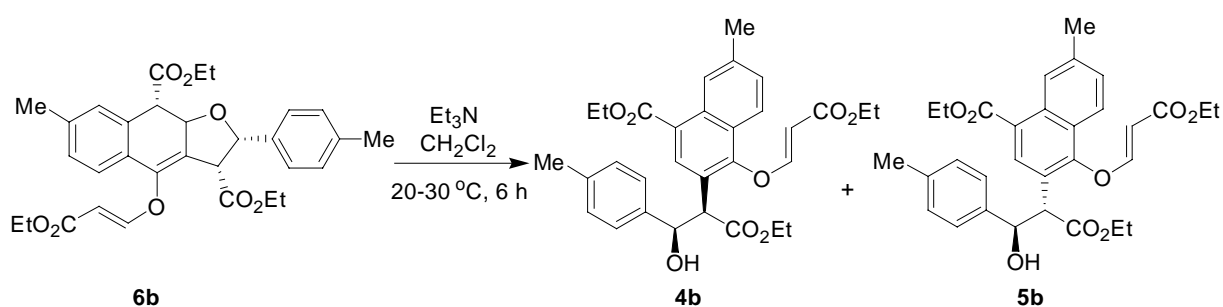
mixture was stirred at $-40\text{ }^{\circ}\text{C}$ for 3 h. Then 1N hydrochloric acid (1.5 ml) was added to quench the reaction. The solution was washed with brine, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel with hexane-ethyl acetate (1:5) to afford pure compound **6**. The crystal of **6** was obtained from hexane.

Transformation of **6b** to **3c**.



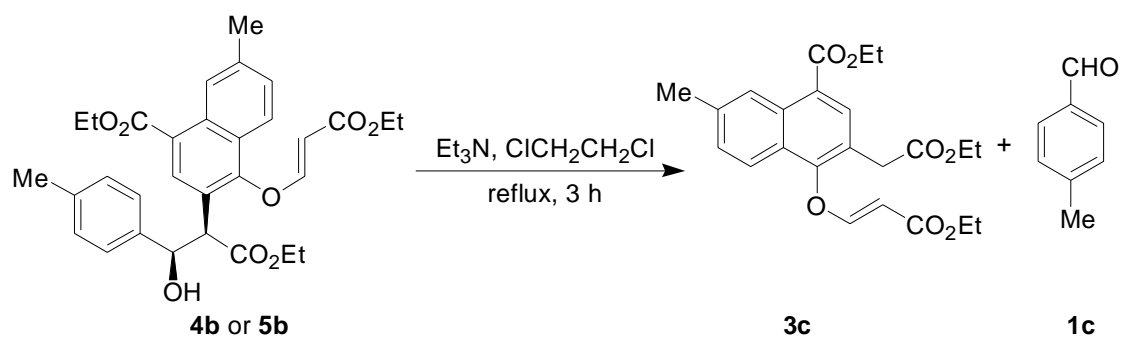
To a solution of **6b** (1 mmol) in $\text{ClCH}_2\text{CH}_2\text{Cl}$ (8 ml) was added three drops of TEA. The solution was refluxed for 5 h and then evaporated in vacuum. The residue was chromatographed on silica gel column with hexane-ethyl acetate (1:5) to give pure **3c** (90% yield) and **1c** (88% yield).

Transformation of **6b** to **4b** and **5b**.



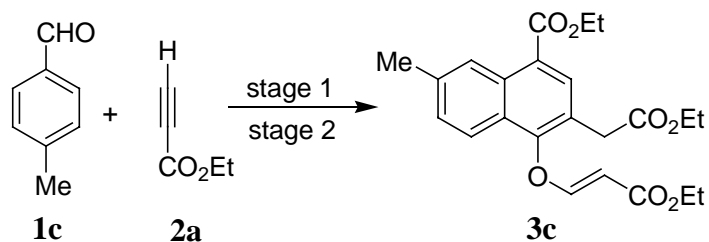
To a solution of **6b** (1 mmol) in CH_2Cl_2 (8 ml) was added three drops of TEA. The solution was stirred at $20-30\text{ }^{\circ}\text{C}$ for 5 h and then concentrated in vacuum. The residue was chromatographed on silica gel column with hexane-ethyl acetate (1:5) to give pure products **4c** (33% yield) and **5c** (60% yield).

Transformation of **4b** or **5b** to **3c**.



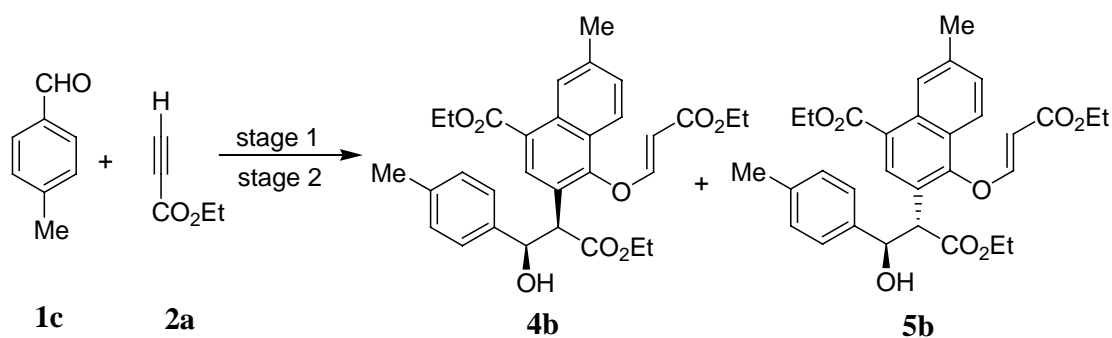
To a solution of **4b** or **5b** (1 mmol) in $\text{ClCH}_2\text{CH}_2\text{Cl}$ (15 ml) was added three drops of TEA. The solution was refluxed for 3 h and then concentrated in vacuum. The residue was purified by column chromatography on silica gel with hexane-ethyl acetate (1:5) to give **3c** in 95% yield, and **1c** in 90% yield.

III. Optimization of Reaction Conditions



entry	solvent	equiv of 2a	equiv of 1c	base / equiv	temperature(°C) / time (h)		yield ^a (%)
					Stage 1	Stage 2	
1	ClCH ₂ CH ₂ Cl	1	1	Et ₃ N / 0.5	-5 / 5	reflux / 10	53
2	ClCH ₂ CH ₂ Cl	1	1	Et ₃ N / 0.5	-10 / 5	reflux / 8	61
3	ClCH ₂ CH ₂ Cl	1	1	Et ₃ N / 0.8	-10 / 8	60 / 10	47
4	ClCH ₂ CH ₂ Cl	1	0.67	Et ₃ N / 0.5	-10 / 5	reflux / 8	60
5	ClCH ₂ CH ₂ Cl	1	0.67	Et ₃ N / 0.5	-20 / 5	reflux / 8	66
6	ClCH ₂ CH ₂ Cl	1	0.67	TOA / 0.5	-20 / 8	reflux / 8	58
7	ClCH ₂ CH ₂ Cl	1	0.67	DABCO / 0.5	-20 / 5	reflux / 8	0
8	ClCH ₂ CH ₂ Cl	1	0.67	DBU / 0.5	-20 / 5	reflux / 8	0
9	ClCH ₂ CH ₂ Cl	1	0.67	pyridine / 0.5	-20 / 5	reflux / 8	0
10	ClCH ₂ CH ₂ Cl	1	0.67	imidazole / 0.5	-20 / 5	reflux / 8	0
11	ClCH ₂ CH ₂ Cl	1	0.67	DIPEA / 0.5	-20 / 5	reflux / 8	0
12	ClCH ₂ CH ₂ Cl	1	0.67	Et ₂ NH / 0.5	-20 / 5	reflux / 8	0
13	THF	1	0.67	Et ₃ N / 0.5	-20 / 5	reflux / 8	19
14	CH ₃ CN	1	0.67	Et ₃ N / 0.5	-20 / 5	reflux / 8	12
15	ClCH ₂ CH ₂ Cl	1	0.67	(i-Pr) ₃ P / 0.5	-20 / 5	reflux / 8	0

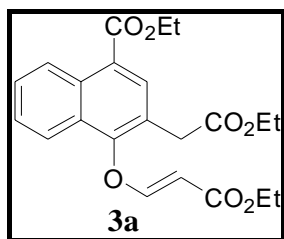
^a Isolated yield refers to ethyl propiolate.



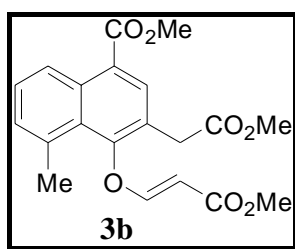
entry	solvent	equiv of 2a	equiv of 1c	base / equiv	temperature(°C) / time (h)		yield (%) ^a	
					Stage 1	Stage 2	4b	5b
1	CH ₂ Cl ₂	1	1	Et ₃ N / 0.5	-5 / 5	5 / 10	15	25
2	CH ₂ Cl ₂	1	1	Et ₃ N / 0.5	-10 / 5	25 / 8	23	35
3	CH ₂ Cl ₂	1	1	Et ₃ N / 0.8	-10 / 8	reflux / 10	18	31
4	CH ₂ Cl ₂	1	0.67	Et ₃ N / 0.5	-10 / 5	25 / 8	22	35
5	CH ₂ Cl ₂	1	0.67	Et ₃ N / 0.5	-20 / 5	25 / 8	26	38
6	ClCH ₂ CH ₂ Cl	1	0.67	Et ₃ N / 0.5	-20 / 5	25 / 8	22	35
7	CH ₂ Cl ₂	1	0.67	TOA / 0.5	-20 / 5	25 / 8	20	33
8	CH ₂ Cl ₂	1	0.67	DABCO / 0.5	-20 / 5	25 / 8	0	0
9	CH ₂ Cl ₂	1	0.67	DBU / 0.5	-10 / 5	25 / 8	0	0
10	CH ₂ Cl ₂	1	0.67	pyridine / 0.5	-10 / 5	25 / 8	0	0
11	CH ₂ Cl ₂	1	0.67	imidazole / 0.5	-10 / 5	25 / 8	0	0
12	CH ₂ Cl ₂	1	0.67	DIPEA / 0.5	-10 / 5	25 / 8	0	0
13	CH ₂ Cl ₂	1	0.67	Et ₂ NH 0.5	-10 / 5	25 / 8	0	0
14	CH ₂ Cl ₂	1	0.67	(i-Pr) ₃ P / 0.5	-20 / 5	25 / 8	0	0

^a Isolated yields refer to ethyl propiolate.

