Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Total Synthesis of Protosappanin A and Its Derivatives via Palladium Catalyzed Ortho C-H Activation/C-C Cyclization under Microwave Irradiation

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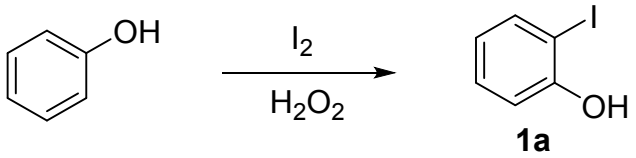
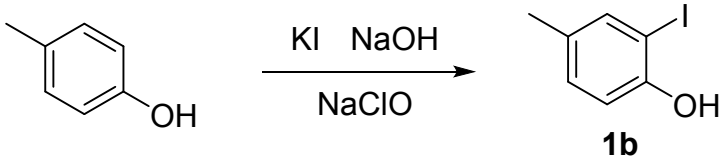
1. Preparation of 2-iodophenols (Compound 1).



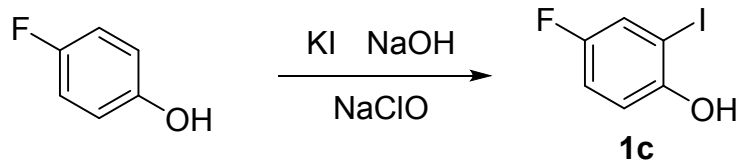
1a

2-iodophenol: phenol (20.0 g, 212.5 mmol) and iodine (27.0 g, 106.3 mmol) in distilled water (600 mL) was added hydrogen peroxide (8 mL of a 30% (m/v) aqueous solution, 212.5 mmol). The mixture was stirred at room temperature or at 50 ℃ for 24 h. Afterwards, 10% (m/v) sodium thiosulfate aqueous solution (350 mL) was added to the mixture, which was extracted with ethyl acetate (3×500 mL). The organic phase was dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. The residue was purified by column chromatography on silica gel using a mixture of cyclohexane/dichloromethane (1/1), affording 22.4 g of 2-iodophenol as white solid (44%).



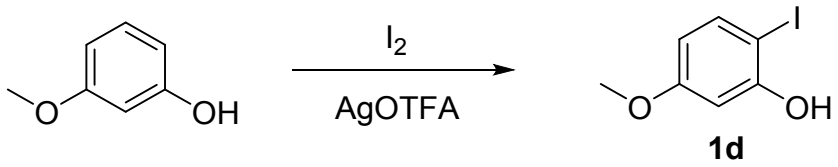
1b

2-iodo-4-methyl-phenol: 2-methylphenol (25 mL, 235.3 mmol) was dissolved in 450 mL of methanol. Potassium iodide (39.1 g, 235.3 mmol) and sodium hydroxide (9.4 g, 235.3 mmol) were added, and the solution was cooled to 0 ℃. Aqueous sodium hypochlorite (290 mL, 5.2% NaOCl) was added dropwise over 3 h at 0-3 ℃. The resulting slurry was stirred for 8h at 0-2 °C and then was treated with 95 mL of 10% aqueous $Na_2S_2O_3$. The mixture was neutralized using 5% aqueous HCl. Then ether (350 mL) was added. The organic layer was washed with brine (350 mL) and dried over Na_2SO_4. Filtration and rotary evaporation at 40 ℃ afforded 49.5 g of 2-iodo-4-methyl-phenol, colorless liquid, yield 90%.



1c

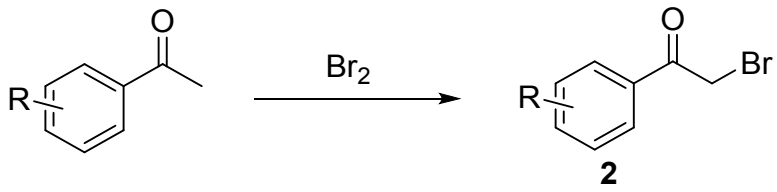
2-iodo-4-fluoro-phenol: 4-fluorophenol (25.0 g, 223 mmol) was dissolved in 430 mL of methanol. Potassium iodide (37.1 g, 223 mmol) and sodium hydroxide (9.0 g, 223 mmol) were added, and the solution was cooled to 0 ℃. Aqueous sodium hypochlorite (275 mL, 5.2% NaOCl) was added dropwise over 3 h at 0-3 ℃. The resulting slurry was stirred for 8 h at 0-2 °C and then was treated with 90 mL of 10% aqueous $Na_2S_2O_3$. The mixture was neutralized using 5% aqueous HCl. Then ether (325 mL) was added. The organic layer was washed with brine (325 mL) and dried over Na_2SO_4. Filtration and rotary evaporation at 40 ℃ afforded 43.2 g of 2-iodo-4-fluoro-phenol, light yellow solid, yield 81%.



1d

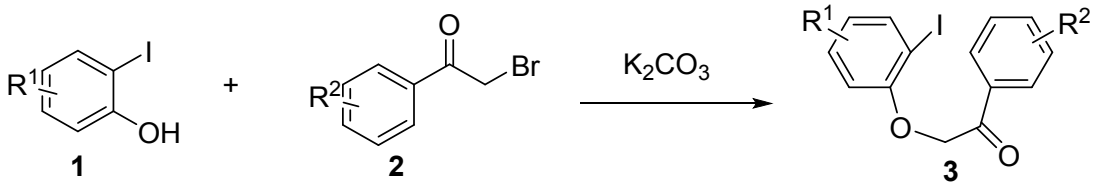
2-iodo-5-methoxy-phenol: I_2 (40.9 g, 161.1 mmol, 1 equiv) was dissolved in $CHCl_3$ (850 mL) with stirring over 1.5 hour. A 2L round-bottomed flask was charged with 3-methoxyphenol (20.0 g, 161.1 mmol, 1 equiv) and AgOTFA (35.6 g, 161.1 mmol, 1 equiv). The solution was added slowly into the round-bottomed flask over 3 h. The reaction was stirred at room temperature for 24 h. The mixture was filtered over celatom and the precipitate washed with $CHCl_3$. The organics were washed with 5% aqueous $Na_2S_2O_3$ (500 mL), saturated $NaHCO_3$, washed with water, washed with brine, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was purified via flash chromatography using CH_2Cl_2 to give 31.8 g of 2-iodo-5-methoxy-phenol as a white solid (79%).

2. Preparation of α-Bromoacetophenones (Compound 2). (General Procedure A)



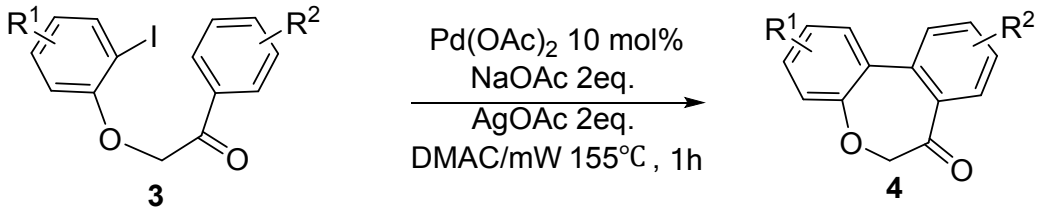
To a solution of the appropriate acetophenone and acetic acid (4 equiv) were added to the flask with stirring under ice-cooling. Then added anhydrous $AlCl_3$ (0.02 equiv). Liquid bromine (1 equiv) in the acetic acid (3 equiv) was added in the flask 1 h. Stired 3 h and then cooled down to room temperature, the K_2CO_3 saturated solution was added to the mixture, which was extracted with ethyl acetate three times. The organic phase was dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. The residue was purified by chromatography on silica gel using a mixture of petroleum ether /dichloromethane (4:1, v/v) to give bromination product **2**.

3. Preparation of α-(2-iodophenoxy)-acetoarylones (Compound 3). (General Procedure B)



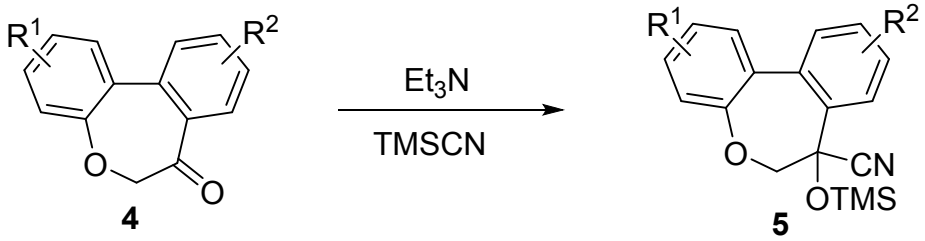
2-iodophenols dissolved in acetone (4 equiv) was added with α-bromoaceto-phenones (1.1 equiv) and anhydrous K_2CO_3 (1.5 equiv). The resulting mixture was stirred for 2 h at room temperature. After filtration, the solvent was evaporated under reduced pressure. The residue was purified by the recrystallization method using alcohol.

4. Preparation of Dibenzo[b, d]oxepinones (Compound 4). (General Procedure C)



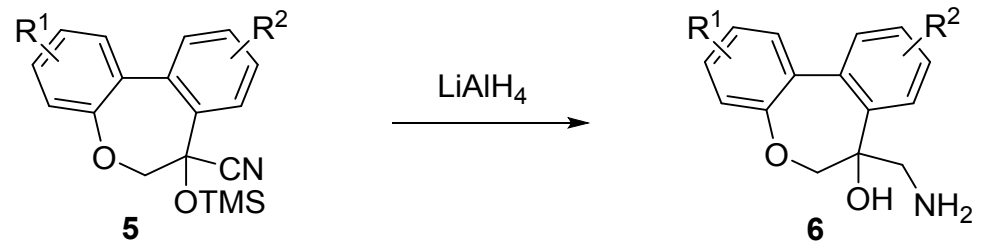
To a mixture of the suitable α-(2-iodophenoxy)-acetoarylones (1 mmol), $Pd(OAc)_2$ (0.1 equiv), NaOAc (2 equiv) and AgOAc (2 equiv) was added DMAC (0.2 M for substrate). The mixture was introduced in a 10 mL sealed tube and was irradiated at 100 W and 155 ℃ for 60 min in a microwave reactor equipped with built-in pressure measurement sensor and a vertically focused IR sensor. After completion of the reaction, the reaction mixture was cooled down to room temperature and water was added to the mixture, which was extracted with ethyl acetate three times. The organic phase was dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. The residue was purified by flash silica gel column chromatography eluting with petroleum ether/ethyl acetate gradient (7:1, v/v).

5. Preparation of Trimethylsilyloxy Dibenzo[b, d]oxepinones (Compound 5). (General Procedure D)



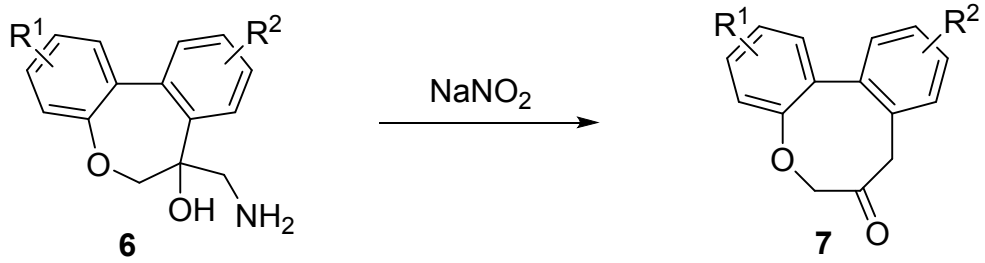
Dibenzo[b, d]oxepinone (1 mmol) was dissolved in DCM, and Et_3N (0.4 equiv) and TMSCN (1.1 equiv) were added. The mixture was stirred for 12 h at 30 ℃ and then was treated with a few of 6% aqueous $NaHSO_4$. Then the mixture was extracted with DCM three times. The organic phase was dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. The crude was used directly in the next step without further purification.

6. Preparation of Dibenzo[b, d]oxepin Aminoalcohols (Compound 6). (General Procedure E)



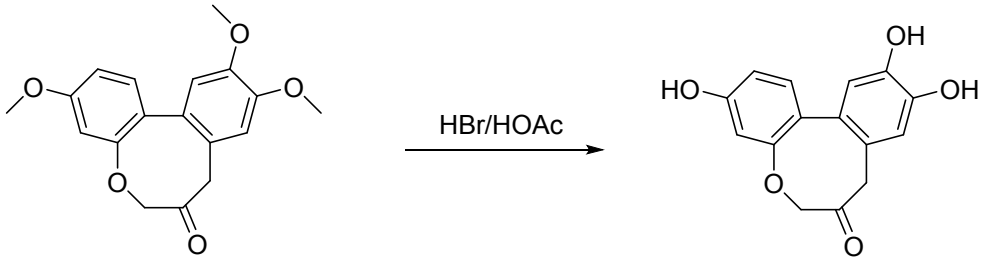
Trimethylsilyloxy dibenzo[b, d]oxepinone (1 mmol) was dissolved in anhydrous ether (0.2 M for substrate) and $LiAlH_4$ was added. The mixture was stirred for 12 h at 0 ℃ under inert atmosphere. Ice water was carefully added to the above reaction solution to quench the reaction. Extraction by DCM, dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. The residue was purified by the recrystallization method using ether.

7. Preparation of Protosappanin A Derivatives (Compound 7). (General Procedure F)



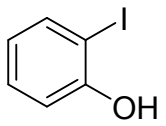
Dibenzo[b, d]oxepin aminoalcohols was dissolved in anhydrous ether (0.2 M for substrate) and 9% $NaNO_2$ solution (5 equiv) was dropped into it slowly. The mixture was stirred for 1 h at 0 ℃, added water. After filtration, Protosappanin A derivative was obtained.

8. Synthesis of Protosappanin A



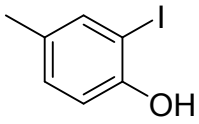
3,9,10-trimethoxy0dibenzo[b, d]oxocinone (1 mmol), 40% HBr (4 equiv) and HOAc (12 equiv) were added in the flask. The mixture was stirred for 20 h at 110 ℃ under inert atmosphere and then cooled down to room temperature. The mixture was poured into ice water and adjusted pH ≈ 5-6. Which was extracted with ethyl acetate three times. The organic phase was dried over Na_2SO_4. After filtration, the solvent was evaporated under reduced pressure. Protosappanin A was obtained by flash silica gel column chromatography eluting with a petroleum ether/ethyl acetate gradient (95:5, v/v).

9. Spectra Data



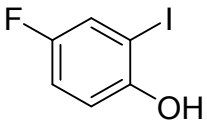
1a

m.p. 37.9 – 39.3 ℃.



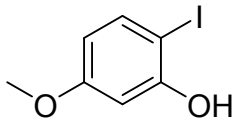
1b

^{1}H NMR (400 MHz, DMSO) δ = 10.00 (s, 1H), 7.49 (d, *J* = 1.6 Hz, 1H), 6.98 (dd, *J* = 8.2, 1.6 Hz, 1H), 6.82 (d, *J* = 8.2 Hz, 1H), 2.17 (s, 3H). ^{13}C NMR (100 MHz, DMSO) δ = 154.8, 139.2, 130.5, 130.3, 115.2, 84.8, 20.0.