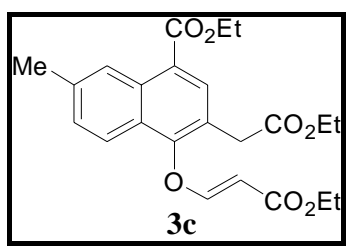
IV. Characterization Data for Products



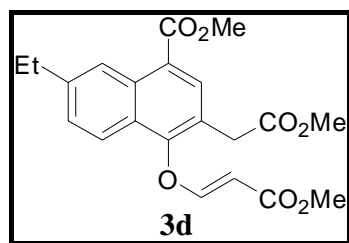
pale yellow oil; ¹H NMR (CDCl₃) δ 8.96 (d, *J* = 8.6 Hz, 1H), 8.17 (s, 1H), 7.92 (d, *J* = 8.4 Hz, 1H), 7.84 (d, *J* = 12.5 Hz, 1H), 7.64 (m, 1H), 7.59 (m, 1H), 5.13 (d, *J* = 12.5 Hz, 1H), 4.48 (q, *J* = 7.2 Hz, 2H), 4.17 (q, *J* = 7.2 Hz, 2H), 4.13 (q, *J* = 7.1 Hz, 2H), 3.8 (s, 2H), 1.47 (t, *J* = 7.1 Hz, 3H), 1.24 (t, *J* = 7.2 Hz, 3H), 1.22 (t, *J* = 7.2 Hz, 3H) ppm; ¹³C NMR (CDCl₃) δ 170.4, 166.9, 166.8, 160.8, 151.8, 133.1, 132.6, 128.5, 127.5, 126.5, 126.1, 122.2, 101.6, 61.5, 60.4, 35.7, 14.6, 14.4, 14.3 ppm; IR (film) ν 2982, 1738, 1716, 1633, 1573, 1508, 1367, 1247, 1122, 1032, 792 cm⁻¹; MS (ESI) *m/z* 423.0 ([M+Na]⁺); HRMS (ESI) calcd for C₂₂H₂₄O₇ ([M+Na]⁺), 423.1414; found, 423.1415.



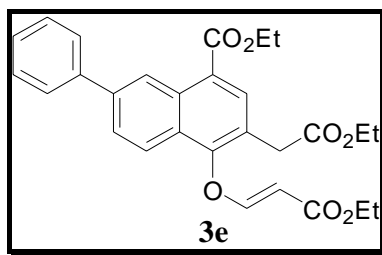
colorless oil; ¹H NMR (CDCl₃) δ 8.73 (d, *J* = 8.7 Hz, 1H), 8.07 (s, 1H), 7.71 (d, *J* = 12.5 Hz, 1H), 7.50 (m, 1H), 7.35 (d, *J* = 7.0 Hz, 1H), 5.03 (d, *J* = 12.5 Hz, 1H), 4.00 (s, 3H), 3.75 (s, 2H), 3.71 (s, 3H), 3.67 (s, 3H), 2.79 (s, 3H) ppm; ¹³C NMR (CDCl₃) δ 171.0, 167.7, 167.3, 161.0, 153.1, 133.9, 133.6, 132.7, 131.1, 128.2, 127.1, 124.6, 123.0, 101.4, 52.7, 52.6, 51.6, 35.8, 24.6 ppm; IR (film) ν 2953, 1739, 1717, 1644, 1631, 1576, 1436, 1321, 1243, 1133, 966, 818 cm⁻¹; MS (ESI) *m/z* 395.1 ([M+Na]⁺); HRMS (ESI) calcd for C₂₀H₂₀O₇ ([M+Na]⁺), 395.1101; found, 395.1098.



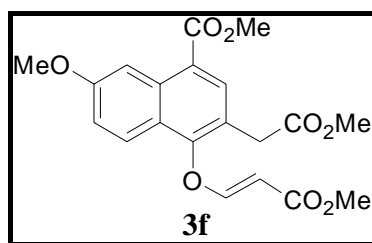
yellow oil; ^1H NMR (CDCl_3) δ 8.75 (s, 1H), 8.13 (s, 1H), 7.82 (m, 2H), 7.41 (d, $J = 8.6$ Hz, 1H), 5.11 (d, $J = 12.5$ Hz, 1H), 4.47 (q, $J = 7.1$ Hz, 2H), 4.14 (m, 4H), 3.75 (s, 2H), 2.55 (s, 3H), 1.47 (t, $J = 7.1$ Hz, 3H), 1.23 (m, 6H) ppm; ^{13}C NMR (CDCl_3) δ 170.5, 167.0, 166.9, 160.9, 151.9, 138.7, 133.1, 132.9, 129.7, 125.5, 125.3, 128.2, 122.0, 121.1, 101.4, 61.5, 61.4, 60.3, 35.6, 22.4, 14.6, 14.4, 14.3 ppm; IR (film) ν 2989, 2940, 1727, 1716, 1639, 1476, 1367, 1330, 1310, 1215, 1152, 1128, 1035, 830, 791 cm^{-1} ; MS (ESI) m/z 437.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{O}_7$ ($[\text{M}+\text{Na}]^+$), 437.1571; found, 437.1573.



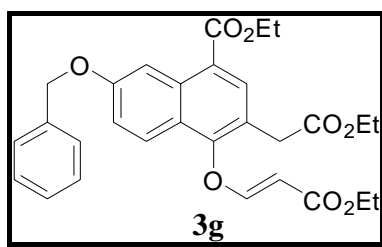
yellow solid; mp 68-70 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 8.78 (s, 1H), 8.14 (s, 1H), 7.83 (m, 2H), 7.45 (m, 1H), 5.15 (d, $J = 12.5$ Hz, 1H), 4.00 (s, 3H), 3.75 (s, 2H), 3.68 (s, 3H), 3.67 (s, 3H), 2.84 (q, $J = 7.6$ Hz, 2H), 1.33 (t, $J = 7.6$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 170.9, 167.3, 167.2, 161.0, 152.0, 145.0, 133.3, 133.0, 128.7, 125.4, 125.0, 124.3, 122.1, 121.0, 101.1, 52.44, 52.40, 51.5, 35.4, 29.6, 15.6 ppm; IR (KBr) ν 2953, 1735, 1717, 1654, 1435, 1341, 125, 1189, 1158, 1144, 1039, 848, 741 cm^{-1} ; MS (ESI) m/z 386.9 ($[\text{M}+\text{H}]^+$); HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{22}\text{O}_7$ ($[\text{M}+\text{Na}]^+$), 409.1258; found, 409.1249.



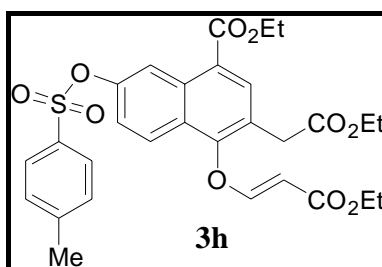
white solid; mp 96-97 °C; $^1\text{H NMR}$ (CDCl_3) δ 9.27 (d, $J = 1.5$ Hz, 1H), 8.22 (s, 1H), 8.00 (d, $J = 8.8$ Hz, 1H), 7.87 (m, 2H), 7.77 (m, 2H), 7.51 (m, 2H), 7.43 (m, 1H), 5.1 (d, $J = 12.4$ Hz, 1H), 4.50 (q, $J = 7.2$ Hz, 2H), 4.19 (q, $J = 7.1$ Hz, 2H), 4.14 (q, $J = 7.1$ Hz, 2H), 3.80 (s, 2H), 1.49 (t, $J = 7.2$ Hz, 3H), 1.25 (m, 6H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 170.5, 166.9, 166.8, 160.8, 151.9, 141.2, 140.8, 133.7, 133.0, 129.2, 128.1, 127.8, 127.1, 126.1, 126.0, 124.6, 122.8, 122.1, 101.6, 61.6, 60.4, 35.8, 14.6, 14.4, 14.3 ppm; IR (KBr) ν 2985, 2933, 1731, 1715, 1638, 1568, 1310, 1251, 1213, 1167, 1131, 1039, 759, 695 cm^{-1} ; MS (ESI) m/z 477.0 ($[\text{M}+\text{H}]^+$); HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{28}\text{O}_7$ ($[\text{M}+\text{Na}]^+$), 499.1727; found, 499.1728.



yellow oil; $^1\text{H NMR}$ (CDCl_3) δ 8.50 (d, $J = 2.4$ Hz, 1H), 8.21 (s, 1H), 7.81 (d, $J = 12.5$ Hz, 1H), 7.80 (d, $J = 9.2$ Hz, 1H), 7.22 (dd, $J = 2.5, 9.2$ Hz, 1H), 5.14 (d, $J = 12.5$ Hz, 1H), 3.99 (s, 3H), 3.97 (s, 3H), 3.73 (s, 2H), 3.69 (s, 3H), 3.67 (s, 3H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 171.0, 167.32, 167.28, 161.0, 160.0, 152.4, 134.8, 134.4, 123.8, 123.5, 122.3, 120.5, 119.5, 104.9, 101.2, 55.6, 52.5, 52.4, 51.6, 35.3 ppm; IR (film) ν 2953, 1740, 1716, 1630, 1577, 1506, 1435, 1418, 1227, 1157, 1126, 1034, 952, 835, 788, 666 cm^{-1} ; MS (ESI) m/z 410.9 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{20}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 411.1050; found, 411.1059.