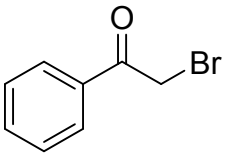
1c

^{1}H NMR (400 MHz, Chloroform) δ = 7.37 (dd, *J* = 7.6, 2.8 Hz, 1H), 7.01 – 6.91 (m, 2H), 5.11 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 156.6 (d, *J* = 240 Hz), 151.6, 124.5 (d, *J* = 20 Hz), 117.0 (d, *J* = 20 Hz), 115.3 (d, *J* = 10 Hz), 84.4.



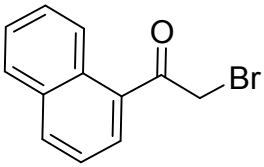
1d

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.49 (d, *J* = 8.8 Hz, 1H), 6.59 (d, *J* = 2.8 Hz, 1H), 6.33 (dd, *J* = 8.8, 2.8 Hz, 1H), 5.24 (s, 1H), 3.77 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 161.8, 155.7, 138.1, 109.5, 101.0, 74.5, 55.6.



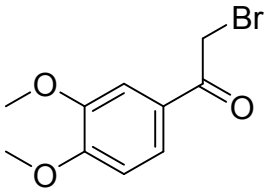
2a

Prepared according General Procedure A. White solid. m.p. 48.2 – 49.7 ℃.



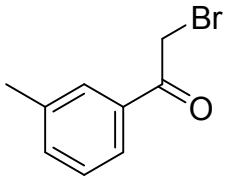
2b

Prepared according General Procedure A. ^{1}H NMR (400 MHz, DMSO) δ = 8.54 – 8.43 (m, 1H), 8.26 – 8.18 (m, 2H), 8.05 (dd, *J* = 8.3, 1.0 Hz, 1H), 7.70 – 7.60 (m, 3H), 5.07 (s, 2H). Light yellow liquid.



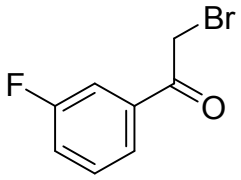
2c

Prepared according General Procedure A. ^{1}H NMR (400 MHz, DMSO) δ = 7.70 (dd, *J* = 8.5, 2.1 Hz, 1H), 7.48 (d, *J* = 2.0 Hz, 1H), 7.10 (d, *J* = 8.5 Hz, 1H), 4.87 (s, 2H), 3.86 (s, 3H), 3.83 (s, 3H). light pink solid.



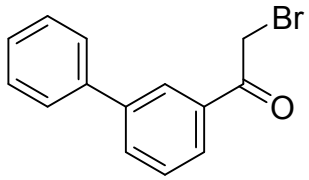
2d

Prepared according General Procedure A. ^{1}H NMR (400 MHz, DMSO) δ = 7.81 (d, *J* = 9.7 Hz, 2H), 7.50 (d, *J* = 7.5 Hz, 1H), 7.44 (t, *J* = 7.5 Hz, 1H), 4.92 (s, 2H), 2.39 (s, 3H). Yellow liquid.



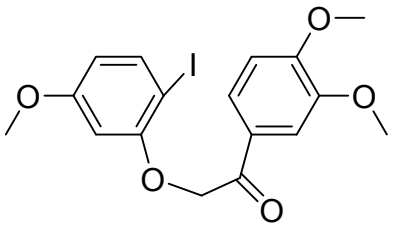
2e

Prepared according General Procedure A. ^{1}H NMR (400 MHz, DMSO) δ = 7.86 (d, *J* = 7.7 Hz, 1H), 7.83 – 7.78 (m, 1H), 7.63 (td, *J* = 8.0, 5.9 Hz, 1H), 7.55 (td, *J* = 8.5, 2.5 Hz, 1H), 4.97 (s, 2H). Yellow liquid.



2f

Prepared according General Procedure A. ^{1}H NMR (400 MHz, DMSO) δ 8.29 (t, *J* = 1.6 Hz, 1H), 7.99 (dd, *J* = 17.3, 7.8 Hz, 2H), 7.76 (d, *J* = 7.4 Hz, 2H), 7.65 (t, *J* = 7.8 Hz, 1H), 7.52 (t, *J* = 7.6 Hz, 2H), 7.43 (t, *J* = 7.3 Hz, 1H), 5.07 (s, 2H). Brown liquid.



3a

Prepared according General Procedure B. White solid. m.p. 69.2 – 71.3 ℃.

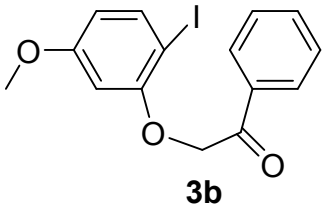
^{1}H NMR (400 MHz, DMSO) δ = 7.72 (dd, *J* = 8.4, 1.8 Hz, 1H), 7.64 (d, *J* = 8.6 Hz, 1H), 7.49 (d, *J* = 1.7 Hz, 1H), 7.11 (d, *J* = 8.5 Hz, 1H), 6.50 (d, *J* = 2.5 Hz, 1H), 6.42 (dd, *J* = 8.6, 2.5 Hz, 1H), 5.60 (s, 2H), 3.87 (s, 3H), 3.84 (s, 3H), 3.70 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 192.9, 161.3, 157.9, 154.1, 149.1, 139.4, 127.6, 123.2, 111.5, 110.8, 108.4, 101.2, 75.5, 71.4, 56.3, 56.1, 55.9.

HRMS (EI) calcd for $C_{17}H_{17}IO_5$ $[M+H]^+$: 429.0199. Found: 429.0189. Anal.calcd for $C_{17}H_{17}IO_5$: C, 47.68; H, 4.00; I, 29.64. Found: C, 47.62; H, 4.01; I, 29.67.

FT-IR (KBr disc): υ= 2936, 1696, 1599, 1256, 1177, 1019, 570 cm^{-1}.

UV-vis spectra absorption peak: 234 nm.



3b

Prepared according General Procedure B. White solid. m.p. 221.2 – 223.7 ℃.

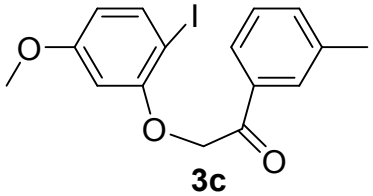
^{1}H NMR (400 MHz, DMSO) δ = 8.04 (s, 1H), 8.02 (d, *J* = 1.2 Hz, 1H), 7.69 (d, *J* = 7.4 Hz, 1H), 7.65 (d, *J* = 8.6 Hz, 1H), 7.57 (t, *J* = 7.7 Hz, 2H), 6.56 (d, *J* = 2.6 Hz, 1H), 6.43 (dd, *J* = 8.6, 2.6 Hz, 1H), 5.67 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 194.5, 161.3, 157.8, 139.4, 134.8, 134.3, 129.3, 128.4, 108.5, 101.1, 75.4, 71.6, 55.9.

HRMS (EI) calcd for $C_{15}H_{13}IO_3$ $[M+H]^+$: 368.9987. Found: 368.9968. Anal.calcd for $C_{15}H_{13}IO_3$: C, 48.94; H, 3.56; I, 34.47. Found: C, 48.95; H, 3.59; I, 34.51.

FT-IR (KBr disc): υ= 2902, 1696, 1581, 1309, 1212, 561 cm^{-1}.

UV-vis spectra absorption peak: 241 nm.



3c

Prepared according General Procedure B. Light yellow solid. m.p. 74.9 – 76.6 ℃.

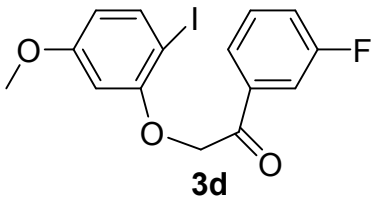
^{1}H NMR (400 MHz, DMSO) δ = 7.85 (s, 1H), 7.82 (d, *J* = 7.8 Hz, 1H), 7.64 (d, *J* = 8.6 Hz, 1H), 7.51 (d, *J* = 7.5 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 1H), 6.53 (d, *J* = 2.6 Hz, 1H), 6.42 (dd, *J* = 8.6, 2.6 Hz, 1H), 5.64 (s, 2H), 3.70 (s, 3H), 2.40 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 194.6, 157.9, 155.5, 154.0, 138.7, 134.9, 129.2, 128.8, 125.7, 125.6, 116.1, 115.9, 113.6, 86.6, 72.1, 21.3.

HRMS (EI) calcd for $C_{16}H_{15}IO_3$ $[M+H]^+$: 383.0144. Found: 383.0125. Anal.calcd for $C_{16}H_{15}IO_3$: C, 50.28; H, 3.96; I, 33.20. Found: C, 50.39; H, 3.90; I, 33.15.

FT-IR (KBr disc): υ= 2928, 1688, 1484, 1256, 1185, 570 cm^{-1}.

UV-vis spectra absorption peak: 235 nm.



3d

Prepared according General Procedure B. White solid. m.p. 60.0 – 61.8 ℃.

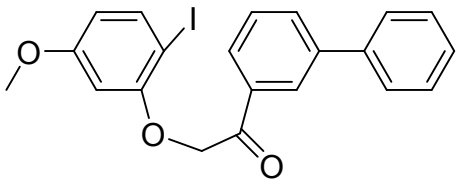
^{1}H NMR (400 MHz, DMSO) δ = 7.88 (d, *J* = 7.7 Hz, 1H), 7.84 (dd, *J* = 9.7, 2.3 Hz, 1H), 7.67 – 7.61 (m, 2H), 7.56 (td, *J* = 8.4, 1.9 Hz, 1H), 6.60 (d, *J* = 2.6 Hz, 1H), 6.43 (dd, *J* = 8.6, 2.6 Hz, 1H), 5.68 (s, 2H), 3.72 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 193.6, 162.6 (d, *J* = 240 Hz), 161.3 (s), 157.7 (s), 139.4 (s), 136.9, 131.5, 124.6, 121.2 (d, *J* = 30 Hz), 115.2 (d, *J* = 30 Hz), 108.6 (s), 101.1 (s), 75.3 (s), 71.7 (s), 55.9 (s).

HRMS (EI) calcd for $C_{15}H_{12}FIO_3$ $[M+H]^+$: 387.9971. Found: 387.9959. Anal.calcd fo r $C_{15}H_{12}FIO_3$: C, 46.66; H, 3.13; F, 4.92; I, 32.86. Found: C, 46.56; H, 3.16; F, 4.95; I, 32.90.

FT-IR (KBr disc): υ= 2928, 1696, 1581, 1484, 1247, 1168, 579 cm^{-1}.

UV-vis spectra absorption peak: 240 nm.



3e

Prepared according General Procedure B. White solid. m.p. 69.1 – 71.3 ℃.

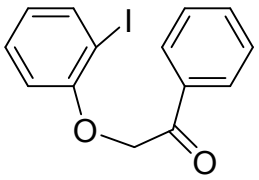
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.27 (t, *J* = 1.7 Hz, 1H), 8.06 – 8.00 (m, 1H), 7.89 – 7.84 (m, 1H), 7.70 – 7.64 (m, 3H), 7.60 (t, *J* = 7.8 Hz, 1H), 7.50 (t, *J* = 7.4 Hz, 2H), 7.43 (dd, *J* = 4.9, 3.7 Hz, 1H), 6.47 – 6.31 (m, 2H), 5.34 (s, 2H), 3.78 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 194.4, 161.5, 157.8, 142.2, 140.1, 139.8, 135.1, 132.8, 129.5, 129.2, 129.2, 128.2, 127.5, 127.3, 108.5, 101.1, 75.4, 72.4, 55.8.

HRMS (EI) calcd for $C_{21}H_{17}IO_3$ $[M+H]^+$: 445.0300. Found: 445.0287. Anal.calcd for $C_{21}H_{17}O_3$: C, 56.77; H, 3.86; I, 28.56. Found: C, 56.83; H, 3.89; I, 28.65.

FT-IR (KBr disc): υ= 2936, 1696, 1581, 1484, 1212, 1168, 587 cm^{-1}.

UV-vis spectra absorption peak: 241 nm.



3f

Prepared according General Procedure B. White solid. m.p. 73.5 – 74.2 ℃.

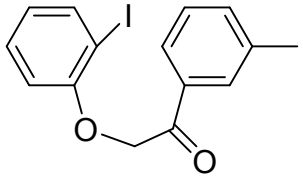
^{1}H NMR (400 MHz, DMSO) δ = 8.02 (d, *J* = 7.3 Hz, 2H), 7.79 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.70 (t, *J* = 7.4 Hz, 1H), 7.58 (t, *J* = 7.7 Hz, 2H), 7.32 – 7.25 (m, 1H), 6.92 (d, *J* = 7.7 Hz, 1H), 6.75 (t, *J* = 7.5 Hz, 1H), 5.68 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 194.6, 157.0, 139.6, 134.8, 134.3, 130.0, 129.3, 128.4, 123.4, 113.2, 86.6, 71.5.

HRMS (EI) calcd for $C_{14}H_{11}IO_2$ $[M+H]^+$: 338.9882. Found: 338.9867. Anal.calcd for $C_{14}H_{11}IO_2$: C, 49.73; H, 3.28; I, 37.53. Found: C, 49.72; H, 3.27; I, 37.56.

FT-IR (KBr disc): υ= 2936, 1696, 1476, 1212, 587 cm^{-1}.

UV-vis spectra absorption peak: 236, 278 nm.



3g

Prepared according General Procedure B. White solid. m.p. 60.4 – 61.5 ℃.

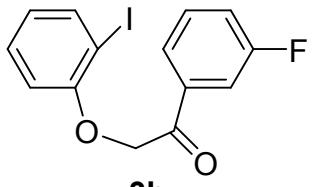
^{1}H NMR (400 MHz, DMSO) δ = 7.85 (s, 1H), 7.84 – 7.77 (m, 2H), 7.52 (d, *J* = 7.6 Hz, 1H), 7.46 (t, *J* = 7.5 Hz, 1H), 7.29 (t, *J* = 7.2 Hz, 1H), 6.90 (d, *J* = 8.1 Hz, 1H), 6.75 (t, *J* = 7.3 Hz, 1H), 5.65 (s, 2H), 2.40 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 194.6, 157.0, 139.6, 138.7, 134.9, 134.8, 129.9, 129.1, 128.8, 125.6, 123.3, 113.2, 86.6, 71.6, 21.3.

HRMS (EI) calcd for $C_{15}H_{13}IO_2$ $[M+H]^+$: 353.0038. Found: 353.0064. Anal.calcd for $C_{15}H_{13}IO_2$: C, 51.16; H, 3.72; I, 36.03. Found: C, 51.22; H, 3.74; I, 36.07.

FT-IR (KBr disc): υ= 2982, 1688, 1468, 1228, 1167, 555 cm^{-1}.

UV-vis spectra absorption peak: 236, 249 nm.



3h

Prepared according General Procedure B. White solid. m.p. 98.7 – 99.9 ℃.

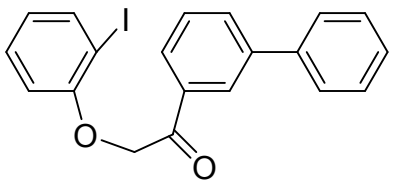
^{1}H NMR (400 MHz, DMSO-d_6) δ = 7.90 – 7.77 (m, 3H), 7.67 – 7.61 (m, 1H), 7.60 – 7.52 (m, 1H), 7.35 – 7.26 (m, 1H), 6.96 (d, *J* = 7.6 Hz, 1H), 6.80 – 6.72 (m, 1H), 5.69 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 193.7, 162.6 (d, *J* = 240 Hz), 156.9, 139.6, 136.9 (d, *J* = 10 Hz), 131.6 (d, *J* = 10 Hz), 130.0, 124.6, 123.4, 121.2 (d, *J* = 20 Hz), 115.1(d, *J* = 20 Hz), 113.3, 86.6, 71.7.

HRMS (EI) calcd for $C_{14}H_{10}FIO_2$ $[M+H]^+$: 356.9788. Found: 356.9793. Anal.calcd fo r $C_{14}H_{10}FIO_2$: C, 47.22; H, 2.83; F, 5.33; I, 35.63. Found: C, 47.23; H, 2.85; F, 5.30; I, 35.63.

FT-IR (KBr disc): υ= 2928, 1696, 1468, 1221, 1080, 526 cm^{-1}.

UV-vis spectra absorption peak: 236 nm.



3i

Prepared according General Procedure B. White solid. m.p. 81.3 – 82.5 ℃.

^{1}H NMR (400 MHz, DMSO) δ = 8.28 (s, 1H), 8.00 (d, *J* = 7.7 Hz, 2H), 7.85 – 7.75 (m, 3H), 7.67 (t, *J* = 7.7 Hz, 1H), 7.52 (t, *J* = 7.6 Hz, 2H), 7.43 (t, *J* = 7.3 Hz, 1H),

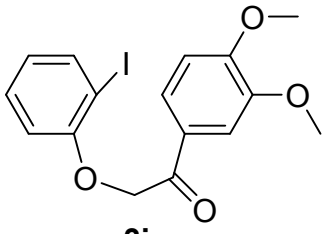
7.34 – 7.26 (m, 1H), 6.98 (d, *J* = 7.7 Hz, 1H), 6.77 (dd, *J* = 10.9, 4.1 Hz, 1H), 5.79 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 194.68, 157.04, 141.20, 139.63, 139.58, 135.45, 132.43, 129.98, 129.52, 128.46, 127.45, 127.23, 126.76, 123.36, 113.34, 86.63, 71.72.

HRMS (EI) calcd for $C_{20}H_{15}IO_2$ $[M+H]^+$: 415.0195. Found: 415.0187. Anal.calcd for $C_{18}H_{13}IO_2$: C, 55.69; H, 3.38; I, 32.69. Found: C, 48.65; H, 3.36; I, 32.71.

FT-IR (KBr disc): υ= 2919, 1696, 1476, 1203, 526 cm^{-1}.

UV-vis spectra absorption peak: 238 nm.



3j

Prepared according General Procedure B. White solid. m.p. 85.8 – 87.2 ℃.

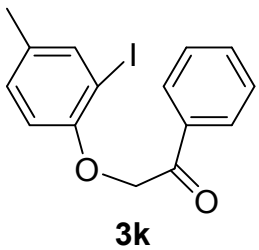
^{1}H NMR (400 MHz, DMSO) δ = 7.79 (d, *J* = 7.3 Hz, 1H), 7.72 (d, *J* = 7.9 Hz, 1H), 7.50 (s, 1H), 7.29 (t, *J* = 7.2 Hz, 1H), 7.11 (d, *J* = 8.2 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 1H), 6.75 (t, *J* = 7.0 Hz, 1H), 5.62 (s, 2H), 3.85 (d, *J* = 11.9 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 193.0, 157.0, 154.1, 149.3, 139.9, 129.6, 127.7, 123.5, 123.5, 112.7, 110.7, 110.3, 86.5, 72.2, 56.3, 56.2.

HRMS (EI) calcd for $C_{16}H_{15}IO_4$ $[M+H]^+$: 399.0093. Found: 399.0096. Anal.calcd for $C_{16}H_{15}IO_4$: C, 48.26; H, 3.80; I, 31.87. Found: C, 48.21; H, 3.82; I, 31.90.

FT-IR (KBr disc): υ= 2936, 1696, 1476, 1274, 1151, 1017, 508 cm^{-1}.

UV-vis spectra absorption peak: 234, 179 nm.



3k

Prepared according General Procedure B. White solid. m.p. 49.4 – 50.9 ℃.

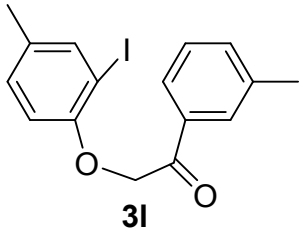
^{1}H NMR (400 MHz, DMSO) δ 8.02 (d, *J* = 8.3 Hz, 2H), 7.69 (t, *J* = 7.4 Hz, 1H), 7.61 (s, 1H), 7.57 (t, *J* = 7.7 Hz, 2H), 7.08 (d, *J* = 8.3 Hz, 1H), 6.80 (d, *J* = 8.4 Hz, 1H), 5.62 (s, 2H), 2.20 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 194.7, 155.0, 139.7, 134.8, 134.3, 132.4, 130.3, 129.3, 128.4, 112.9, 86.4, 71.6, 19.9.

HRMS (EI) calcd for $C_{15}H_{13}IO_2$ $[M+H]^+$: 353.0038. Found: 353.0054. Anal.calcd for $C_{15}H_{13}IO_2$: C, 51.16; H, 3.72; I, 36.03. Found: C, 51.12; H, 3.39; I, 32.72.

FT-IR (KBr disc): υ= 2919, 1688, 1484, 1221, 587 cm^{-1}.

UV-vis spectra absorption peak: 237 nm.



3l

Prepared according General Procedure B. Light yellow solid. m.p. 41.6 – 43.5 ℃.

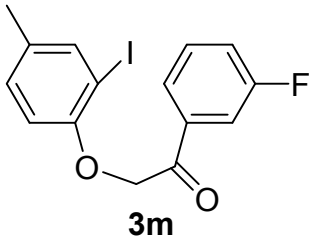
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.83 (s, 1H), 7.80 (d, *J* = 7.5 Hz, 1H), 7.59 (d, *J* = 1.5 Hz, 1H), 7.37 (dt, *J* = 15.0, 7.5 Hz, 2H), 7.01 (dd, *J* = 8.3, 1.5 Hz, 1H), 6.63 (d, *J* = 8.3 Hz, 1H), 5.24 (s, 2H), 2.41 (s, 3H), 2.22 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 194.6, 154.9, 140.1, 138.7, 134.8, 134.5, 133.2, 130.0, 129.0, 128.7, 125.6, 112.6, 86.4, 72.4, 21.4, 20.0.

HRMS (EI) calcd for $C_{16}H_{15}IO_2$ $[M+H]^+$: 367.0195. Found: 367.0186. Anal.calcd for $C_{16}H_{15}IO_2$: C, 52.48; H, 4.13; I, 34.65. Found: C, 52.55; H, 3.34; I, 32.70.

FT-IR (KBr disc): υ= 2902, 1696, 1484, 1239, 544cm^{-1}.

UV-vis spectra absorption peak: 237 nm.



3m

Prepared according General Procedure B. White solid. m.p. 71.3 – 74.6 ℃.

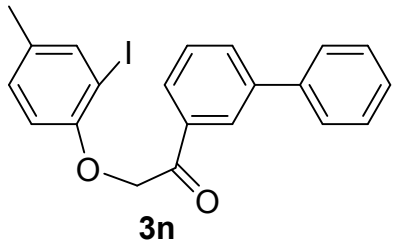
^{1}H NMR (400 MHz, DMSO) δ = 7.84 (dd, *J* = 16.4, 8.5 Hz, 2H), 7.63 (d, *J* = 7.6 Hz, 2H), 7.57 (d, *J* = 8.5 Hz, 1H), 7.09 (d, *J* = 7.7 Hz, 1H), 6.84 (d, *J* = 8.4 Hz, 1H), 5.63 (s, 2H), 2.21 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 193.8, 162.6 (d, *J* = 240 Hz), 154.9, 139.7, 136.9 (d, *J* = 10 Hz), 132.5, 131.5, 130.3, 124.6, 121.1 (d, *J* = 20 Hz), 115.1 (d, *J* = 20 Hz), 113.0, 86.4, 71.8, 19.9.

HRMS (EI) calcd for $C_{15}H_{12}FIO_2$ $[M+H]^+$: 370.9944. Found: 370.9919. Anal.calcd for $C_{15}H_{12}FIO_2$: C, 48.67; H, 3.27; F, 5.13; I, 34.28. Found: C, 48.64; H, 3.28; F, 5.11; I, 34.32.

FT-IR (KBr disc): υ= 2892, 1705, 1494, 1247, 1151, 508 cm^{-1}.

UV-vis spectra absorption peak: 236 nm.



3n

Prepared according General Procedure B. White solid. m.p. 72.8 – 74.8 ℃.

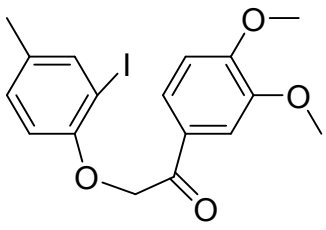
^{1}H NMR (400 MHz, DMSO) δ = 8.27 (s, 1H), 7.99 (dd, *J* = 6.7, 3.5 Hz, 2H), 7.77 (d, *J* = 7.4 Hz, 2H), 7.65 (dd, *J* = 15.1, 7.4 Hz, 2H), 7.52 (t, *J* = 7.6 Hz, 2H), 7.43 (t, *J* = 7.3 Hz, 1H), 7.10 (d, *J* = 7.4 Hz, 1H), 6.86 (d, *J* = 8.4 Hz, 1H), 5.73 (s, 2H), 2.21 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 194.8, 155.0, 141.2, 139.7, 139.6, 135.5, 132.4, 132.4, 130.3, 130.0, 129.5, 128.4, 127.4, 127.2, 126.7, 113.0, 86.4, 71.8, 19.9.

HRMS (EI) calcd for $C_{21}H_{17}IO_2$ $[M+H]^+$: 429.0351. Found: 429.0374. Anal.calcd for $C_{21}H_{17}IO_2$: C, 58.90; H, 4.00; I, 29.63. Found: C, 58.92; H, 4.03; I, 32.60.

FT-IR (KBr disc): υ= 2919, 1696, 1484, 1195, 552 cm^{-1}.

UV-vis spectra absorption peak: 235 nm.



3o

Prepared according General Procedure B. Light yellow. m.p. 65.6 – 67.5 ℃.

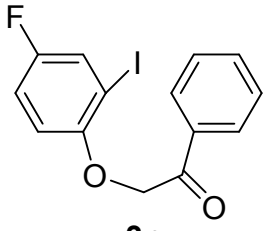
^{1}H NMR (400 MHz, DMSO) δ = 7.69 (d, *J* = 1.9 Hz, 1H), 7.61 (d, *J* = 1.6 Hz, 1H), 7.49 (d, *J* = 1.9 Hz, 1H), 7.10 (d, *J* = 8.4 Hz, 2H), 6.76 (d, *J* = 8.4 Hz, 1H), 5.55 (s, 2H), 3.86 (s, 3H), 3.83 (s, 3H), 2.20 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 193.2, 155.1, 154.0, 149.1, 139.7, 132.4, 130.3, 127.6, 123.1, 113.0, 111.5, 110.8, 86.5, 71.5, 56.3, 56.1, 19.9.

HRMS (EI) calcd for $C_{17}H_{17}IO_4$ $[M+H]^+$: 413.0250. Found: 413.0272. Anal.calcd for $C_{17}H_{17}IO_4$: C, 49.53; H, 4.16; I, 30.79. Found: C, 49.42; H, 4.21; I, 30.85.

FT-IR (KBr disc): υ= 2914, 1685, 1607, 1238, 1046, 517 cm^{-1}.

UV-vis spectra absorption peak: 279 nm.



3p

Prepared according General Procedure B. White solid. m.p. 87.6 – 89.1 ℃.

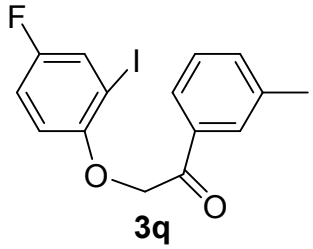
^{1}H NMR (400 MHz, DMSO) δ = 8.04 – 7.99 (m, 2H), 7.72 – 7.66 (m, 2H), 7.57 (dd, *J* = 10.6, 4.7 Hz, 2H), 7.17 (ddd, *J* = 9.0, 8.2, 3.1 Hz, 1H), 6.95 (dd, *J* = 9.2, 4.6 Hz, 1H), 5.67 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 194.5, 156.7 (d, *J* = 240 Hz), 154.0, 134.7, 134.3, 129.3, 128.4, 126.0, 125.7, 116.2, 115.9, 113.7 (d, *J* = 10 Hz), 86.6 (d, *J* = 10 Hz), 72.1.

HRMS (EI) calcd for $C_{14}H_{10}FIO_2$ $[M+H]^+$: 356.9788. Found: 356.9794. Anal.calcd fo r $C_{14}H_{10}FIO_2$: C, 47.22; H, 2.83; F, 5.33; I, 35.63. Found: C, 58.92; H, 4.03; F, 5.32; I, 32.61.

FT-IR (KBr disc): υ= 2915, 1643, 1421, 1250, 1154, 541cm^{-1}.

UV-vis spectra absorption peak: 245 nm.



3q

Prepared according General Procedure B. White solid. m.p. 65.4 – 66.7 ℃.

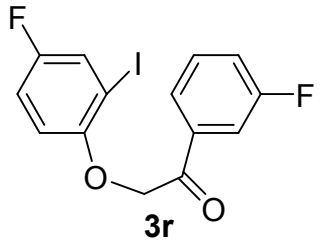
^{1}H NMR (400 MHz, DMSO) δ = 7.84 (s, 1H), 7.81 (d, *J* = 7.6 Hz, 1H), 7.68 (dd, *J* = 7.8, 3.0 Hz, 1H), 7.51 (d, *J* = 7.5 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 1H), 7.17 (td, *J* = 8.7, 3.1 Hz, 1H), 6.93 (dd, *J* = 9.1, 4.6 Hz, 1H), 5.64 (s, 2H), 2.40 (s, 3H).

^{13}C NMR (101 MHz, DMSO) δ = 194.6, 161.3, 157.8, 139.4, 138.7, 134.9 (d, *J* = 10 Hz), 129.2, 128.8, 125.7, 108.5, 101.1, 75.4, 71.6, 55.9, 21.4.

HRMS (EI) calcd for $C_{15}H_{12}FIO_2$ $[M+H]^+$: 370.9944. Found: 370.9961. Anal.calcd fo r $C_{15}H_{12}FIO_2$: C, 48.67; H, 3.27; F, 5.13; I, 34.28. Found: C, 48.64; H, 3.28; F, 5.11; I, 34.32.