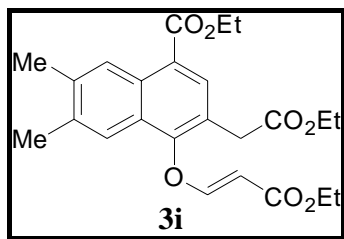


pale yellow solid; mp 70-72 °C; $^1\text{H NMR}$ (CDCl_3) δ 8.63 (d, $J = 2.4$ Hz, 1H), 8.22 (s, 1H), 7.83 (m, 2H), 7.52 (d, $J = 7.4$ Hz, 2H), 7.42 (m, 2H), 7.30 (m, 2H), 5.24 (s, 2H), 5.13 (d, $J = 12.5$ Hz, 1H), 4.48 (q, $J = 7.1$ Hz, 2H), 4.16 (m, 4H), 3.74 (s, 2H), 1.47 (t, $J = 7.1$ Hz, 3H), 1.24 (m, 6H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 170.7, 167.0, 160.9, 159.1, 152.3, 136.7, 134.7, 134.3, 128.9, 128.4, 128.1, 124.1, 123.9, 122.5, 120.7, 119.9, 106.2, 101.6, 70.4, 61.5, 61.4, 60.4, 35.6, 14.7, 14.5, 14.4 ppm; IR (KBr) ν 3405, 2924, 1732, 1720, 1702, 1642, 1624, 1420, 1384, 1145, 1134, 671, 604 cm^{-1} ; MS (ESI) m/z 505.3 ($[\text{M}-\text{H}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{30}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 529.1833; found, 529.1853.

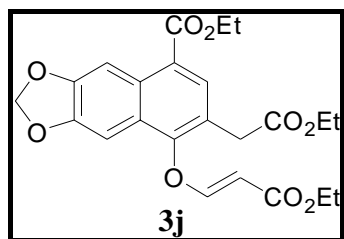


colorless oil; $^1\text{H NMR}$ (CDCl_3) δ 8.66 (d, $J = 2.3$ Hz, 1H), 8.22 (s, 1H), 7.87 (d, $J = 9.2$ Hz, 1H), 7.78 (d, $J = 12.4$ Hz, 1H), 7.77 (d, $J = 8.3$ Hz, 2H), 7.33 (d, $J = 8.2$ Hz, 2H), 7.29 (dd, $J = 2.3$ Hz, $J = 9.2$ Hz, 1H), 5.1 (d, $J = 12.4$ Hz, 1H), 4.42 (q, $J = 7.1$ Hz, 2H), 4.15 (m, 4H), 3.75 (s, 2H), 2.45 (s, 3H), 1.43 (t, $J = 7.1$ Hz, 3H), 1.24 (m, 6H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 170.2, 166.7, 166.0, 160.5, 151.9, 149.6, 145.8, 134.7, 133.0, 132.5, 130.1, 128.8, 125.7, 125.6, 124.3, 122.93, 122.91, 119.3, 102.0, 61.69, 61.66, 60.5, 35.6, 21.9, 14.5, 14.4, 14.3 ppm; IR (film) ν 2982, 2933, 1736, 1716, 1632, 1574, 1377, 1239, 1178, 1123, 1036, 919, 665 cm^{-1} ; MS (ESI) m/z 593.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{30}\text{O}_{10}\text{S}$ ($[\text{M}+\text{Na}]^+$),

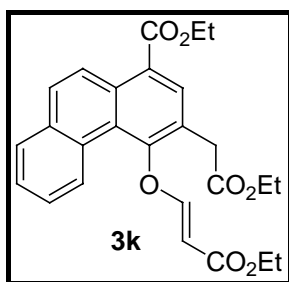
593.1452; found, 593.1459.



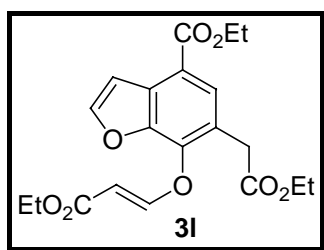
yellow solid; mp 84-85 °C; ¹H NMR (CDCl₃) δ 8.73 (s, 1H), 8.07 (s, 1H), 7.84 (d, *J* = 12.4 Hz, 1H), 7.63 (s, 1H), 5.11 (d, *J* = 12.4 Hz, 1H), 4.47 (q, *J* = 7.1 Hz, 2H), 4.17 (m, 4H), 3.74 (s, 2H), 2.47 (s, 3H), 2.44 (s, 3H), 1.4 (t, *J* = 7.2 Hz, 3H), 1.24 (m, 6H) ppm; ¹³C NMR (CDCl₃) δ 170.6, 167.12, 167.06, 161.0, 151.3, 138.8, 137.6, 132.2, 131.7, 126.1, 125.9, 125.1, 121.6, 121.1, 101.3, 61.5, 61.4, 60.4, 35.8, 20.9, 20.7, 14.6, 14.5, 14.3 ppm; IR (KBr) ν 2982, 1732, 1709, 1654, 1570, 1498, 1421, 1326, 1252, 1144, 1044, 1031, 950, 842 cm⁻¹; MS (ESI) *m/z* 450.9 ([M+Na]⁺); HRMS (ESI) calcd for C₂₄H₂₈O₇ ([M+Na]⁺), 451.1727; found, 451.1725.



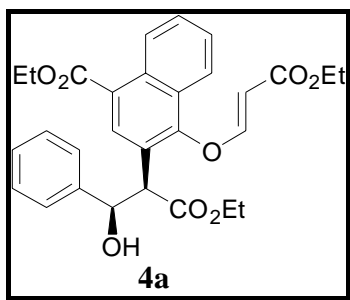
white solid; mp 106-108 °C; ¹H NMR (CDCl₃) δ 8.40 (s, 1H), 8.04 (s, 1H), 7.78 (d, *J* = 12.5 Hz, 1H), 7.15 (s, 1H), 6.09 (s, 2H), 5.10 (d, *J* = 12.5 Hz, 1H), 4.45 (q, *J* = 7.1 Hz, 2H), 4.14 (m, 4H), 3.70 (s, 2H), 1.45 (t, *J* = 7.1 Hz, 3H), 1.23 (m, 6H) ppm; ¹³C NMR (CDCl₃) δ 170.6, 167.0, 166.9, 160.6, 151.3, 150.1, 148.8, 131.6, 130.7, 124.8, 124.5, 121.0, 103.4, 102.0, 101.5, 98.6, 61.5, 60.4, 35.7, 14.6, 14.4, 14.3 ppm; IR (KBr) ν 2986, 1732, 1711, 1651, 1497, 1470, 1452, 1329, 1246, 1220, 1139, 1039 cm⁻¹; MS (ESI) *m/z* 467.1 ([M+Na]⁺); HRMS (ESI) calcd for C₂₃H₂₄O₉ ([M+Na]⁺), 467.1313; found, 467.1306.



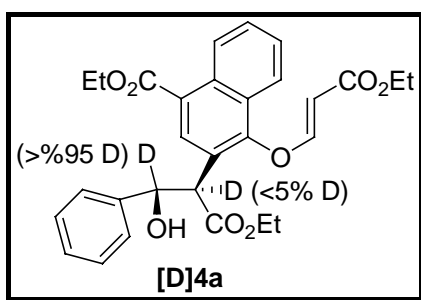
yellow oil; ¹H NMR (CDCl₃) δ 9.06 (m, 1H), 8.74 (d, *J* = 9.3 Hz, 1H), 8.16 (s, 1H), 7.91 (m, 1H), 7.87 (d, *J* = 9.3 Hz, 1H), 7.63 (m, 3H), 5.18 (d, *J* = 12.5 Hz, 1H), 4.52 (q, *J* = 7.2 Hz, 2H), 4.20 (q, *J* = 7.1 Hz, 2H), 4.06 (q, *J* = 7.1 Hz, 2H), 3.86 (s, 2H), 1.49 (t, *J* = 7.1 Hz, 3H), 1.27 (t, *J* = 7.2 Hz, 3H), 1.17 (t, *J* = 7.1 Hz, 3H) ppm; ¹³C NMR (CDCl₃) δ 170.6, 167.5, 166.7, 159.8, 153.9, 133.3, 133.0, 132.6, 130.3, 128.9, 128.2, 127.73, 127.70, 127.66, 127.2, 125.3, 124.1, 123.5, 102.2, 61.8, 61.5, 60.3, 36.5, 14.6, 14.4 ppm; IR (film) ν 2982, 2937, 1737, 1731, 1715, 1645, 1633, 1563, 1367, 1239, 1113, 1038, 834, 752 cm⁻¹; MS (ESI) *m/z* 473.1 ([M+Na]⁺); HRMS (ESI) calcd for C₂₆H₂₆O₇ ([M+Na]⁺), 473.1573; found, 473.1565.



yellow gum; ¹H NMR (CDCl₃) δ 8.02 (d, *J* = 12.2 Hz, 1H), 7.93 (s, 1H), 7.74 (d, *J* = 2.0 Hz, 1H), 7.41 (d, *J* = 2.0 Hz, 1H), 5.50 (d, *J* = 12.2 Hz, 1H), 4.45 (q, *J* = 7.1 Hz, 2H), 4.18 (m, 4H), 3.77 (s, 2H), 1.46 (t, *J* = 7.1 Hz, 3H), 1.26 (m, 6H) ppm; ¹³C NMR (CDCl₃) δ 170.7, 166.9, 165.8, 159.7, 147.5, 145.5, 141.9, 130.8, 129.1, 121.8, 120.0, 108.7, 102.7, 61.5, 61.4, 60.5, 35.7, 14.7, 14.5, 14.4 ppm; IR (film) ν 2982, 1737, 1731, 1715, 1651, 1586, 1498, 1369, 1301, 1204, 1122, 1036, 798 cm⁻¹; MS (ESI) *m/z* 413.1 ([M+Na]⁺); HRMS (ESI) calcd for C₂₀H₂₂O₈ ([M+Na]⁺), 413.1210; found, 413.1211.