FT-IR (KBr disc): υ= 2902, 1688, 1599, 1282, 1239, 799, 509 cm^{-1}.

UV-vis spectra absorption peak: 241 nm.



3r

Prepared according General Procedure B. White solid. m.p. 69.3 – 70.3 ℃.

^{1}H NMR (400 MHz, DMSO) δ = 7.86 (d, *J* = 7.6 Hz, 1H), 7.81 (d, *J* = 9.5 Hz, 1H), 7.71 – 7.66 (m, 1H), 7.66 – 7.60 (m, 1H), 7.56 (td, *J* = 8.4, 2.1 Hz, 1H), 7.18 (td, *J* = 8.7, 3.1 Hz, 1H), 6.98 (dd, *J* = 9.1, 4.6 Hz, 1H), 5.67 (s, 2H).

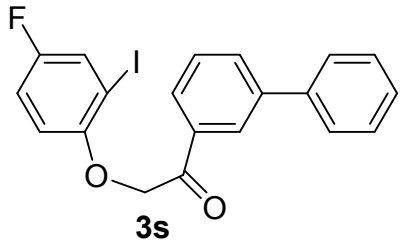
^{13}C NMR (100 MHz, DMSO) δ = 193.7 (d, *J* = 10 Hz), 162.6 (d *J* = 240 Hz), 156.8 (d, *J* = 240 Hz), 153.88, 136.9 (d, *J* = 10 Hz), 131.6 (d, *J* = 10 Hz), 125.9 (d, *J* = 30 Hz),

124.6, 121.2 (d, J = 20 Hz), 116.1 (d, J = 30 Hz), 115.1 (d, J = 20 Hz), 113.7 (d, J = 10 Hz), 86.6 (d, J = 10 Hz), 72.24.

HRMS (EI) calcd for $C_{14}H_9FIO_2$ $[M+H]^+$: 374.9693. Found: 374.9676. Anal.calcd for $C_{14}H_9FIO_2$: C, 44.95; H, 2.42; F, 10.16; I, 33.92. Found: C, 44.90; H, 2.45; F, 10.17; I, 34.93.

FT-IR (KBr disc): υ= 3078, 1705, 1599, 1476, 1247, 1175, 1080, 490 cm^{-1}.

UV-vis spectra absorption peak: 236 nm.



3s

Prepared according General Procedure B. Yellow solid. m.p. 74.1 – 76.5 ℃.

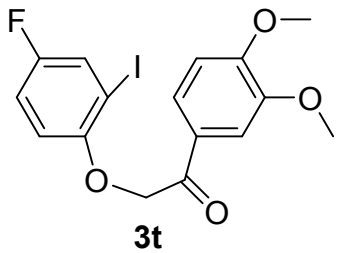
^{1}H NMR (400 MHz, DMSO) δ = 8.25 (s, 1H), 7.98 (d, J = 7.5 Hz, 2H), 7.76 (d, J = 7.4 Hz, 2H), 7.67 (ddd, J = 14.2, 8.8, 5.4 Hz, 2H), 7.51 (t, J = 7.6 Hz, 2H), 7.42 (t, J = 7.3 Hz, 1H), 7.18 (td, J = 8.7, 3.0 Hz, 1H), 6.99 (dd, J = 9.1, 4.6 Hz, 1H), 5.76 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 194.6, 156.7 (d, J = 240 Hz), 154.0, 141.2, 139.6, 135.4, 132.4, 130.0, 129.5, 128.5, 127.4, 127.2, 126.8, 125.9 (d, J = 30 Hz), 116.1 (d, J = 30 Hz), 113.8 (d, J = 10 Hz), 86.6 (d, J = 10 Hz), 72.31.

HRMS (EI) calcd for $C_{20}H_{14}FIO_2$ $[M+H]^+$: 433.0101. Found: 433.0117. Anal.calcd fo r $C_{20}H_{14}FIO_2$: C, 55.58; H, 3.26; F, 4.40; I, 29.36. Found: C, 55.49; H, 3.29; F, 4.42; I, 39.40.

FT-IR (KBr disc): υ= 2919, 1696, 1484, 1195, 552 cm^{-1}.

UV-vis spectra absorption peak: 241 nm.



3t

Prepared according General Procedure B. White solid. m.p. 85.9 – 87.3 ℃.

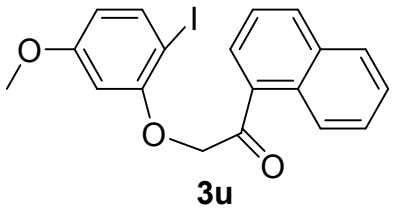
^{1}H NMR (400 MHz, DMSO) δ = 7.75 – 7.65 (m, 2H), 7.49 (d, *J* = 1.9 Hz, 1H), 7.18 (td, *J* = 8.7, 3.1 Hz, 1H), 7.11 (d, *J* = 8.5 Hz, 1H), 6.91 (dd, *J* = 9.1, 4.6 Hz, 1H), 5.61 (s, 2H), 3.87 (s, 3H), 3.84 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 192.9, 156.7 (d, *J* = 240 Hz), 154.1, 154.1, 149.1, 127.5, 125.8 (d, *J* = 20 Hz), 123.1, 116.0 (d, *J* = 20 Hz), 113.7 (d, *J* =10 Hz), 111.5, 110.7, 86.6, 71.9, 56.3, 56.1.

HRMS (EI) calcd for $C_{16}H_{14}FIO_4$ $[M+H]^+$: 416.9999. Found: 416.9976. Anal.calcd fo r $C_{16}H_{14}FIO_4$: C, 46.18; H, 3.39; F, 4.56; I, 30.49. Found: C, 46.23; H, 3.37; F, 4.58; I, 30.44.

FT-IR (KBr disc): υ= 2945, 1678, 1484, 1274, 1159, 553 cm^{-1}.

UV-vis spectra absorption peak: 234 nm.



3u

Prepared according General Procedure B. White solid. m.p. 82.2 – 84.0 ℃.

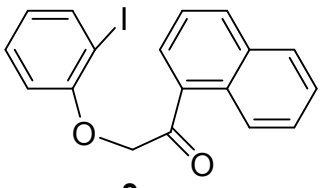
^{1}H NMR (400 MHz, DMSO) δ = 8.49 (d, *J* = 8.2 Hz, 1H), 8.28 (d, *J* = 7.0 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 8.07 – 8.02 (m, 1H), 7.64 (dd, *J* = 11.1, 2.5 Hz, 4H), 6.61 (d, *J* = 2.6 Hz, 1H), 6.42 (dd, *J* = 8.6, 2.6 Hz, 1H), 5.70 (s, 2H), 3.70 (s, 3H).

^{13}C NMR (101 MHz, DMSO) δ = 198.4, 161.3, 157.7, 139.4, 134.0, 133.7, 132.5, 130.0, 129.2, 129.1, 128.6, 127.0, 125.4, 125.2, 108.8, 100.8, 75.3, 72.7, 55.9.

HRMS (EI) calcd for C19H15IO3 $[M+H]^+$: 419.0144. Found: 419.0136. Anal.calcd for $C_{19}H_{15}IO_3$: C, 54.57; H, 3.62; I, 30.34. Found: C, 54.50; H, 3.58; I, 30.23.

FT-IR (KBr disc): υ= 2924, 1705, 1576, 1166, 1063, 594 cm^{-1}.

UV-vis spectra absorption peak: 235 nm.



3v

Prepared according General Procedure B. White solid. m.p. 77.4 – 79.1 ℃.

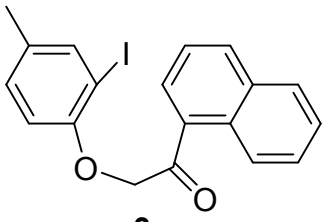
^{1}H NMR (400 MHz, DMSO) δ = 8.52 (d, *J* = 8.2 Hz, 1H), 8.30 (d, *J* = 6.9 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 8.06 – 8.02 (m, 1H), 7.80 (dd, *J* = 7.7, 1.4 Hz, 1H), 7.69 – 7.58 (m, 3H), 7.35 – 7.29 (m, 1H), 7.01 (d, *J* = 8.2 Hz, 1H), 6.76 (dd, *J* = 10.9, 4.1 Hz, 1H), 5.70 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 198.4, 157.0, 139.6, 134.0, 133.8, 132.3, 130.0, 130.0, 129.3, 129.1, 128.6, 127.0, 125.5, 125.2, 123.4, 113.1, 86.7, 72.6.

HRMS (EI) calcd for $C_{18}H_{13}IO_2$ $[M+H]^+$: 389.0038. Found: 389.0023. Anal.calcd for $C_{18}H_{13}IO_2$: C, 55.69; H, 3.38; I, 32.69. Found: C, 48.65; H, 3.36; I, 32.71.

FT-IR (KBr disc): υ= 2971, 1670, 1484, 1247, 1062, 561 cm^{-1}.

UV-vis spectra absorption peak: 234 nm.



3w

Prepared according General Procedure B. Light yellow solid. m.p. 74.0 – 75.4 ℃.

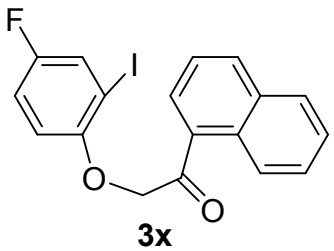
^{1}H NMR (400 MHz, DMSO) δ = 8.49 (d, *J* = 8.0 Hz, 1H), 8.29 – 8.25 (m, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 7.68 – 7.60 (m, 4H), 7.11 (dd, *J* = 8.4, 1.6 Hz, 1H), 6.88 (d, *J* = 8.4 Hz, 1H), 5.63 (s, 2H), 2.21 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 198.6, 154.9, 139.8, 134.0, 133.7, 132.5, 132.4, 130.3, 130.0, 129.3, 129.1, 128.5, 127.0, 125.5, 125.2, 112.8, 72.8, 19.8.

HRMS (EI) calcd for $C_{19}H_{15}IO_2$ $[M+H]^+$: 403.0195. Found: 403.0169. Anal.calcd for $C_{19}H_{15}IO_2$: C, 56.74; H, 3.76; I, 31.55. Found: C, 56.75; H, 3.28; I, 32.65.

FT-IR (KBr disc): υ= 2919, 1678, 1476, 1230, 1062, 561 cm^{-1}.

UV-vis spectra absorption peak: 235 nm.



3x

Prepared according General Procedure B. White solid. m.p. 58.9 – 61.0 ℃.

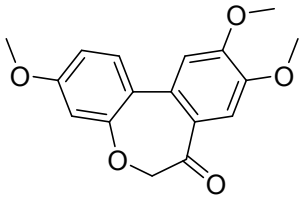
^{1}H NMR (400 MHz, DMSO) δ = 8.51 (d, *J* = 8.1 Hz, 1H), 8.27 (t, *J* = 7.3 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 8.06 – 8.02 (m, 1H), 7.71 – 7.60 (m, 4H), 7.20 (td, *J* = 8.6, 3.0 Hz, 1H), 7.03 (dd, *J* = 9.1, 4.6 Hz, 1H), 5.68 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 198.3, 156.7 (d, *J* = 240 Hz), 153.9, 133.9, 132.3, 130.0, 129.3, 129.1, 128.6, 127.0, 126.0, 125.8, 125.5, 125.2, 116.2, 116.0, 113.6 (d, *J* = 10 Hz), 86.6, 73.2.

HRMS (EI) calcd for $C_{18}H_{12}FIO_2$ $[M+H]^+$: 406.9944. Found: 406.9936. Anal.calcd fo r $C_{18}H_{12}FIO_2$: C, 53.23; H, 2.98; F, 4.68; I, 31.24. Found: C, 53.26; H, 2.99; F, 4.66; I, 31.22.

FT-IR (KBr disc): υ= 2935, 1675, 1479, 1265, 1196, 1064, 582 cm^{-1}.

UV-vis spectra absorption peak: 234 nm.



4a

Prepared according General Procedure C. White solid. m.p. 206.5 – 207.2 ℃.

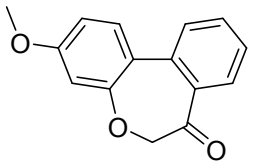
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.49 (s, 1H), 7.47 (d, *J* = 8.8 Hz, 1H), 6.93 (s, 1H), 6.86 (dd, *J* = 8.6, 2.4 Hz, 1H), 6.76 (d, *J* = 2.4 Hz, 1H), 4.77 (s, 2H), 4.00 (s, 3H), 3.97 (s, 3H), 3.86 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 201.7, 161.1, 158.1, 153.7, 148.5, 132.2, 130.7, 128.1, 125.3, 112.3, 111.8, 111.5, 106.3, 82.2, 56.3, 56.3, 55.7.

HRMS (EI) calcd for $C_{17}H_{16}O_5$ $[M+H]^+$: 301.1076. Found: 301.1082. Anal.calcd for $C_{17}H_{16}O_5$: C, 67.99; H, 5.37. Found: C, 67.93; H, 5.43.

FT-IR (KBr disc): υ= 3007, 2923, 2845, 1667, 1498, 1207, 1029, 865, 791, 694 cm^{-1}.

UV-vis spectra absorption peak: 257, 291 nm.



4b

Prepared according General Procedure C. White solid. m.p. 113.4 – 115.7 ℃.

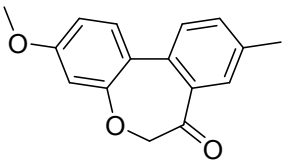
^{1}H NMR (400 MHz, DMSO) δ = 7.78 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.74 (td, *J* = 7.7, 1.4 Hz, 1H), 7.62 (d, *J* = 8.7 Hz, 1H), 7.59 (d, *J* = 7.8 Hz, 1H), 7.50 (td, *J* = 7.6, 1.1 Hz, 1H), 6.96 (dd, *J* = 8.7, 2.6 Hz, 1H), 6.84 (d, *J* = 2.6 Hz, 1H), 4.90 (s, 2H), 3.82 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 203.8, 161.4, 158.0, 136.8, 135.8, 134.3, 131.5, 129.5, 129.5, 127.9, 125.1, 112.7, 107.5, 82.8, 56.0.

HRMS (EI) calcd for $C_{15}H_{12}O_3$ $[M+H]^+$: 241.0864. Found: 241.0859. Anal.calcd for $C_{15}H_{12}O_3$: C, 74.99; H, 5.03. Found: C, 74.96; H, 5.06.

FT-IR (KBr disc): υ= 2917, 1680, 1608, 1256, 1168, 1036 cm^{-1}.

UV-vis spectra absorption peak: 301 nm.



4c

Prepared according General Procedure C. White solid. m.p. 137.9 – 139.4 ℃.

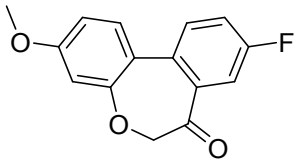
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.72 (d, *J* = 0.7 Hz, 1H), 7.45 (dd, *J* = 13.4, 5.0 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 1H), 6.85 (dd, *J* = 8.7, 2.6 Hz, 1H), 6.75 (d, *J* = 2.6 Hz, 1H), 4.80 (s, 2H), 3.84 (s, 3H), 2.42 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.0, 161.1, 157.9, 137.4, 135.3, 134.7, 134.5, 130.8, 130.0, 129.2, 125.4, 112.3, 106.4, 82.6, 55.7, 21.0.

HRMS (EI) calcd for $C_{16}H_{14}O_3$ $[M+H]^+$: 255.1021. Found: 255.1018. Anal.calcd for $C_{16}H_{14}O_3$: C, 75.58; H, 5.55. Found: C, 75.63; H, 5.50.

FT-IR (KBr disc): υ= 2919, 1680, 1608, 1256, 1168, 1036 cm^{-1}.

UV-vis spectra absorption peak: 322, 339 nm.



4d

Prepared according General Procedure C. White solid. m.p. 161.9 – 163.5 ℃.

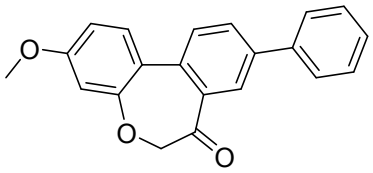
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.71 (d, *J* = 0.9 Hz, 1H), 7.45 (dd, *J* = 12.8, 5.1 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 1H), 6.85 (dd, *J* = 8.7, 2.6 Hz, 1H), 6.75 (d, *J* = 2.6 Hz, 1H), 4.80 (s, 2H), 3.84 (s, 3H), 2.42 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 202.3, 162.3 (d, *J* = 170 Hz), 160.7, 158.0, 137.2 (d, *J* = 6.4 Hz), 133.6, 131.4 (d, *J* = 10 Hz), 131.0, 124.6, 121.0 (d, *J* = 22.2 Hz), 116.1 (d, *J* = 20 Hz), 112.6, 106.6, 82.4, 55.7.

HRMS (EI) calcd for $C_{15}H_{11}FO_3$ $[M+H]^+$: 259.0770. Found: 259.0781. Anal.calcd for $C_{15}H_{11}FO_3$: C, 69.76; H, 4.29; F, 7.36. Found: C, 69.69; H, 4.27; F, 7.45.

FT-IR (KBr disc): υ= 2910, 1678, 1484, 1274, 1195, 1072 cm^{-1}.

UV-vis spectra absorption peak: 272, 244 nm.



4e

Prepared according General Procedure C. White solid. m.p. 140.7 – 143.4 ℃.

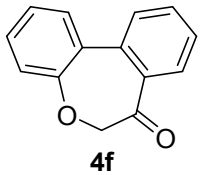
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (d, *J* = 2.0 Hz, 1H), 7.87 (dd, *J* = 8.1, 2.1 Hz, 1H), 7.69 – 7.65 (m, 2H), 7.55 (dd, *J* = 9.7, 8.6 Hz, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.38 (t, *J* = 7.4 Hz, 1H), 6.89 (dd, *J* = 8.7, 2.6 Hz, 1H), 6.79 (d, *J* = 2.6 Hz, 1H), 4.86 (s, 2H), 3.86 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 203.6, 161.4, 158.1, 140.2, 139.5, 136.1, 136.0, 132.1, 131.0, 129.8, 129.1, 128.2, 128.0, 127.1, 125.1, 112.4, 106.5, 82.6, 55.7.

HRMS (EI) calcd for $C_{21}H_{16}O_3$ $[M+H]^+$: 317.1177. Found: 317.1159. Anal.calcd for $C_{21}H_{16}O_3$: C, 79.73; H, 5.10. Found: C, 79.78; H, 5.05.

FT-IR (KBr disc): υ= 2914, 1693, 1459, 1237, 1035 cm^{-1}.

UV-vis spectra absorption peak: 301 nm.



4f

Prepared according General Procedure C. White solid. m.p. 77.3 – 80.0 ℃.

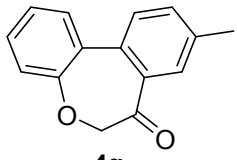
^{1}H NMR (400 MHz, DMSO) δ = 7.78 (dd, *J* = 12.0, 4.5 Hz, 2H), 7.72 – 7.65 (m, 2H), 7.57 (td, *J* = 7.6, 1.1 Hz, 1H), 7.47 (td, *J* = 7.7, 1.7 Hz, 1H), 7.38 (td, *J* = 7.6, 1.3 Hz, 1H), 7.27 (dd, *J* = 7.9, 1.2 Hz, 1H), 4.91 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.0, 156.8, 136.6, 136.4, 134.3, 133.0, 131.0, 130.7, 129.9, 129.4, 128.7, 126.6, 121.9, 83.1.

HRMS (EI) calcd for $C_{14}H_{10}O_2$ $[M+H]^+$: 211.0759. Found: 211.0763. Anal.calcd for $C_{14}H_{10}O_2$: C, 79.98; H, 4.79. Found: C, 79.89; H, 4.88.

FT-IR (KBr disc): υ= 2919, 1688, 1599, 1494, 1239, 1062 cm^{-1}.

UV-vis spectra absorption peak: 309 nm.



4g

Prepared according General Procedure C. White solid. m.p. 55.9 – 56.7 ℃.

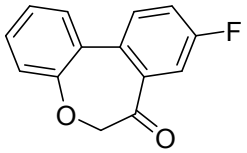
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.72 (s, 1H), 7.56 (dd, *J* = 7.7, 1.7 Hz, 1H), 7.49 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.37 (dt, *J* = 7.6, 1.7 Hz, 1H), 7.29 (dt, *J* = 7.5, 1.4 Hz, 1H), 7.21 (dd, *J* = 7.9, 1.3 Hz, 1H), 4.82 (s, 2H), 2.45 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.0, 156.8, 138.1, 135.8, 134.5, 134.3, 133.2, 130.1, 129.9, 129.8, 129.4, 125.9, 121.3, 82.7, 20.9.

HRMS (EI) calcd for $C_{15}H_{12}O_2$ $[M+H]^+$: 225.0915. Found: 225.0931. Anal.calcd for $C_{15}H_{12}O_2$: C, 80.34; H, 5.39. Found: C, 80.42; H, 5.31.

FT-IR (KBr disc): υ= 2915, 1682, 1600, 1510, 1297, 1061 cm^{-1}.

UV-vis spectra absorption peak: 318 nm.



4h

Prepared according General Procedure C. Light yellow solid. m.p. 130.0-132.1 ℃.

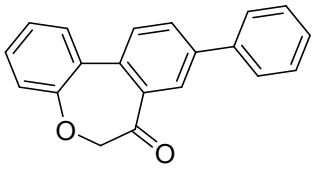
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.97 (dd, *J* = 8.7, 6.1 Hz, 1H), 7.55 (dd, *J* = 7.7, 1.5 Hz, 1H), 7.43 (td, *J* = 7.7, 1.6 Hz, 1H), 7.33 (td, *J* = 7.6, 1.2 Hz, 1H), 7.24 (dd, *J* = 6.5, 1.7 Hz, 2H), 7.20 – 7.13 (m, 1H), 4.82 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 202.4, 166.0 (d, *J* = 260 Hz), 156.9, 140.1 (d, *J* = 10 Hz), 132.8 (d, *J* = 10 Hz), 132.4 (d, *J* = 20 Hz), 131.1, 130.3, 126.3, 121.7 , 116.3(d, *J* = 30 Hz), 115.6, 115.3, 82.62.

HRMS (EI) calcd for $C_{14}H_9FO_2$ $[M+H]^+$: 229.2302. Found: 229.2311. Anal.calcd for $C_{14}H_9FO_2$: C, 73.68; H, 5.39; F, 8.32. Found: C, 73.65; H, 5.37; F, 8.37.

FT-IR (KBr disc): υ= 2928. 1688, 1608, 1484, 1274, 1177 cm^{-1}.

UV-vis spectra absorption peak: 273 nm.



4i

Prepared according General Procedure C. White solid. m.p. 121.0 – 122.8 ℃.

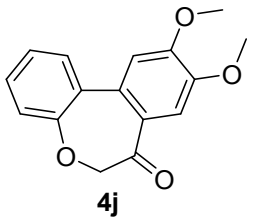
^{1}H NMR (400 MHz, DMSO) δ = 8.13 – 8.02 (m, 2H), 7.82 – 7.71 (m, 4H), 7.57 – 7.37 (m, 5H), 7.29 (dd, *J* = 7.9, 1.3 Hz, 1H), 4.96 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 203.3, 156.4, 139.7, 138.4, 136.4, 135.1, 132.1, 131.7, 130.5, 130.2, 130.1, 129.2, 128.2, 126.8, 126.7, 126.1, 121.5, 82.5.

HRMS (EI) calcd for $C_{20}H_{14}O_2$ $[M+H]^+$: 287.1072. Found: 287.1056. Anal.calcd for $C_{20}H_{14}O_2$: C, 83.90; H, 4.93. Found: C, 83.87; H, 4.96.

FT-IR (KBr disc): υ= 2920, 1685, 1592, 1499, 1351, 1269, 1078 cm^{-1}.

UV-vis spectra absorption peak: 306 nm.



4j

Prepared according General Procedure C. White solid. m.p. 121.0 – 122.8 ℃.

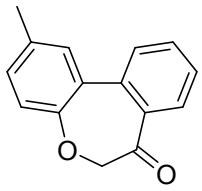
^{1}H NMR (400 MHz, DMSO) δ = 7.79 (dd, *J* = 7.7, 1.6 Hz, 1H), 7.44 (td, *J* = 7.6, 1.7 Hz, 1H), 7.39 – 7.34 (m, 2H), 7.25 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.16 (s, 1H), 4.83 (s, 2H), 3.98 (s, 3H), 3.88 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 201.6, 156.9, 153.7, 148.9, 132.9, 131.2, 130.8, 130.3, 128.4, 126.3, 121.6, 112.7, 111.7, 82.3, 56.4, 56.1.

HRMS (EI) calcd for $C_{16}H_{14}O_4$ $[M+H]^+$: 271.0970. Found: 271.0968. Anal.calcd for $C_{16}H_{14}O_4$: C, 71.10; H, 5.22. Found: C, 71.15; H, 5.17.

FT-IR (KBr disc): υ= 2921, 1670, 1591, 1520, 1353, 1282, 1019 cm^{-1}.

UV-vis spectra absorption peak: 279 nm.



4k

Prepared according General Procedure C. White solid. m.p. 106.6 – 109.3 ℃.

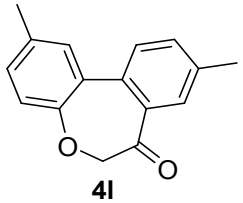
^{1}H NMR (400 MHz, DMSO) δ = 7.76 (dd, *J* = 11.8, 4.5 Hz, 2H), 7.69 – 7.63 (m, 1H), 7.55 (td, *J* = 7.6, 1.2 Hz, 1H), 7.48 (d, *J* = 1.7 Hz, 1H), 7.25 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.14 (d, *J* = 8.1 Hz, 1H), 4.86 (s, 2H), 2.37 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 204.2, 154.7, 136.7, 136.5, 135.7, 134.2, 132.6, 131.3, 131.0, 129.8, 129.4, 128.5, 121.5, 83.1, 20.9.

HRMS (EI) calcd for $C_{15}H_{12}O_2$ $[M+H]^+$: 225.0915. Found: 225.0922. Anal.calcd for $C_{15}H_{12}O_2$: C, 80.34; H, 5.39. Found: C, 80.25; H, 5.48.

FT-IR (KBr disc): υ= 2910, 1678, 1599, 1502, 1282, 1054 cm^{-1}.

UV-vis spectra absorption peak: 310 nm.



4l

Prepared according General Procedure C. White solid. m.p. 83.7 – 85.1 ℃.

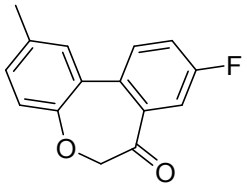
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.70 (s, 1H), 7.45 (s, 1H), 7.34 (d, *J* = 1.7 Hz, 1H), 7.16 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.09 (d, *J* = 8.1 Hz, 1H), 4.78 (s, 1H), 2.44 (s, 1H), 2.39 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 203.7, 154.9, 144.3, 137.2, 135.4, 133.7, 133.0, 130.8, 130.7, 130.0, 129.7, 128.8, 121.1, 82.7, 21.8, 21.0.

HRMS (EI) calcd for $C_{16}H_{14}O_2$ $[M+H]^+$: 239.1072. Found: 239.1069. Anal.calcd for $C_{16}H_{14}O_2$: C, 80.65; H, 5.92. Found: C, 80.59; H, 5.98.

FT-IR (KBr disc): υ= 2928, 1688, 1494, 1239, 1045 cm^{-1}.

UV-vis spectra absorption peak: 321 nm.



4m

Prepared according General Procedure C. Light yellow solid. m.p. 110.3 – 111.4 ℃.

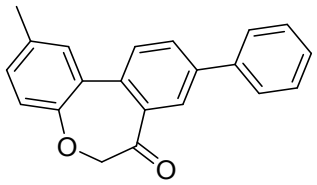
^{1}H NMR (400 MHz, DMSO): δ = 7.87 (dd, *J* = 8.7, 6.2 Hz, 1H), 7.54 (dd, *J* = 10.2, 2.3 Hz, 2H), 7.40 (td, *J* = 8.5, 2.6 Hz, 1H), 7.28 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.15 (d, *J* = 8.1 Hz 1H), 4.85 (s, 2H), 2.37 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.7, 158.3 (d, *J* = 240 Hz), 150.7, 138.2, 136.8, 133.6, 130.1, 128.7, 128.4, 126.5, 118.0 (d, *J* = 30 Hz), 115.3 (d, *J* = 10 Hz), 114.6 (d, *J* = 20 Hz), 66.5, 21.6.

HRMS (EI) calcd for $C_{15}H_{11}FO_2$ $[M+H]^+$: 243.0821. Found: 243.0819. Anal.calcd for $C_{15}H_{11}O_2$: C, 74.37; H, 4.58; F, 7.84. Found: C, 74.38; H, 4.61; F, 7.88.

FT-IR (KBr disc): υ= 2919, 1678, 1608, 1484, 1292, 1177, 1043 cm^{-1}.

UV-vis spectra absorption peak: 269 nm.



4n

Prepared according General Procedure C. White solid. m.p. 82.4 – 84.7 ℃.

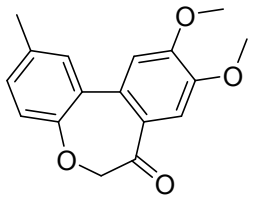
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.14 (d, *J* = 2.1 Hz, 1H), 7.90 (dd, *J* = 8.1, 2.1 Hz, 1H), 7.68 (dd, *J* = 5.2, 3.3 Hz, 2H), 7.63 (d, *J* = 8.1 Hz, 1H), 7.48 (dd, *J* = 10.2, 4.8 Hz, 2H), 7.42 – 7.37 (m, 2H), 7.19 (dd, *J* = 8.1, 2.0 Hz, 1H), 7.13 (d, *J* = 8.1 Hz, 1H), 4.84 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.3, 154.8, 140.9, 139.5, 136.6, 136.1, 135.7, 132.6, 132.0, 131.0, 130.7, 130.1, 129.1, 128.1, 127.2, 121.2, 82.9, 21.1.