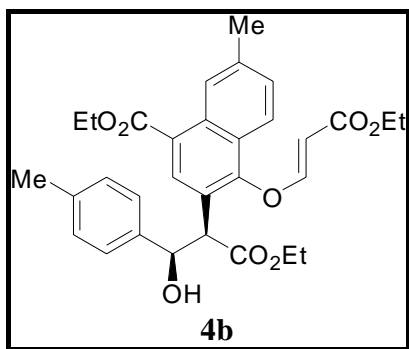


pale yellow gum; $^1\text{H NMR}$ (CDCl_3) δ 8.94 (d, $J = 8.7$ Hz, 1H), 8.46 (s, 1H), 7.85 (d, $J = 8.4$ Hz, 1H), 7.61 (m, 3H), 7.26 (m, 5H), 5.50 (dd, $J_1 = 2.3$, $J_2 = 6.5$ Hz, 1H), 5.20 (d, $J = 12.4$ Hz, 1H), 4.51 (m, 2H), 4.40 (d, $J = 6.6$ Hz, 1H), 4.13 (m, 2H), 4.05 (m, 2H), 2.79 (d, $J = 2.6$ Hz, 1H), 1.49 (t, $J = 7.1$ Hz, 3H), 1.23 (t, $J = 7.1$ Hz, 3H), 1.07 (t, $J = 7.2$ Hz, 3H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 171.9, 167.1, 167.0, 161.2, 152.7, 140.9, 132.5, 131.2, 128.62, 128.58, 128.4, 127.4, 126.9, 126.7, 126.5, 126.0, 123.2, 122.6, 101.9, 74.7, 61.64, 61.60, 60.3, 51.9, 14.6, 14.5, 14.0 ppm; IR (KBr) ν 3483, 2981, 1716, 1630, 1572, 1508, 1367, 1248, 1156, 1123, 1031, 766, 701 cm^{-1} ; MS (ESI) m/z 524.0 ($[\text{M}+\text{NH}_4]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{30}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 529.1833; found, 529.1846.

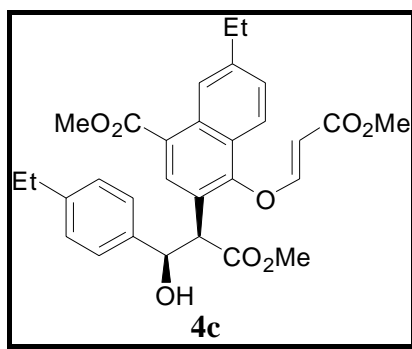


colorless gum; $^1\text{H NMR}$ (CDCl_3) δ 8.94 (d, $J = 6.0$ Hz, 1H), 8.47 (s, 1H), 7.86 (d, $J = 8.4$ Hz, 1H), 7.61 (m, 3H), 7.27 (m, 5H), 5.21 (d, $J = 12.4$ Hz, 1H), 4.51 (m, 2H), 4.40 (s, 1H), 4.12 (m, 2H), 4.05 (m, 2H), 2.81 (b, 1H), 1.50 (t, $J = 7.1$ Hz, 3H), 1.24 (t, $J = 7.1$ Hz, 3H), 1.07 (t, $J = 7.1$ Hz, 3H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 171.9, 167.1, 167.0, 161.3, 152.7, 140.9, 132.5, 131.2, 128.61, 128.57, 128.4, 127.4, 126.9, 126.7, 126.5, 126.0, 123.2, 122.6, 101.9, 61.63, 61.61, 60.3, 51.9, 14.6, 14.5, 14.0 ppm; IR (KBr) ν 3489, 2982, 2937, 1716, 1631, 1572, 1508,

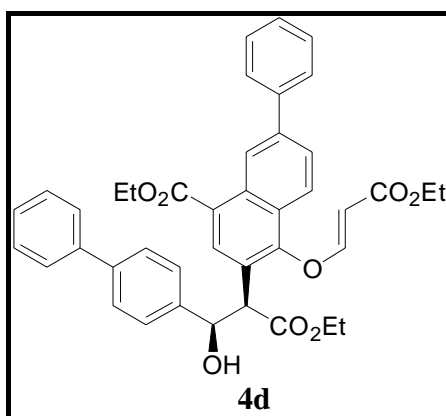
1367, 1247, 1124, 1032, 761, 710 cm^{-1} ; MS (ESI) m/z 530.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{29}\text{DO}_8$ ($[\text{M}+\text{Na}]^+$), 530.1896; found, 530.1896.



pale yellow gum; ^1H NMR (CDCl_3) δ 8.73 (s, 1H), 8.44 (s, 1H), 7.76 (d, $J = 8.6$ Hz, 1H), 7.64 (d, $J = 12.4$ Hz, 1H), 7.39 (d, $J = 8.7$ Hz, 1H), 7.18 (d, $J = 7.9$ Hz, 2H), 7.07 (d, $J = 7.8$ Hz, 2H), 5.44 (d, $J = 7.0$ Hz, 1H), 5.19 (d, $J = 12.4$ Hz, 1H), 4.49 (q, $J = 7.1$ Hz, 2H), 4.37 (d, $J = 7.0$ Hz, 1H), 4.13 (m, 2H), 4.03 (m, 2H), 2.71 (b, 1H), 2.30 (s, 3H), 2.27 (s, 3H), 1.48 (t, $J = 7.2$ Hz, 3H), 1.22 (t, $J = 7.1$ Hz, 3H), 1.06 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 171.9, 167.2, 167.0, 161.4, 152.7, 138.8, 138.1, 138.0, 132.8, 131.2, 129.5, 129.2, 126.7, 125.5, 125.3, 125.1, 122.4, 101.8, 74.6, 61.5, 61.4, 60.2, 51.9, 22.4, 21.3, 14.6, 14.5, 14.0 ppm; DEPT (135) δ 161.4, 131.1, 129.5, 129.2, 126.6, 125.5, 122.4, 101.7, 74.6, 51.8, 22.4, 21.3, 14.6, 14.5, 14.0 ppm; IR (KBr) ν 3489, 2981, 2919, 1716, 1631, 1571, 1369, 1314, 1251, 1171, 1123, 1039, 817, 793 cm^{-1} ; MS (ESI) m/z 552.2 ($[\text{M}+\text{NH}_4]^+$); HRMS (ESI) calcd for $\text{C}_{31}\text{H}_{34}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 557.2146; found, 557.2135.

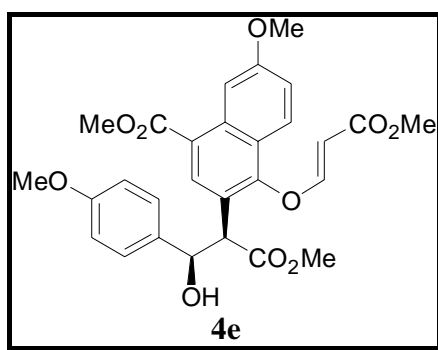


pale yellow gum; $^1\text{H NMR}$ (CDCl_3) δ 8.78 (s, 1H), 8.48 (s, 1H), 7.78 (d, $J = 8.7$ Hz, 1H), 7.59 (d, $J = 12.4$ Hz, 1H), 7.43 (m, 1H), 7.20 (d, $J = 8.0$ Hz, 2H), 7.09 (d, $J = 8.0$ Hz, 2H), 5.47 (d, $J = 7.0$ Hz, 1H), 5.25 (d, $J = 12.4$ Hz, 1H), 4.40 (d, $J = 7.0$ Hz, 1H), 4.02 (s, 3H), 3.67 (s, 3H), 3.56 (s, 3H), 2.86 (q, $J = 7.6$ Hz, 2H), 2.69 (b, 1H), 2.60 (q, $J = 7.6$ Hz, 2H), 1.34 (t, $J = 7.6$ Hz, 3H), 1.19 (t, $J = 7.6$ Hz, 3H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 172.3, 167.5, 167.4, 161.5, 152.9, 145.1, 144.5, 138.3, 133.0, 131.3, 128.6, 128.1, 126.6, 125.3, 125.0, 124.4, 122.5, 122.3, 101.4, 74.5, 52.51, 52.49, 51.7, 51.5, 29.7, 28.7, 15.6 ppm; IR (KBr) ν 3489, 2964, 1720, 1646, 1630, 1570, 1502, 1436, 1321, 1258, 1242, 1157, 1127, 1036, 949, 834, 791 cm^{-1} ; MS (ESI) m/z 542.9 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{30}\text{H}_{32}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 543.1989; found, 543.2004.

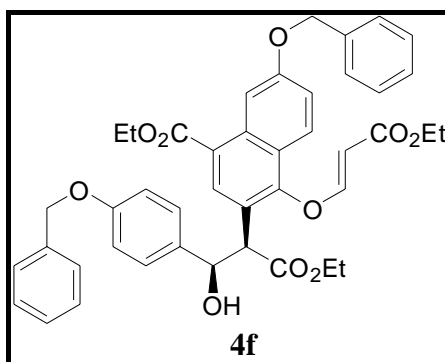


yellow solid; mp 163-164 $^\circ\text{C}$; $^1\text{H NMR}$ (CDCl_3) δ 9.24 (d, $J = 1.1$ Hz, 1H), 8.51 (s, 1H), 7.94 (d, $J = 8.8$ Hz, 1H), 7.83 (m, 1H), 7.75 (m, 3H), 7.57 (m, 2H), 7.51 (m, 4H), 7.38 (m, 6H),

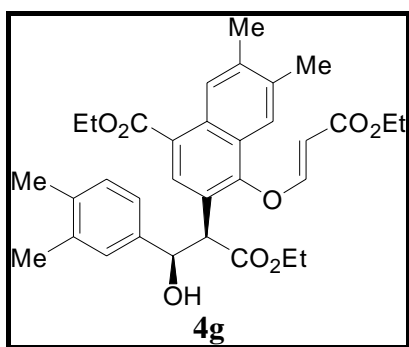
5.56 (d, $J = 6.7$ Hz, 1H), 5.25 (d, $J = 12.4$ Hz, 1H), 4.51 (q, $J = 7.1$ Hz, 2H), 4.45 (d, $J = 6.7$ Hz, 1H), 4.08 (m, 4H), 2.86 (b, 1H), 1.49 (t, $J = 7.2$ Hz, 3H), 1.19 (t, $J = 7.1$ Hz, 3H), 1.09 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 171.8, 167.0, 166.9, 161.1, 152.6, 141.2, 141.1, 140.74, 140.67, 139.9, 132.9, 131.6, 129.1, 128.9, 128.1, 127.7, 127.5, 127.2, 127.1, 127.0, 125.9, 124.4, 123.12, 123.07, 102.0, 74.4, 61.6, 61.5, 60.3, 51.9, 14.6, 14.3, 14.0 ppm; IR (KBr) ν 3448, 2981, 2929, 1733, 1716, 1629, 1567, 1487, 1408, 1368, 1315, 1253, 1173, 1126, 1037, 833, 768, 697 cm^{-1} ; MS (ESI) m/z 681.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{41}\text{H}_{38}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 681.2459; found, 681.2482.



pale yellow solid; mp 65-66 °C; ^1H NMR (CDCl_3) δ 8.56 (s, 1H), 5.51 (d, $J = 2.5$ Hz, 1H), 7.74 (d, $J = 9.3$ Hz, 1H), 7.51 (d, $J = 12.4$ Hz, 1H), 7.20 (dd, $J_1 = 2.5$, $J_2 = 9.3$ Hz, 1H), 7.17 (d, $J = 8.7$ Hz, 2H), 6.78 (d, $J = 8.7$ Hz, 2H), 5.45 (d, $J = 6.5$ Hz, 1H), 5.20 (d, $J = 12.4$ Hz, 1H), 4.35 (d, $J = 6.6$ Hz, 1H), 4.02 (s, 3H), 4.00 (s, 3H), 3.76 (s, 3H), 3.67 (s, 3H), 3.59 (s, 3H), 2.69 (b, 1H) ppm; ^{13}C NMR (CDCl_3) δ 172.6, 167.5, 167.4, 161.4, 160.1, 160.0, 153.3, 134.8, 133.1, 132.5, 127.9, 124.2, 123.4, 122.2, 120.6, 120.3, 114.0, 105.0, 101.5, 74.3, 55.7, 55.4, 52.6, 52.5, 51.6, 51.4 ppm; IR (KBr) ν 3489, 2953, 2839, 1716, 1627, 1577, 1513, 1436, 1418, 1250, 1160, 1127, 1032, 949, 834, 788, 557 cm^{-1} ; MS (ESI) m/z 547.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{28}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 547.1575; found, 547.1596.

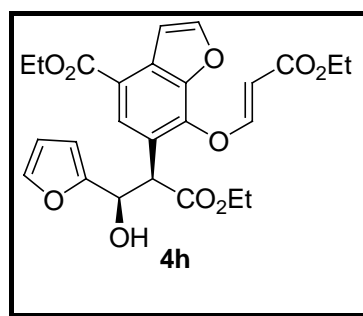


pale yellow gum; $^1\text{H NMR}$ (CDCl_3) δ 8.60 (d, $J = 2.3$ Hz, 1H), 8.52 (s, 1H), 7.78 (d, $J = 9.3$ Hz, 1H), 7.65 (d, $J = 12.4$ Hz, 1H), 7.52 (d, $J = 7.5$ Hz, 2H), 7.42 (m, 4H), 7.38 (m, 3H), 7.28 (m, 2H), 7.21 (d, $J = 8.6$ Hz, 2H), 6.88 (d, $J = 8.6$ Hz, 2H), 5.42 (d, $J = 6.9$ Hz, 1H), 5.24 (s, 2H), 5.20 (d, $J = 12.4$ Hz, 1H), 5.03 (s, 2H), 4.49 (m, 2H), 4.32 (d, $J = 7.0$ Hz, 1H), 4.13 (m, 2H), 4.03 (m, 2H), 2.67 (b, 1H), 1.49 (t, $J = 7.1$ Hz, 3H), 1.22 (t, $J = 7.1$ Hz, 3H), 1.06 (t, $J = 7.1$ Hz, 3H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 172.0, 167.2, 167.0, 161.3, 159.1, 158.8, 153.1, 137.1, 136.7, 134.6, 133.4, 132.2, 128.9, 128.8, 128.4, 128.2, 128.1, 128.0, 127.7, 124.3, 124.0, 122.3, 121.0, 120.6, 114.9, 106.1, 101.9, 74.4, 70.3, 70.1, 61.5, 61.4, 60.3, 51.8, 14.7, 14.5, 14.1 ppm; IR (KBr) ν 3483, 2980, 2931, 1712, 1626, 1509, 1420, 1245, 1226, 1173, 1124, 1036, 1027, 835, 738, 69 cm^{-1} ; MS (ESI) m/z 741.3 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{43}\text{H}_{42}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 741.2670; found, 741.2680.

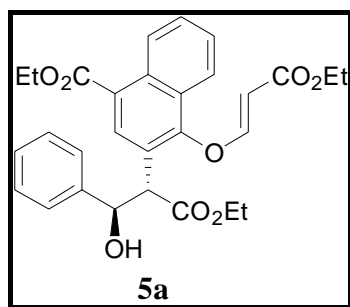


colorless gum; $^1\text{H NMR}$ (CDCl_3) δ 8.71 (s, 1H), 8.38 (s, 1H), 7.68 (d, $J = 12.4$ Hz, 1H), 7.60 (s, 1H), 7.09 (s, 1H), 7.03 (m, 2H), 5.39 (dd, $J_1 = 3.0$, $J_2 = 7.3$ Hz, 1H), 5.21 (d, $J = 12.4$ Hz,

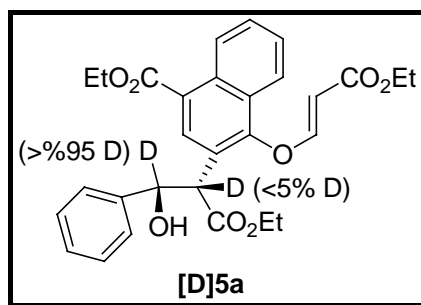
1H), 4.49 (q, $J = 7.1$ Hz, 2H), 4.36 (d, $J = 7.4$ Hz, 1H), 4.14 (m, 2H), 4.02 (m, 2H), 2.49 (d, $J = 3.2$ Hz, 1H), 2.47 (s, 3H), 2.43 (s, 3H), 2.21 (s, 3H), 2.20 (s, 3H), 1.49 (t, $J = 7.1$ Hz, 3H), 1.23 (t, $J = 7.1$ Hz, 3H), 1.05 (t, $J = 7.2$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 171.9, 167.3, 167.2, 161.6, 152.2, 138.9, 138.6, 137.4, 136.8, 136.7, 131.6, 130.0, 129.8, 128.1, 126.0, 125.8, 125.1, 124.2, 122.5, 122.0, 101.6, 74.7, 61.4, 60.3, 52.0, 20.9, 20.7, 20.0, 19.7, 14.7, 14.5, 14.0 ppm; IR (KBr) ν 3500, 2979, 2938, 1715, 1644, 1633, 1567, 1499, 1369, 1253, 1227, 1142, 1117, 1042, 737, 666 cm^{-1} ; MS (ESI) m/z 585.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{33}\text{H}_{38}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 585.2459; found, 585.2463.



pale yellow gum; ^1H NMR (CDCl_3) δ 8.08 (s, 1H), 7.88 (d, $J = 12.3$ Hz, 1H), 7.73 (d, $J = 2.1$ Hz, 1H), 7.39 (d, $J = 2.1$ Hz, 1H), 2.35 (m, 1H), 6.27 (dd, $J_1 = 1.8$ Hz, $J_2 = 3.2$ Hz, 1H), 6.18 (d, $J = 3.2$ Hz, 1H), 5.52 (d, $J = 12.2$ Hz, 1H), 5.47 (m, 1H), 4.58 (d, $J = 6.7$ Hz, 1H), 4.43 (q, $J = 7.1$ Hz, 2H), 4.20 (q, $J = 7.1$ Hz, 2H), 4.13 (m, 2H), 2.86 (d, $J = 4.7$ Hz, 1H), 1.45 (t, $J = 7.1$ Hz, 3H), 1.28 (t, $J = 7.2$ Hz, 3H), 1.15 (t, $J = 7.2$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 171.6, 166.9, 165.7, 159.8, 153.7, 147.6, 145.5, 142.34, 142.29, 130.7, 127.7, 122.4, 120.1, 110.6, 108.7, 107.7, 102.9, 68.7, 61.7, 61.4, 60.5, 49.4, 14.6, 14.5, 14.2 ppm; IR (film) ν 3470, 3131, 2982, 2935, 1714, 1651, 1585, 1496, 1370, 1301, 1186, 1123, 1036, 799, 737 cm^{-1} ; MS (ESI) m/z 509.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{25}\text{H}_{26}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 509.1420; found, 509.1416.