HRMS (EI) calcd for $C_{21}H_{16}O_2$ $[M+H]^+$: 301.1228. Found: 301.1231. Anal.calcd for $C_{21}H_{16}O_2$: C, 83.98; H, 5.37. Found: C, 83.67; H, 5.68.

FT-IR (KBr disc): υ= 2902, 1681, 1484, 1230, 1007 cm^{-1}.

UV-vis spectra absorption peak: 284 nm.



4o

Prepared according General Procedure C. White solid. m.p. 151.4 – 154.2 ℃.

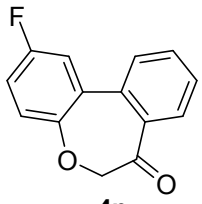
^{1}H NMR (400 MHz, DMSO) δ = 7.56 (d, *J* = 1.7 Hz, 1H), 7.34 (s, 1H), 7.20 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.14 (s, 1H), 7.11 (d, *J* = 8.1 Hz, 1H), 4.76 (s, 2H), 3.97 (s, 3H), 3.86 (s, 3H), 2.38 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 201.4, 154.2, 153.2, 148.3, 134.9, 132.0, 130.9, 130.5, 130.2, 128.0, 120.8, 112.1, 111.2, 81.8, 55.9, 55.6, 20.5.

HRMS (EI) calcd for $C_{17}H_{16}O_4$ $[M+H]^+$: 285.1127. Found: 285.1132. Anal.calcd for $C_{17}H_{16}O_2$: C, 71.82; H, 5.67. Found: C, 71.95; H, 5.80.

FT-IR (KBr disc): υ= 2919, 1670, 1512, 1468, 1265, 1203, 1027 cm^{-1}.

UV-vis spectra absorption peak: 294 nm.



4p

Prepared according General Procedure C. White solid. m.p. 131.6 – 132.2 ℃.

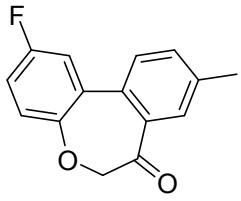
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.92 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.69 (td, *J* = 7.7, 1.5 Hz, 1H), 7.51 (dd, *J* = 11.0, 4.4 Hz, 2H), 7.30 – 7.26 (m, 1H), 7.20 (dd, *J* = 8.8, 5.0 Hz, 1H), 7.07 (ddd, *J* = 8.8, 7.7, 3.0 Hz, 1H), 4.82 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 203.8, 160.1 (d, *J* = 240 Hz), 153.1, 136.5, 135.5 (d, *J* = 10 Hz), 134.8, 134.3, 130.1, 129.5, 129.3, 123.8 (d, *J* = 10 Hz), 117.4 (d, *J* = 30 Hz), 116.9 (d, *J* = 20 Hz), 83.2.

HRMS (EI) calcd for $C_{14}H_9FO_2$ $[M+H]^+$: 229.0665. Found: 229.0659. Anal.calcd for $C_{14}H_9FO_2$: C, 73.68; H, 3.98; F, 8.32. Found: C, 73.65; H, 3.95; F, 8.38.

FT-IR (KBr disc): υ= 2928, 1688, 1484, 1282, 1168 cm^{-1}.

UV-vis spectra absorption peak: 289 nm.



4q

Prepared according General Procedure C. White solid. m.p. 121.7 – 123.3 ℃.

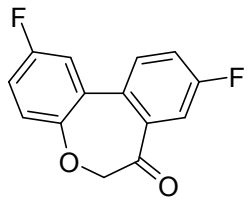
^{1}H NMR (400 MHz, DMSO) δ = 7.61 (d, *J* = 3.8 Hz, 3H), 7.53 (dd, *J* = 9.8, 2.7 Hz, 1H), 7.37 – 7.21 (m, 2H), 4.88 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.7, 158.2 (d, *J* = 240 Hz), 150.7, 137.8, 133.9, 133.4 (d, *J* = 10 Hz), 129.3, 129.2, 118.0, 117.7, 115.1 (d, *J* = 10 Hz), 114.5, 114.3, 66.3, 21.4.

HRMS (EI) calcd for $C_{15}H_{11}FO_2$ $[M+H]^+$: 243.0821. Found: 243.0817. Anal.calcd for $C_{15}H_{11}FO_2$: C, 74.37; H, 4.58; F, 7.84. Found: C, 74.32; H, 4.61; F, 7.86.

FT-IR (KBr disc): υ= 2919, 1722, 1494, 1274, 1185, 1054 cm^{-1}.

UV-vis spectra absorption peak: 312 nm.



4r

Prepared according General Procedure C. White solid. m.p. 165.1 – 166.7 ℃.

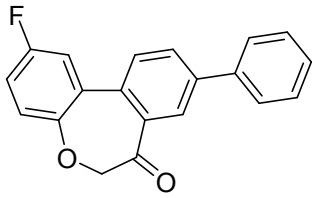
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.97 (dd, *J* = 8.5, 6.0 Hz, 1H), 7.24 – 7.18 (m, 3H), 7.13 – 7.07 (m, 1H), 4.80 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.7, 162.8 (d, *J* = 250 Hz), 158.2 (d, *J* = 240 Hz), 150.6, 139.0, 132.0 (d, *J* = 10 Hz), 130.0 (d, *J* = 10 Hz), 125.1, 118.0, 116.7, 115.3 (d, *J* = 20 Hz), 114.9 (d, *J* = 10 Hz), 114.7, 66.1.

HRMS (EI) calcd for $C_{14}H_8F_2O_2$ $[M+H]^+$: 247.0570. Found: 247.0565. Anal.calcd for $C_{14}H_8F_2O_2$: C, 68.30; H, 3.28; F, 15.43. Found: C, 68.20; H, 3.34; F, 15.47.

FT-IR (KBr disc): υ= 2928, 1688, 1608, 1512, 1282, 1168, 1029 cm^{-1}.

UV-vis spectra absorption peak: 264 nm.



4s

Prepared according General Procedure C. White solid. m.p. 142.1 – 144.7 ℃.

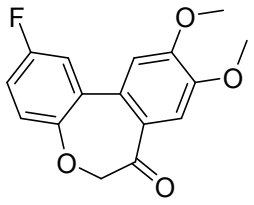
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (d, *J* = 2.0 Hz, 1H), 7.92 (dd, *J* = 8.1, 2.1 Hz, 1H), 7.71 – 7.65 (m, 2H), 7.60 (d, *J* = 8.1 Hz, 1H), 7.48 (t, *J* = 7.5 Hz, 2H), 7.40 (t, *J* = 7.3 Hz, 1H), 7.31 (dd, *J* = 9.2, 3.0 Hz, 1H), 7.21 (dd, *J* = 8.8, 5.0 Hz, 1H), 7.11 – 7.05 (m, 1H), 4.85 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 203.5, 160.4 (d, *J* = 240 Hz), 153.0, 141.6, 139.3, 136.6, 134.8, 134.6 (d, *J* = 10 Hz), 132.2, 130.1, 129.1, 128.3, 127.2, 123.0 (d, *J* = 10 Hz), 116.9, 116.7 (d, *J* = 10 Hz), 116.4, 83.0.

HRMS (EI) calcd for $C_{20}H_{13}FO_2$ $[M+H]^+$: 305.0978. Found: 305.0969. Anal.calcd for $C_{20}H_{13}FO_2$: C, 78.94; H, 4.31; F, 6.24. Found: C, 78.74; H, 4.43; F, 6.32.

FT-IR (KBr disc): υ= 2910, 1678, 1476, 1239, 1168, 1032 cm^{-1}.

UV-vis spectra absorption peak: 241, 291 nm.



4t

Prepared according General Procedure C. Light yellow solid. m.p. 186.0-188.2 ℃.

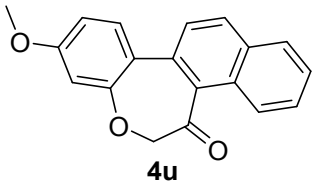
^{1}H NMR (400 MHz, DMSO) δ = 7.67 (dd, *J* = 10.0, 2.7 Hz, 1H), 7.36 (s, 1H), 7.29 – 7.21 (m, 2H), 7.17 (s, 1H), 4.82 (s, 2H), 3.98 (s, 3H), 3.87 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 200.9, 159.5 (d, *J* = 240 Hz), 153.2, 152.6 (d, *J* = 10 Hz), 148.7, 134.2 (d, *J* = 10 Hz), 129.5, 128.0, 122.8 (d, *J* = 10 Hz), 116.5 (d, *J* = 20 Hz), 116.1 (d *J* = 30 Hz), 112.4, 111.2, 81.9, 56.0, 55.6.

HRMS (EI) calcd for $C_{16}H_{13}FO_4$ $[M+H]^+$: 289.0876. Found: 289.0879. Anal.calcd for $C_{16}H_{13}FO_4$: C, 66.66; H, 4.55; F, 6.59. Found: C, 66.45; H, 4.69; F, 6.66.

FT-IR (KBr disc): υ= 2919, 1661, 1581, 1520, 1292, 1159, 1027 cm^{-1}.

UV-vis spectra absorption peak: 285, 255 nm.



4u

Prepared according General Procedure C. White solid. m.p. 157.1 – 160.8 ℃.

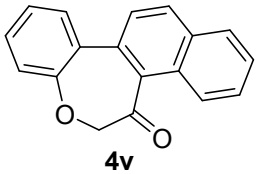
^{1}H NMR (400 MHz, DMSO) δ = 8.21 (d, *J* = 8.6 Hz, 1H), 8.08 – 8.00 (m, 2H), 7.64 (ddd, *J* = 21.1, 13.6, 7.8 Hz, 4H), 7.01 (dd, *J* = 8.6, 2.2 Hz, 1H), 6.90 (d, *J* = 2.2 Hz, 1H), 5.12 (s, 2H), 3.84 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 206.6, 161.3, 157.8, 134.7, 133.6, 132.8, 132.8, 131.8, 130.2, 128.7, 128.3, 127.0, 126.8, 126.1, 125.4, 112.9, 107.5, 86.5, 56.0.

HRMS (EI) calcd for $C_{19}H_{14}O_3$ $[M+H]^+$: 291.1021. Found: 291.1014. Anal.calcd for $C_{19}H_{14}O_3$: C, 78.61; H, 4.86. Found: C, 78.59; H, 4.88.

FT-IR (KBr disc): υ= 2918, 1689, 1597, 1469, 1341, 1154, 1024 cm^{-1}.

UV-vis spectra absorption peak: 267 nm.



4v

Prepared according General Procedure C. White solid. m.p. 114.2 – 116.5 ℃.

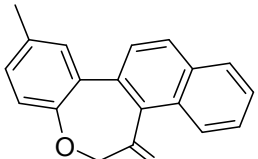
^{1}H NMR (400 MHz, DMSO) δ = 8.26 (d, *J* = 8.6 Hz, 1H), 8.07 (ddd, *J* = 6.7, 5.8, 2.4 Hz, 2H), 7.76 (dd, *J* = 7.6, 1.7 Hz, 1H), 7.71 (d, *J* = 8.6 Hz, 1H), 7.65 (pd, *J* = 6.8, 1.8 Hz, 2H), 7.50 (td, *J* = 7.7, 1.7 Hz, 1H), 7.45 – 7.40 (m, 1H), 7.32 (dd, *J* = 7.9, 1.3 Hz, 1H), 5.14 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 206.3, 156.6, 135.2, 133.9, 133.7, 133.2, 132.8, 130.9, 130.3, 130.2, 128.4, 128.3, 126.8, 126.6, 126.3, 125.8, 121.6, 86.3.

HRMS (EI) calcd for $C_{18}H_{12}O_2$ $[M+H]^+$: 261.0915. Found: 261.0931. Anal.calcd for $C_{18}H_{12}O_2$: C, 83.06; H, 4.65. Found: C, 83.21; H, 4.80.

FT-IR (KBr disc): υ= 2919, 1670, 1591, 1520, 1353, 1282, 1019 cm^{-1}.

UV-vis spectra absorption peak: 263 nm.



4w

Prepared according General Procedure C. White solid. m.p. 164.9 – 167.0 ℃.

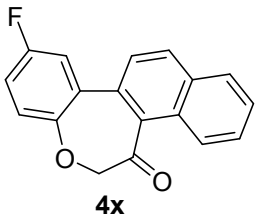
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (d, *J* = 8.5 Hz, 1H), 8.06 (d, *J* = 8.6 Hz, 1H), 7.91 – 7.87 (m, 1H), 7.56 (ddd, *J* = 11.0, 8.1, 1.3 Hz, 3H), 7.42 (d, *J* = 1.5 Hz, 1H), 7.19 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.14 (d, *J* = 8.1 Hz, 1H), 4.96 (s, 2H), 2.42 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.5, 159.4, 157.0, 150.6, 138.0, 136.7, 133.5, 130.0, 128.6, 128.3, 126.3, 117.9, 117.7, 115.2, 115.1, 114.6, 114.4, 66.4, 21.5.

HRMS (EI) calcd for $C_{19}H_{14}O_2$ $[M+H]^+$: 275.1072. Found: 275.1069. Anal.calcd for $C_{19}H_{14}O_2$: C, 83.19; H, 5.14. Found: C, 83.32; H, 5.27.

FT-IR (KBr disc): υ= 2887, 1688, 1494, 1239, 1054 cm^{-1}.

UV-vis spectra absorption peak: 260 nm.



4x

Prepared according General Procedure C. Light yellow solid. m.p. 153.1- 155.0 ℃.

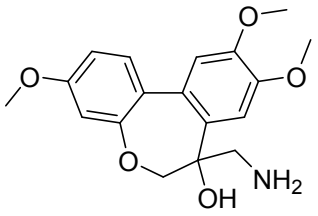
^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.27 (d, J = 8.6 Hz, 1H), 8.07 (dt, J = 9.7, 4.3 Hz, 2H), 7.74 (d, J = 8.6 Hz, 1H), 7.68 – 7.62 (m, 3H), 7.38 – 7.30 (m, 2H), 5.13 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.9, 160.55 (d, J = 230 Hz), 152.5, 135.4 (d, J = 10 Hz), 134.1 (d, J = 10 Hz), 133.4, 133.0, 130.3, 128.4, 127.1, 126.1, 125.9, 123.0 (d, J = 10 Hz), 117.3, 117.0, 116.8, 116.5, 86.4.

HRMS (EI) calcd for $C_{18}H_{11}FO_2$ $[M+H]^+$: 279.0821. Found: 279.0843. Anal.calcd for $C_{18/}H_{11}FO_2$: C, 77.69; H, 3.98; F, 6.83. Found: C, 77.81; H, 3.90; F, 6.79.

FT-IR (KBr disc): υ= 2919, 1697, 1476, 1239, 1054 cm^{-1}.

UV-vis spectra absorption peak: 262 nm.



6a

Prepared according General Procedure D and E. White solid. m.p. 133.0 – 134.5 ℃.

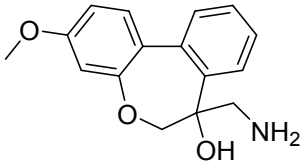
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.40 (s, 1H), 7.33 (d, J = 8.2 Hz, 1H), 6.93 (s, 1H), 6.78 (d, J = 8.6 Hz, 1H), 6.67 (s, 1H), 4.50 (d, J = 11.6 Hz, 1H), 4.33 (d, J = 11.5 Hz, 1H), 3.97 (s, 1H), 3.93 (s, 2H), 3.83 (s, 2H), 2.69 (d, J = 12.4 Hz, 1H), 2.49 (d, J = 12.2 Hz, 1H).

^{13}C NMR (100 MHz, DMSO) δ = 159.9, 156.4, 148.3, 147.7, 135.1, 129.8, 127.0, 126.9, 113.0, 110.9, 110.6, 106.8, 82.6, 75.9, 56.0, 55.9, 55.7, 50.5.

HRMS (EI) calcd for $C_{18}H_{21}NO_5$ $[M+H]^+$: 332.1798. Found: 332.1782. Anal.calcd for $C_{18}H_{21}NO_3$: C, 65.24; H, 6.39; N, 4.23. Found: C, 65.28; H, 6.36; N, 4.22.

FT-IR (KBr disc): υ= 3737, 3341, 2857, 1617, 1512, 1247, 1159, 1036 cm^{-1}.

UV-vis spectra absorption peak: 299, 268, 229 nm.



6b

Prepared according General Procedure D and E. White solid. m.p. 96.3 – 98.8 ℃.

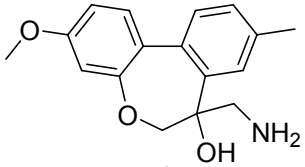
^{1}H NMR (400 MHz, DMSO) δ = 7.73 (d, *J* = 6.6 Hz, 1H), 7.36 (dt, *J* = 6.9, 6.5 Hz, 4H), 6.83 (dd, *J* = 8.6, 2.6 Hz, 1H), 6.67 (d, *J* = 2.6 Hz, 1H), 4.48 (d, *J* = 11.4 Hz, 1H), 4.20 (d, *J* = 11.4 Hz, 1H), 3.78 (s, 3H), 2.46 – 2.26 (m, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 160.5, 156.4, 142.8, 135.0, 129.9, 129.0, 128.0, 127.2, 127.0, 126.4, 111.1, 107.0, 82.8, 76.1, 55.8, 50.3.

HRMS (EI) calcd for $C_{16}H_{17}NO_3$ $[M+H]^+$: 272.1286. Found: 272.1294. Anal.calcd for $C_{16}H_{17}NO_3$: C, 70.83; H, 6.32; N, 5.16. Found: C, 70.89; H, 6.36; N, 5.26.

FT-IR (KBr disc): υ= 3737, 3160, 2919, 1678, 1599, 1494, 1300, 1195, 1027 cm^{-1}.

UV-vis spectra absorption peak: 265, 224 nm.



6c

Prepared according General Procedure D and E. White solid. m.p. 128.8 – 130.4 ℃.

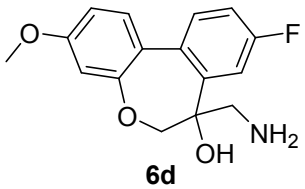
^{1}H NMR (400 MHz, DMSO) δ = 7.54 (s, 1H), 7.35 (d, *J* = 8.1 Hz, 1H), 7.26 (d, *J* = 7.3 Hz, 1H), 7.17 (d, *J* = 6.9 Hz, 1H), 6.80 (d, *J* = 7.9 Hz, 1H), 6.64 (s, 1H), 4.45 (d, *J* = 11.1 Hz, 1H), 4.17 (d, *J* = 11.3 Hz, 1H), 3.77 (s, 3H), 2.36 (s, 5H), 1.53 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 160.2, 156.3, 142.5, 136.0, 132.1, 129.8, 129.0, 128.5, 127.0, 127.0, 111.0, 106.9, 82.5, 76.0, 55.8, 50.2, 21.5.

HRMS (EI) calcd for $C_{17}H_{19}NO_3$ $[M+H]^+$: 286.1443. Found: 286.1452. Anal.calcd for $C_{17}H_{19}NO_3$: C, 71.56; H, 6.71; N, 4.91. Found: C, 71.60; H, 6.66; N, 4.92.

FT-IR (KBr disc): υ= 3720, 3385, 2945, 1599, 1468, 1282, 1159 cm^{-1}.

UV-vis spectra absorption peak: 265 nm.



6d

Prepared according General Procedure D and E. White solid. m.p. 138.3 – 139.4 ℃.

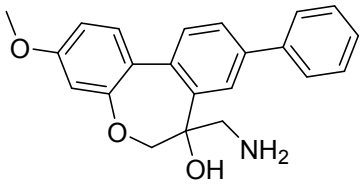
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.56 (dd, *J* = 10.4, 2.8 Hz, 1H), 7.35 (dd, *J* = 8.5, 5.6 Hz, 1H), 7.30 (d, *J* = 8.6 Hz, 1H), 7.06 (td, *J* = 8.2, 2.8 Hz, 1H), 6.78 (dd, *J* = 8.6, 2.6 Hz, 1H), 6.67 (d, *J* = 2.6 Hz, 1H), 4.51 (d, *J* = 11.5 Hz, 1H), 4.31 (d, *J* = 11.5 Hz, 1H), 3.83 (s, 3H), 2.70 (d, *J* = 12.5 Hz, 1H), 2.47 (d, *J* = 12.5 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 162.2 (d, *J* = 240 Hz) , 160.6 ,156.4, 143.9 (d, *J* = 10 Hz), 130.9, 130.6 (d, *J* = 10 Hz), 129.6, 126.2, 114.8 (d, *J* = 20 Hz), 113.4 (d, *J* = 20 Hz), 111.2, 106.8, 84.5, 74.3, 55.6, 49.4.

HRMS (EI) calcd for $C_{16}H_{16}FNO_3$ $[M+H]^+$: 290.1192. Found: 290.1169. Anal.calcd for $C_{16}H_{16}NO_3$: C, 66.43; H, 5.57; N, 4.84; F, 6.57. Found: C, 66.53; H, 5.49; N, 4.73; F, 6.58.

FT-IR (KBr disc): υ= 3737, 3367, 2787, 1617, 1494, 1274, 1203, 1116, 1036 cm^{-1}.

UV-vis spectra absorption peak: 262 nm.



6e

Prepared according General Procedure D and E. White solid. m.p. 166.8 – 168.7 ℃.

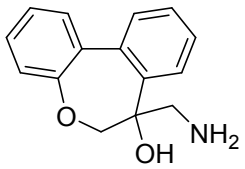
^{1}H NMR (400 MHz, DMSO) δ = 8.01 (d, *J* = 1.8 Hz, 1H), 7.72 (d, *J* = 7.4 Hz, 2H), 7.67 (dd, *J* = 8.0, 1.8 Hz, 1H), 7.52 – 7.47 (m, 3H), 7.45 (d, *J* = 8.6 Hz, 1H), 7.38 (t, *J* = 7.3 Hz, 1H), 6.84 (dd, *J* = 8.6, 2.6 Hz, 1H), 6.69 (d, *J* = 2.5 Hz, 1H), 5.76 (s, 0H), 4.52 (d, *J* = 11.4 Hz, 1H), 4.27 – 4.22 (m, 1H), 3.80 (s, 3H), 2.48 – 2.39 (m, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 160.5, 156.5, 143.3, 140.7, 138.6, 134.1, 130.0, 129.7, 129.5, 127.9, 127.1, 126.4, 126.1, 124.9, 111.1, 106.9, 82.5, 76.3, 55.8, 50.3.

HRMS (EI) calcd for $C_{22}H_{21}NO_3$ $[M+H]^+$: 348.1599. Found: 348.1567. Anal.calcd for $C_{22}H_{21}NO_3$: C, 76.06; H, 6.09; N, 4.03. Found: C, 76.02; H, 6.11; N, 4.05.

FT-IR (KBr disc): υ= 3737, 3377, 2936, 1617, 1484, 1177, 1027 cm^{-1}.

UV-vis spectra absorption peak: 291, 229 nm.



6f

Prepared according General Procedure D and E. White solid. m.p. 124.6 – 127.3 ℃.

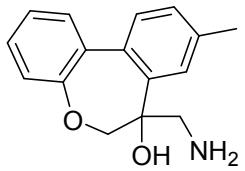
^{1}H NMR (400 MHz, DMSO) δ = 7.76 (s, 1H), 7.46 (d, *J* = 7.1 Hz, 1H), 7.41 (s, 3H), 7.32 (d, *J* = 7.3 Hz, 1H), 7.25 (d, *J* = 7.2 Hz, 1H), 7.08 (d, *J* = 7.7 Hz, 1H), 4.49 (d, *J* = 11.4 Hz, 1H), 4.24 (d, *J* = 11.4 Hz, 1H), 2.34 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 154.9, 142.5, 135.1, 134.7, 129.0, 128., 128.6, 127.6, 127.1, 125.8, 124.8, 121.0, 83.0, 75.7, 50.0.

HRMS (EI) calcd for $C_{15}H_{15}NO_2$ $[M+H]^+$:242.1181. Found: 242.1189. Anal.calcd for $C_{15}H_{15}NO_2$: C, 74.67; H, 6.27; N, 5.81. Found: C, 74.59; H, 6.31; N, 5.85.

FT-IR (KBr disc): υ= 3773, 3315, 2936, 1599, 1450, 1371, 1265, 1027 cm^{-1}.

UV-vis spectra absorption peak: 253, 228 nm.



6g

Prepared according General Procedure D and E. White solid. m.p. 132.4 – 134.2 ℃.

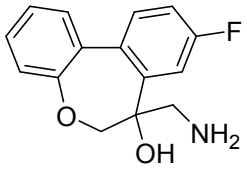
^{1}H NMR (400 MHz, DMSO) δ = 7.58 (s, 1H), 7.43 (dd, *J* = 7.5, 1.4 Hz, 1H), 7.29 (td, *J* = 7.9, 2.3 Hz, 2H), 7.25 – 7.18 (m, 2H), 7.08 – 7.03 (m, 1H), 4.46 (d, *J* = 11.4 Hz, 1H), 4.21 (d, *J* = 11.4 Hz, 1H), 2.38 (s, 3H), 2.33 (s, 2H), 1.16 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 155.4, 142.9, 136.7, 135.4, 132.3, 129.3, 129.1, 129.0, 128.6, 127.0, 125.2, 121.4, 83.2, 76.1, 50.6, 21.6.

HRMS (EI) calcd for $C_{16}H_{17}NO_2$ $[M+H]^+$: 256.1337. Found: 256.1319. Anal.calcd for $C_{16}H_{17}NO_2$: C, 75.27; H, 6.71; N, 5.49. Found: C, 75.21; H, 6.74; N, 5.52.

FT-IR (KBr disc): υ= 3972, 3330, 2737, 1509, 1432, 1201, 1054 cm^{-1}.

UV-vis spectra absorption peak: 258 nm.



6h

Prepared according General Procedure D and E. White solid. m.p. 126.4 – 128.2 ℃.

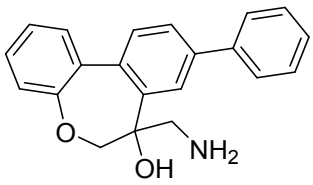
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.81 (dd, *J* = 8.7, 6.0 Hz, 1H), 7.42 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.34 (td, *J* = 7.7, 1.6 Hz, 1H), 7.23 (dd, *J* = 7.5, 1.1 Hz, 1H), 7.17 (dd, *J* = 9.7, 2.6 Hz, 1H), 7.14 – 7.04 (m, 2H), 4.52 (d, *J* = 11.5 Hz, 1H), 4.33 (d, *J* = 11.5 Hz, 1H), 2.64 (d, *J* = 12.5 Hz, 1H), 2.42 (d, *J* = 12.5 Hz, 1H), 1.49 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 163.2, 159.6 (d, *J* = 250 Hz), 151.7, 139.2, 136.4 (d, *J* = 10 Hz), 128.7, 123.2 (d, *J* = 10 Hz), 116.3 (d, *J* = 20 Hz), 116.1 (d, *J* = 20 Hz), 115.6 (d, *J* =20 Hz), 114.6, 114.4, 83.8, 76.0, 50.6.

HRMS (EI) calcd for $C_{15}H_{14}FNO_2$ $[M+H]^+$: 260.1087. Found: 260.1042. Anal.calcd for $C_{15}H_{14}FNO_2$: C, 69.49; H, 5.44; N, 5.40; F, 7.33. Found: C, 69.51; H, 5.43; N, 5.41; F, 7.35.

FT-IR (KBr disc): υ= 3755, 3324, 2795, 1608, 1494, 1432, 1230, 1177, 1036 cm^{-1}.

UV-vis spectra absorption peak: 246 nm.



6i

Prepared according General Procedure D and E. White solid. m.p. 108.7 – 109.5 ℃.

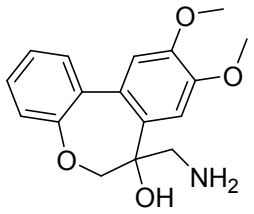
^{1}H NMR (400 MHz, DMSO) δ = 8.04 (d, *J* = 2.0 Hz, 1H), 7.76 – 7.68 (m, 3H), 7.55 – 7.48 (m, 4H), 7.42 – 7.32 (m, 2H), 7.27 (td, *J* = 7.4, 1.4 Hz, 1H), 7.11 (dd, *J* = 7.8, 1.3 Hz, 1H), 5.52 (s, 1H), 4.52 (d, *J* = 11.4 Hz, 1H), 4.27 (d, *J* = 11.4 Hz, 1H), 2.39 (s, 2H), 1.23 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 155.5, 143.6, 140.6, 139.2, 134.9, 134.3, 130.1, 129.6, 129.4, 129.1, 127.9, 127.1, 126.2, 125.3, 124.8, 121.5, 83.2, 76.4, 50.6.

HRMS (EI) calcd for $C_{21}H_{19}NO_2$ $[M+H]^+$: 318.1494. Found: 318.1459. Anal.calcd for $C_{21}H_{19}NO_2$: C, 79.47; H, 6.03; N, 4.41. Found: C, 79.39; H, 6.05; N, 4.47.

FT-IR (KBr disc): υ= 3722, 3328, 2789, 1602, 1429, 1249, 1034 cm^{-1}.

UV-vis spectra absorption peak: 229, 280 nm.



6j

Prepared according General Procedure D and E. White solid. m.p. 68.5 – 70.1 ℃.