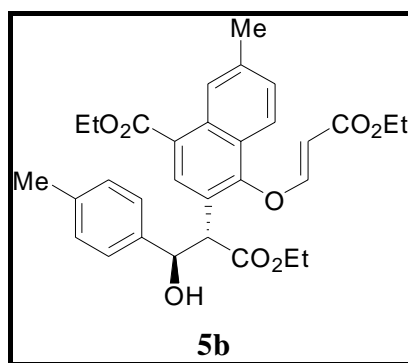


colorless gum; ^1H NMR (CDCl_3) δ 8.90 (d, $J = 8.7$ Hz, 1H), 8.21 (s, 1H), 7.76 (d, $J = 8.3$ Hz, 1H), 7.60 (m, 1H), 7.51 (m, 1H), 7.46 (d, $J = 12.4$ Hz, 1H), 7.13 (m, 5H), 5.36 (dd, $J_1 = 3.7$, $J_2 = 9.1$ Hz, 1H), 5.09 (d, $J = 12.4$ Hz, 1H), 4.50 (q, $J = 7.1$ Hz, 2H), 4.38 (q, $J = 9.1$ Hz, 1H), 4.19 (m, 4H), 3.57 (d, $J = 3.8$ Hz, 1H), 1.49 (t, $J = 7.1$ Hz, 3H), 1.25 (t, $J = 7.1$ Hz, 3H), 1.19 (t, $J = 7.2$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.9, 166.82, 166.80, 160.9, 151.8, 140.2, 132.4, 130.6, 128.7, 128.5, 128.4, 127.5, 126.9, 126.8, 126.5, 126.1, 123.6, 122.5, 102.1, 75.7, 61.9, 61.7, 60.4, 52.8, 14.6, 14.5, 14.1 ppm; IR (KBr) ν 3483, 2981, 1716, 1632, 1572, 1508, 1367, 1248, 1155, 1122, 1034, 790, 701, 542 cm^{-1} ; MS (ESI) m/z 507.0 ($[\text{M}+\text{H}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{30}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 529.1833; found, 529.1835.

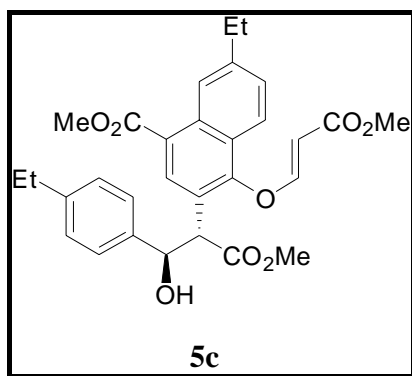


colorless gum; ^1H NMR (CDCl_3) δ 8.89 (d, $J = 8.7$ Hz, 1H), 8.21 (s, 1H), 7.76 (d, $J = 8.4$ Hz, 1H), 7.61 (m, 1H), 7.51 (m, 1H), 7.46 (d, $J = 12.4$ Hz, 1H), 7.14 (m, 5H), 5.09 (d, $J = 12.4$ Hz, 1H), 4.50 (q, $J = 7.1$ Hz, 2H), 4.38 (s, 1H), 4.14 (m, 4H), 3.55 (b, 1H), 1.49 (t, $J = 7.2$ Hz, 3H), 1.25 (t, $J = 7.1$ Hz, 3H), 1.19 (t, $J = 7.2$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.9, 166.8, 160.9, 151.8, 140.1, 132.4, 130.6, 128.7, 128.5, 128.4, 127.5, 126.9, 126.8, 126.5, 126.1,

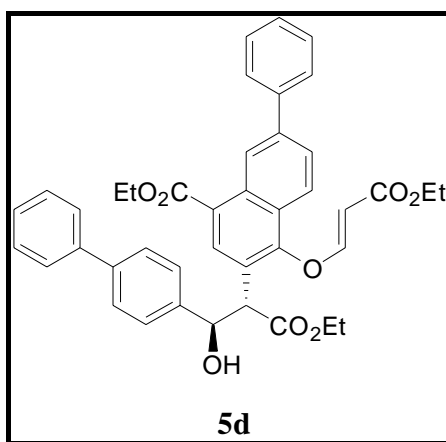
123.6, 122.5, 102.1, 61.9, 61.6, 60.3, 52.9, 14.6, 14.5, 14.1 ppm; IR (KBr) ν 3483, 2981, 1716, 1631, 1572, 1508, 1367, 1247, 1124, 1032, 761, 710 cm^{-1} ; MS (ESI) m/z 530.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{29}\text{DO}_8$ ($[\text{M}+\text{Na}]^+$), 530.1896; found, 530.1893.



yellow gum; ^1H NMR (CDCl_3) δ 8.68 (s, 1H), 8.20 (s, 1H), 7.65 (d, $J = 8.6$ Hz, 1H), 7.48 (d, $J = 12.4$ Hz, 1H), 7.33 (d, $J = 8.7$ Hz, 1H), 7.04 (d, $J = 7.9$ Hz, 2H), 6.91 (d, $J = 7.9$ Hz, 2H), 5.31 (d, $J = 9.3$ Hz, 1H), 5.06 (d, $J = 12.4$ Hz, 1H), 4.48 (m, 2H), 4.36 (d, $J = 9.3$ Hz, 1H), 4.16 (m, 4H), 3.58 (b, 1H), 2.51 (s, 3H), 2.18 (s, 3H), 1.48 (t, $J = 7.2$ Hz, 3H), 1.24 (t, $J = 7.1$ Hz, 3H), 1.18 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.9, 166.9, 166.8, 160.9, 151.7, 138.8, 137.9, 137.2, 132.6, 130.7, 129.5, 129.0, 126.7, 125.4, 125.2, 124.9, 122.6, 122.4, 101.8, 75.5, 61.7, 61.4, 60.2, 52.4, 22.3, 21.2, 14.5, 14.4, 14.0 ppm; IR (KBr) ν 3495, 2981, 2930, 1716, 1632, 1570, 1369, 1313, 1250, 1172, 1122, 1040, 819, 794 cm^{-1} ; MS (ESI) m/z 552.2 ($[\text{M}+\text{NH}_4]^+$); HRMS (ESI) calcd for $\text{C}_{31}\text{H}_{34}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 557.2146; found, 557.2142.

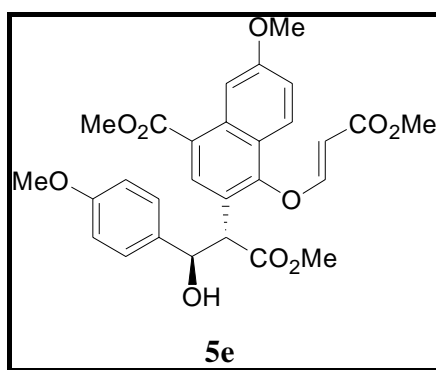


pale yellow solid; mp 54-55 °C; ^1H NMR (CDCl_3) δ 8.73 (s, 1H), 8.21 (s, 1H), 7.68 (d, $J = 8.7$ Hz, 1H), 7.42 (d, $J = 12.6$ Hz, 1H), 7.39 (d, $J = 8.9$ Hz, 1H), 7.07 (d, $J = 8.0$ Hz, 2H), 6.96 (d, $J = 7.9$ Hz, 2H), 5.36 (m, 1H), 5.10 (d, $J = 12.4$ Hz, 1H), 4.39 (d, $J = 9.3$ Hz, 1H), 4.02 (s, 3H), 3.71 (s, 3H), 3.69 (s, 3H), 3.37 (d, $J = 1.9$ Hz, 1H), 2.82 (q, $J = 7.6$ Hz, 2H), 2.51 (q, $J = 7.6$ Hz, 2H), 1.31 (t, $J = 7.6$ Hz, 3H), 1.11 (t, $J = 7.6$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 173.5, 167.29, 167.26, 161.2, 152.1, 145.2, 144.5, 137.4, 132.9, 130.9, 128.7, 128.0, 126.8, 125.3, 125.0, 124.3, 122.5, 101.6, 75.5, 52.8, 52.6, 52.4, 51.6, 29.6, 28.6, 15.6, 15.5 ppm; IR (KBr) ν 3483, 2964, 1720, 1647, 1631, 1570, 1502, 1436, 1409, 1319, 1286, 1258, 1241, 1157, 1126, 1036, 947, 832, 797 cm^{-1} ; MS (ESI) m/z 543.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{30}\text{H}_{32}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 543.1989; found, 543.1978.

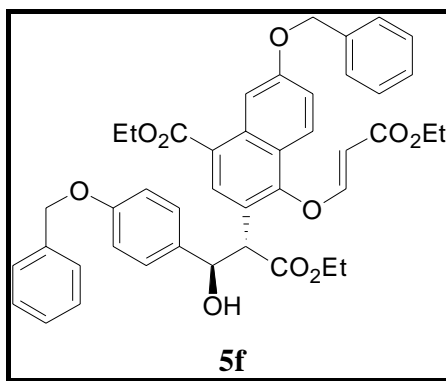


pale yellow solid; mp 66-68 °C; ^1H NMR (CDCl_3) δ 9.23 (d, $J = 1.0$ Hz, 1H), 8.34 (s, 1H), 7.88 (d, $J = 8.8$ Hz, 1H), 7.81 (m, 1H), 7.74 (m, 2H), 7.67 (d, $J = 12.4$ Hz, 1H), 7.50 (m, 4H),

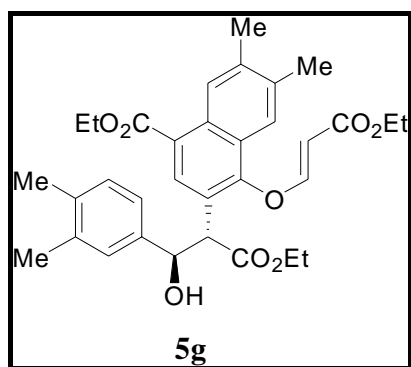
7.37 (m, 5H), 7.29 (m, 3H), 5.48 (d, $J = 7.6$ Hz, 1H), 5.17 (d, $J = 12.4$ Hz, 1H), 4.52 (m, 3H), 4.25 (m, 2H), 4.01 (m, 2H), 3.80 (b, 1H), 1.51 (t, $J = 7.1$ Hz, 3H), 1.25 (t, $J = 7.1$ Hz, 3H), 1.18 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.9, 166.9, 160.9, 151.9, 141.4, 141.0, 140.71, 140.66, 139.4, 132.9, 131.4, 129.2, 128.9, 128.2, 127.8, 127.6, 127.4, 127.21, 127.17, 126.1, 126.0, 124.5, 123.6, 123.3, 102.3, 75.5, 62.0, 61.7, 60.4, 52.7, 14.7, 14.4, 14.2 ppm; IR (KBr) ν 3467, 2980, 2936, 1715, 1631, 1567, 1489, 1408, 1370, 1313, 1249, 1174, 1124, 1038, 838, 766, 698 cm^{-1} ; MS (ESI) m/z 681.2 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{41}\text{H}_{38}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 681.2459; found, 681.2486.



white solid; mp 138-140 °C; ^1H NMR (CDCl_3) δ 8.44 (d, $J = 2.5$ Hz, 1H), 8.31 (s, 1H), 7.65 (d, $J = 9.3$ Hz, 1H), 7.35 (d, $J = 12.4$ Hz, 1H), 7.16 (dd, $J_1 = 2.5$, $J_2 = 9.3$ Hz, 1H), 7.05 (d, $J = 8.7$ Hz, 2H), 6.64 (d, $J = 8.7$ Hz, 2H), 5.33 (dd, $J_1 = 3.4$, $J_2 = 9.5$ Hz, 1H), 5.03 (d, $J = 12.4$ Hz, 1H), 4.34 (d, $J = 9.5$ Hz, 1H), 4.02 (s, 3H), 3.95 (s, 3H), 3.72 (s, 3H), 3.682 (s, 3H), 3.679 (s, 3H), 3.31 (d, $J = 3.5$ Hz, 1H) ppm; ^{13}C NMR (CDCl_3) δ 173.6, 167.3, 167.2, 161.0, 160.1, 159.5, 152.4, 134.7, 132.3, 131.8, 128.0, 124.2, 123.6, 122.2, 121.0, 120.4, 113.9, 104.9, 101.6, 75.3, 55.7, 55.3, 52.8, 52.5, 52.4, 51.5 ppm; IR (KBr) ν 3483, 2954, 2849, 1736, 1717, 1628, 1576, 1515, 1435, 1418, 1318, 1247, 1159, 1127, 1032, 831, 551 cm^{-1} ; MS (ESI) m/z 547.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{28}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 547.1575; found, 547.1583.

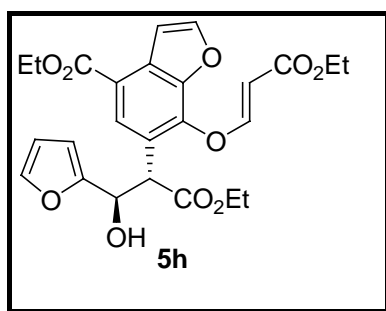


yellow gum; $^1\text{H NMR}$ (CDCl_3) δ 8.54 (d, $J = 2.4$ Hz, 1H), 8.25 (s, 1H), 7.68 (d, $J = 9.3$ Hz, 1H), 7.50 (m, 3H), 7.40 (m, 2H), 7.30 (m, 6H), 7.24 (m, 1H), 7.07 (d, $J = 8.7$ Hz, 2H), 6.73 (d, $J = 8.7$ Hz, 2H), 5.30 (dd, $J_1 = 3.5$, $J_2 = 9.3$ Hz, 1H), 5.20 (s, 2H), 5.09 (d, $J = 12.4$ Hz, 1H), 4.93 (q, $J = 11.7$ Hz, 2H), 4.46 (q, $J = 7.1$ Hz, 2H), 4.31 (d, $J = 9.3$ Hz, 1H), 4.21 (m, 1H), 4.14 (m, 3H), 3.42 (d, $J = 3.6$ Hz, 1H), 1.47 (t, $J = 7.1$ Hz, 3H), 1.22 (m, 6H) ppm; $^{13}\text{C NMR}$ (CDCl_3) δ 173.1, 166.9, 166.8, 160.9, 159.1, 158.9, 152.2, 137.1, 136.6, 134.5, 132.7, 131.8, 128.9, 128.7, 128.4, 128.10, 128.07, 127.7, 124.3, 124.0, 122.3, 121.4, 120.6, 114.8, 106.0, 102.0, 75.4, 70.3, 70.0, 61.8, 61.4, 60.4, 52.5, 14.6, 14.5, 14.1 ppm; IR (KBr) ν 3442, 2980, 2923, 1713, 1626, 1509, 1245, 1226, 1173, 1124, 1037, 832, 737, 697 cm^{-1} ; MS (ESI) m/z 741.3 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{43}\text{H}_{42}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 741.2670; found, 741.2683.

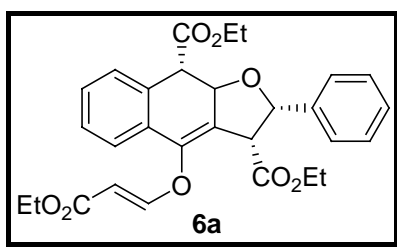


pale yellow gum; $^1\text{H NMR}$ (CDCl_3) δ 8.66 (s, 1H), 8.17 (s, 1H), 7.51 (d, $J = 12.4$ Hz, 1H), 7.49 (s, 1H), 7.00 (s, 1H), 6.86 (d, $J = 7.8$ Hz, 1H), 6.81 (m, 1H), 5.28 (dd, $J_1 = 3.3$, $J_2 = 9.1$ Hz, 1H), 5.09 (d, $J = 12.4$ Hz, 1H), 4.47 (q, $J = 7.1$ Hz, 2H), 4.36 (d, $J = 9.1$ Hz, 1H), 4.17 (m,

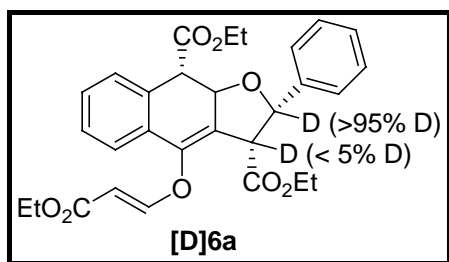
4H), 3.38 (d, $J = 3.8$ Hz, 1H), 2.43 (s, 3H), 2.38 (s, 3H), 2.11 (s, 3H), 2.10 (s, 3H), 1.48 (t, $J = 7.1$ Hz, 3H), 1.25 (t, $J = 7.2$ Hz, 3H), 1.18 (t, $J = 7.2$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 173.1, 167.1, 167.0, 161.2, 151.3, 138.9, 137.7, 137.5, 136.7, 136.6, 131.4, 129.9, 129.6, 128.0, 125.9, 125.7, 125.0, 124.3, 122.8, 121.9, 101.7, 75.6, 61.8, 61.4, 60.3, 52.4, 20.9, 20.7, 19.9, 19.6, 14.6, 14.5, 14.2 ppm; IR (KBr) ν 3500, 2980, 2939, 1715, 1645, 1632, 156, 1499, 1448, 1369, 1253, 1228, 1141, 1117, 1040, 737, 666 cm^{-1} ; MS (ESI) m/z 585.1 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{33}\text{H}_{38}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 585.2459; found, 585.2467.



pale yellow solid; mp 130-131 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 7.91 (s, 1H), 7.83 (d, $J = 12.1$ Hz, 1H), 7.71 (d, $J = 2.1$ Hz, 1H), 7.35 (d, $J = 2.1$ Hz, 1H), 7.25 (d, $J = 0.9$ Hz, 1H), 6.12 (dd, $J_1 = 1.9$ Hz, $J_2 = 3.2$ Hz, 1H), 6.06 (d, $J = 3.1$ Hz, 1H), 5.52 (d, $J = 12.2$ Hz, 1H), 5.33 (dd, $J_1 = 4.8$ Hz, $J_2 = 9.1$ Hz, 1H), 4.58 (d, $J = 9.2$ Hz, 1H), 4.43 (m, 2H), 4.19 (m, 4H), 3.74 (d, $J = 4.9$ Hz, 1H), 1.45 (t, $J = 7.2$ Hz, 3H), 1.30 (t, $J = 7.2$ Hz, 3H), 1.20 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.9, 166.9, 165.5, 159.5, 152.7, 147.7, 145.3, 142.7, 141.4, 130.7, 127.2, 122.9, 120.2, 110.3, 108.7, 108.5, 103.1, 69.3, 62.0, 61.4, 60.5, 50.3, 14.6, 14.5, 14.2 ppm; IR (KBr) ν 3462, 3125, 2986, 1716, 1639, 1580, 1495, 1370, 1311, 1223, 1117, 1035, 750 cm^{-1} ; MS (ESI) m/z 509.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{25}\text{H}_{26}\text{O}_{10}$ ($[\text{M}+\text{Na}]^+$), 509.1420; found, 509.1415.

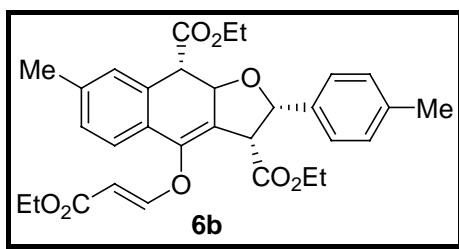


colorless crystal; mp 128-130 °C; ^1H NMR (CDCl_3) δ 7.60 (d, $J = 12.4$ Hz, 1H), 7.36 (d, $J = 7.3$ Hz, 2H), 7.28 (m, 6H), 7.13 (m, 1H), 5.78 (dd, $J_1 = 1.2$, $J_2 = 13.3$ Hz, 1H), 5.57 (d, $J = 6.2$ Hz, 1H), 5.44 (d, $J = 12.4$ Hz, 1H), 4.39 (m, 2H), 4.12 (m, 2H), 4.04 (m, 2H), 3.71 (m, 2H), 1.3 (t, $J = 7.1$ Hz, 3H), 1.22 (t, $J = 7.1$ Hz, 3H), 0.83 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.3, 168.8, 166.8, 159.5, 142.4, 137.4, 131.9, 129.7, 129.3, 128.4, 128.3, 126.9, 126.4, 125.1, 123.1, 101.6, 85.1, 80.9, 61.7, 61.3, 60.4, 52.6, 52.1, 14.54, 14.48, 13.8 ppm; IR (KBr) ν 2981, 2938, 1739, 1719, 1642, 1452, 1373, 1321, 1275, 1189, 1119, 1035, 962, 747, 702, 594 cm^{-1} ; MS (ESI) m/z 529.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{29}\text{H}_{30}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 529.1833; found, 529.1809.

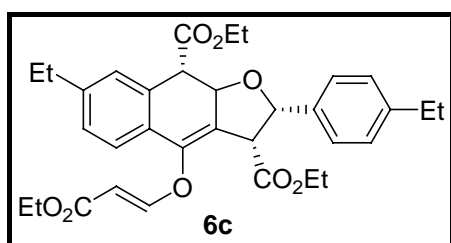


colorless crystal; mp 128-129 °C; ^1H NMR (CDCl_3) δ 7.60 (d, $J = 12.4$ Hz, 1H), 7.37 (d, $J = 1.5$ Hz, 2H), 7.30 (m, 6H), 7.13 (m, 1H), 5.77 (dd, $J_1 = 1.3$, $J_2 = 13.3$ Hz, 1H), 5.43 (d, $J = 12.4$ Hz, 1H), 4.39 (m, 2H), 4.12 (m, 2H), 4.04 (m, 2H), 3.71 (m, 2H), 1.37 (t, $J = 7.2$ Hz, 3H), 1.22 (t, $J = 7.1$ Hz, 3H), 0.83 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.3, 168.8, 166.8, 159.5, 142.4, 137.3, 132.0, 129.7, 129.3, 128.4, 128.3, 126.9, 126.4, 125.1, 123.1, 101.6, 80.9, 61., 61.3, 60.4, 52.6, 52.0, 14.54, 14.48, 13.8 ppm; IR (KBr) ν 2984, 2940, 1741, 1710, 1642, 1449, 1369, 1327, 1280, 1184, 1117, 1033, 746, 702 cm^{-1} ; MS (ESI) m/z 530.1

([M+Na]⁺); HRMS (ESI) calcd for C₂₉H₂₉DO₈ ([M+Na]⁺), 530.1896; found, 530.1879.

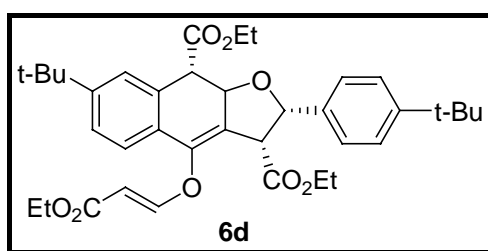


colorless crystal; mp 152-153 °C; ¹H NMR (CDCl₃) δ 7.60 (d, *J* = 12.3 Hz, 1H), 7.25 (d, *J* = 7.4 Hz, 2H), 7.11 (m, 4H), 6.92 (s, 1H), 5.73 (d, *J* = 13.2 Hz, 1H), 5.53 (d, *J* = 6.0 Hz, 1H), 5.42 (d, *J* = 12.4 Hz, 1H), 4.39 (m, 2H), 4.12 (m, 2H), 4.02 (d, *J* = 13.2 Hz, 1H), 3.97 (d, *J* = 5.9 Hz, 1H), 3.74 (m, 2H), 2.32 (s, 3H), 2.30 (s, 3H), 1.38 (t, *J* = 7.0 Hz, 3H), 1.23 (t, *J* = 7.0 Hz, 3H), 0.87 (t, *J* = 7.3 Hz, 3H) ppm; ¹³C NMR (CDCl₃) δ 172.6, 169.0, 167.0, 159.7, 142.4, 139.9, 138.1, 134.4, 132.0, 129.0, 128.9, 127.8, 126.7, 126.3, 124.2, 123.1, 101.5, 85.1, 81.0, 61.7, 61.2, 60.4, 52.7, 52.2, 21.8, 21.4, 14.6, 14.5, 13.9 ppm; IR (KBr) ν 2985, 1741, 1709, 1627, 1370, 1315, 1223, 1174, 1136, 1124, 1032, 835, 798 cm⁻¹; MS (ESI) *m/z* 557.3 ([M+Na]⁺); HRMS (ESI) calcd for C₃₁H₃₄O₈ ([M+Na]⁺), 557.2146; found, 557.2142.



colorless crystal; mp 116-117 °C; ¹H NMR (CDCl₃) δ 7.62 (d, *J* = 12.4 Hz, 1H), 7.30 (d, *J* = 7.9 Hz, 2H), 7.19 (d, *J* = 7.8 Hz, 1H), 7.14 (m, 3H), 6.97 (s, 1H), 5.77 (d, *J* = 13.2 Hz, 1H), 5.56 (d, *J* = 6.2 Hz, 1H), 5.45 (d, *J* = 12.4 Hz, 1H), 4.42 (m, 2H), 4.14 (m, 2H), 4.05 (d, *J* = 13.2 Hz, 1H), 4.00 (d, *J* = 6.2 Hz, 1H), 3.75 (q, *J* = 7.0 Hz, 2H), 2.63 (m, 4H), 1.40 (t, *J* = 7.1 Hz, 3H), 1.22 (m, 9H), 0.85 (t, *J* = 7.1 Hz, 3H) ppm; ¹³C NMR (CDCl₃) δ 172.4, 168.9,

166.8, 159.6, 146.1, 144.5, 142.4, 134.6, 131.9, 127.7, 127.6, 126.8, 126.6, 126.3, 124.1, 123.0, 101.4, 85.0, 80.9, 61.6, 61.1, 60.3, 52.6, 52.1, 29.0, 28.8, 15.9, 15.4, 14.5, 14.4, 13.8 ppm; IR (KBr) ν 2967, 2936, 1738, 1720, 1650, 1370, 1311, 1186, 1118, 1038, 968, 849 cm^{-1} ; MS (ESI) m/z 585.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{33}\text{H}_{38}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 585.2459; found, 585.2449.



white solid; mp 121-122 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 7.62 (d, $J = 12.4$ Hz, 1H), 7.33 (m, 5H), 7.20 (d, $J = 8.1$ Hz, 1H), 7.18 (s, 1H), 5.79 (d, $J = 13.2$ Hz, 1H), 5.57 (d, $J = 6.2$ Hz, 1H), 5.46 (d, $J = 12.4$ Hz, 1H), 4.42 (m, 2H), 4.15 (m, 2H), 4.06 (d, $J = 13.2$ Hz, 1H), 4.00 (d, $J = 6.2$ Hz, 1H), 3.85 (q, $J = 7.1$ Hz, 2H), 1.42 (t, $J = 7.1$ Hz, 3H), 1.31 (s, 9H), 1.30 (s, 9H), 1.26 (t, $J = 7.1$ Hz, 3H), 0.79 (t, $J = 7.1$ Hz, 3H) ppm; ^{13}C NMR (CDCl_3) δ 172.4, 169.0, 167.0, 159.7, 153.0, 151.4, 142.4, 134.5, 131.7, 126.6, 126.2, 125.2, 125.1, 124.3, 124.1, 122.8, 101.5, 85.0, 80.9, 61.6, 61.1, 60.4, 52.8, 52.1, 35.2, 34.8, 31.6, 31.4, 14.8, 14.5, 13.8 ppm; IR (KBr) ν 2964, 1736, 1717, 1646, 1465, 1370, 1314, 1182, 1127, 1038, 967 cm^{-1} ; MS (ESI) m/z 641.0 ($[\text{M}+\text{Na}]^+$); HRMS (ESI) calcd for $\text{C}_{37}\text{H}_{46}\text{O}_8$ ($[\text{M}+\text{Na}]^+$), 641.3081; found, 641.3079.