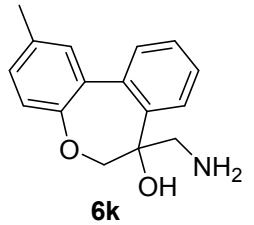
^{1}H NMR (400 MHz, DMSO) δ = 7.50 (d, *J* = 7.4 Hz, 1H), 7.34 (s, 1H), 7.25 (dt, *J* = 24.0, 7.3 Hz, 2H), 7.05 (d, *J* = 7.7 Hz, 1H), 6.99 (s, 1H), 4.45 (d, *J* = 11.4 Hz, 1H), 4.20 (d, *J* = 11.4 Hz, 1H), 3.83 (s, 6H), 2.30 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 155.0, 147.9, 147.7, 135.0, 134.8, 128.7, 128.3, 126.5, 124.7, 120.9, 112.9, 110.2, 82.8, 75.4, 55.6, 55.5, 50.5.

HRMS (EI) calcd for $C_{17}H_{19}NO_4$ $[M+H]^+$: 302.1392. Found: 302.1387. Anal.calcd for $C_{17}H_{19}NO_4$: C, 67.76; H, 6.36; N, 4.65. Found: C, 67.72; H, 6.33; N, 6.43.

FT-IR (KBr disc): υ= 3769, 3319, 2751, 1536, 1249, 1142, 1038 cm^{-1}.

UV-vis spectra absorption peak: 269, 235 nm.



6k

Prepared according General Procedure D and E. White solid. m.p. 136.4 – 138.3 ℃.

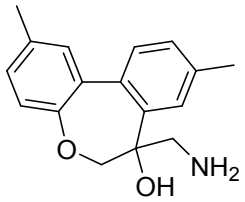
^{1}H NMR (400 MHz, DMSO) δ = 7.78 – 7.70 (m, 1H), 7.39 (q, *J* = 3.3 Hz, 3H), 7.26 (s, 1H), 7.12 (dd, *J* = 8.0, 1.5 Hz, 1H), 6.96 (d, *J* = 8.0 Hz, 1H), 5.36 (s, 1H), 4.44 (d, *J* = 11.4 Hz, 1H), 4.18 (d, *J* = 11.4 Hz, 1H), 2.32 (d, *J* = 12.2 Hz, 5H), 1.12 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 153.2, 143.1, 135.4, 135.3, 134.3, 129.9, 129.5, 129.2, 128.0, 127.5, 126.3, 121.2, 83.4, 76.3, 50.6, 21.0.

HRMS (EI) calcd for $C_{16}H_{17}NO_2$ $[M+H]^+$: 256.1337. Found: 256.1348. Anal.calcd for $C_{16}H_{17}NO_2$: C, 75.27; H, 6.71; N, 5.49. Found: C, 75.31; H, 6.75; N, 5.41.

FT-IR (KBr disc): υ= 3963, 3315, 2752, 1520, 1423, 1212, 1045 cm^{-1}.

UV-vis spectra absorption peak: 255, 229 nm.



6l

Prepared according General Procedure D and E. White solid. m.p. 144.7 – 146.1 ℃.

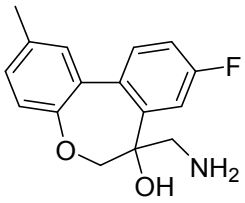
^{1}H NMR (400 MHz, DMSO) δ = 7.56 (d, *J* = 0.9 Hz, 1H), 7.30 (d, *J* = 7.7 Hz, 1H), 7.24 – 7.18 (m, 2H), 7.09 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.94 (d, *J* = 8.0 Hz, 1H), 4.42 (d, *J* = 11.4 Hz, 1H), 4.16 (d, *J* = 11.4 Hz, 1H), 2.38 (s, 3H), 2.33 (s, 3H), 2.30 (s, 2H), 1.19 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 153.1, 142.8, 136.6, 135.2, 134.1, 132.4, 129.6, 129.3, 129.2, 128.5, 127.0, 121.1, 83.2, 76.2, 50.6, 21.6, 21.0.

HRMS (EI) calcd for $C_{17}H_{19}NO_2$ $[M+H]^+$:270.1494. Found: 270.1459. Anal.calcd for $C_{17}H_{19}NO_2$: C, 75.81; H, 7.11; N, 5.20. Found: C, 75.79; H, 7.16; N, 5.17.

FT-IR (KBr disc): υ= 3755, 3350, 2761, 1599, 1494, 1441, 1203, 1036 cm^{-1}.

UV-vis spectra absorption peak: 260, 228 nm.



6m

Prepared according General Procedure D and E. White solid. m.p. 178.2 – 180.4 ℃.

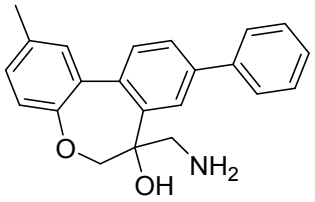
^{1}H NMR (400 MHz, DMSO) δ = 9.33 (d, *J* = 7.7 Hz, 1H), 7.90 (d, *J* = 8.7 Hz, 2H), 7.66 (d, *J* = 8.8 Hz, 1H), 7.50 – 7.43 (m, 3H), 7.12 (d, *J* = 8.0 Hz, 1H), 6.96 (d, *J* = 8.1 Hz, 1H), 5.98 (s, 1H), 4.47 (d, *J* = 11.8 Hz, 1H), 4.13 (d, *J* = 11.7 Hz, 1H), 3.05 (d, *J* = 13.6 Hz, 1H), 2.85 (d, *J* = 13.5 Hz, 1H), 2.36 (s, 3H), 1.71 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.8, 159.3 (d, *J* = 240 Hz), 153.3 (d, *J* = 10 Hz), 138.1, 136.0, 135.0, 132.6, 130.6, 129.5, 128.7, 123.6 (d, *J* = 10 Hz), 116.7 (d, *J* = 20 Hz), 115.9 (d, *J* = 30 Hz), 78.4, 49.2, 21.1.

HRMS (EI) calcd for $C_{16}H_{16}FNO_2$ $[M+H]^+$: 274.1243. Found: 271.1269. Anal.calcd for $C_{16}H_{16}FNO_2$: C, 70.31; H, 5.90; F, 6.95; N, 5.12. Found: C, 70.29; H, 5.81; F, 6.99; N, 5.19.

FT-IR (KBr disc): υ= 3720, 3357, 2752, 1494, 1292, 1124, 1045 cm^{-1}.

UV-vis spectra absorption peak: 297, 281 nm.



6n

Prepared according General Procedure D and E. White solid. m.p. 137.7 – 138.8 ℃.

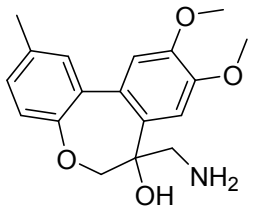
^{1}H NMR (400 MHz, DMSO) δ = 8.03 (d, *J* = 1.9 Hz, 1H), 7.75 – 7.72 (m, 2H), 7.69 (dd, *J* = 7.9, 2.0 Hz, 1H), 7.52 (d, *J* = 7.9 Hz, 3H), 7.40 (d, *J* = 7.3 Hz, 1H), 7.32 (d, *J* = 1.7 Hz, 1H), 7.14 (dd, *J* = 8.1, 1.7 Hz, 1H), 6.99 (d, *J* = 8.0 Hz, 1H), 4.48 (d, *J* = 11.4 Hz, 1H), 4.23 (d, *J* = 11.4 Hz, 1H), 2.38 (s, 2H), 2.36 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 153.2, 143.4, 140.6, 139.2, 134.7, 134.4, 134.3, 130.1, 130.0, 130.0, 129.5, 128.0, 127.1, 126.2, 124.8, 121.3, 83.2, 76.3, 50.5, 21.0.

HRMS (EI) calcd for $C_{22}H_{21}NO_2$ $[M+H]^+$: 332.1650. Found: 332.1636. Anal.calcd for $C_{22}H_{21}NO_2$: C, 79.73; H, 6.39; N, 4.23. Found: C, 79.69; H, 6.38; N, 4.28.

FT-IR (KBr disc): υ= 3710, 3354, 2787, 1494, 1195, 1045 cm^{-1}.

UV-vis spectra absorption peak: 278, 229 nm.



6o

Prepared according General Procedure D and E. White solid. m.p. 145.5 – 147.7 ℃.

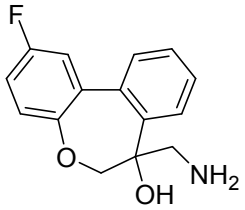
^{1}H NMR (400 MHz, DMSO) δ = 7.34 (s, 1H), 7.29 (d, *J* = 1.5 Hz, 1H), 7.07 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.98 (s, 1H), 6.93 (d, *J* = 8.0 Hz, 1H), 4.41 (d, *J* = 11.4 Hz, 1H), 4.16 (d, *J* = 11.4 Hz, 1H), 3.83 (s, 3H), 3.82 (s, 3H), 2.34 (s, 3H), 2.28 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 152.7, 147.8, 147.7, 135.1, 134.7, 133.6, 128.9, 128.7, 126.7, 120.6, 112.8, 110.2, 82.9, 75.6, 55.7, 55.5, 50.4`, 20.5.

HRMS (EI) calcd for $C_{18}H_{21}NO_2$ $[M+H]^+$: 316.1549. Found: 316.1564. Anal.calcd for $C_{18}H_{21}NO_2$: C, 68.55; H, 6.71; N, 4.44. Found: C, 68.51; H, 6.72; N, 4.47.

FT-IR (KBr disc): υ= 3789, 3324, 2936, 1599, 1520, 1458, 1282, 1027 cm^{-1}.

UV-vis spectra absorption peak: 294, 268 nm.



6p

Prepared according General Procedure D and E. White solid. m.p. 154.5 – 155.7 ℃.

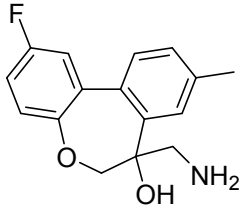
^{1}H NMR (400 MHz, DMSO) δ = 7.81 – 7.71 (m, 1H), 7.48 – 7.36 (m, 3H), 7.30 (dd, *J* = 9.5, 2.9 Hz, 1H), 7.18 – 7.08 (m, 2H), 5.36 (s, 1H), 4.48 (d, *J* = 11.4 Hz, 1H), 4.20 (d, *J* = 11.4 Hz, 1H), 2.36 (s, 2H), 1.29 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 159.5 (d, *J* = 240 Hz), 151.6, 143.1, 137.7 (d, *J* = 10 Hz), 134.3, 129.5, 128.1, 126.4, 123.0 (d, *J* = 10 Hz), 115.7, 115.5 (d, *J* = 10 Hz), 115.1, 83.8, 76.2, 50.6.

HRMS (EI) calcd for $C_{15}H_{14}FNO_2$ [M+H]+: 260.1087. Found: 260.1054. Anal.calcd for $C_{15}H_{14}FNO_2$: C, 69.49; H, 5.44; F, 7.33; N, 5.40. Found: C, 69.43; H, 5.42; F, 7.38; N, 5.43.

FT-IR (KBr disc): υ= 3720, 2795, 1494, 1441, 1168, 1036 cm^{-1}.

UV-vis spectra absorption peak: 284, 256, 229 nm.



6q

Prepared according General Procedure D and E. White solid. m.p. 174.9 – 176.6 ℃.

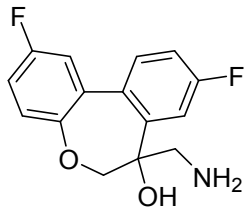
^{1}H NMR (400 MHz, DMSO) δ = 7.57 (d, *J* = 1.2 Hz, 1H), 7.33 (d, *J* = 7.8 Hz, 1H), 7.28 – 7.20 (m, 2H), 7.10 (dt, *J* = 8.9, 3.1 Hz, 2H), 5.34 (s, 1H), 4.45 (d, *J* = 11.4 Hz, 1H), 4.17 (d, *J* = 11.4 Hz, 1H), 2.38 (s, 3H), 2.34 (s, 2H), 1.23 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 159.5 (s, *J* = 240 Hz), 151.7, 140.2, 137.8 (d, *J* = 10 Hz), 137.2, 134.1, 130.2, 128.7, 126.4, 122.9, 115.5 (d, *J* = 20 Hz), 115.2 (d, *J* = 20 Hz), 83.7, 76.1, 50.8, 21.0.

HRMS (EI) calcd for $C_{16}H_{16}FNO_2$ $[M+H]^+$: 274.1243. Found: 274.1258. Anal.calcd for $C_{16}H_{16}FNO_2$: C, 70.31; H, 5.90; F, 6.95; N, 5.12. Found: C, 70.30; H, 5.85; F, 6.98; N, 5.15.

FT-IR (KBr disc): υ= 3781, 3350, 2778, 1617, 1494, 1168, 1027 cm^{-1}.

UV-vis spectra absorption peak: 285, 255 nm.



6r

Prepared according General Procedure D and E. White solid. m.p. 112.3 – 123.2 ℃.

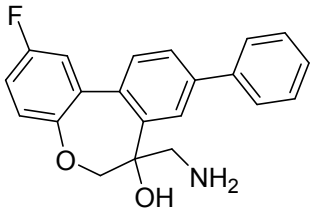
^{1}H NMR (400 MHz, DMSO) δ = 7.77 (dd, *J* = 8.7, 6.1 Hz, 1H), 7.37 (dd, *J* = 9.5, 3.0 Hz, 1H), 7.32 (dd, *J* = 10.0, 2.7 Hz, 1H), 7.27 – 7.15 (m, 2H), 7.13 (dd, *J* = 8.8, 5.2 Hz, 1H), 5.41 (s, 1H), 4.47 (d, *J* = 11.4 Hz, 1H), 4.20 (d, *J* = 11.4 Hz, 1H), 2.34 (s, 2H), 1.13 (t, *J* = 93.3 Hz, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 163.2, 160.7 (d, *J* = 20 Hz), 158.3, 151.6, 139.2, 136.5 (d, *J* = 10 Hz), 128.7 (d, *J* = 10 Hz), 123.2 (d, *J* = 10 Hz), 116.3 (d, *J* = 20 Hz), 116.1 (d, *J* = 20 Hz), 115.6 (d, *J* = 20 Hz24.2), 114.5 (d, *J* = 20 Hz), 83.8, 76.0, 50.6.

HRMS (EI) calcd for $C_{15}H_{13}F_2NO_2$ $[M+H]^+$: 278.0992. Found: 278.0935. Anal.calcd for $C_{15}H_{13}F_2NO_2$: C, 64.98; H, 4.73; F, 13.70; N, 5.05. Found: C, 64.95; H, 4.75; F, 13.65; N, 5.11.

FT-IR (KBr disc): υ= 3749, 3359, 2778, 1591, 1494, 1432, 1177, 1036 cm^{-1}.

UV-vis spectra absorption peak: 278, 228 nm.



6s

Prepared according General Procedure D and E. White solid. m.p. 145.3 – 147.0 ℃.

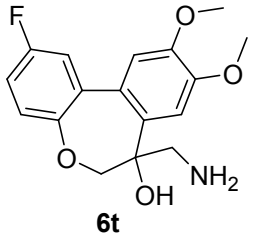
^{1}H NMR (400 MHz, DMSO) δ = 8.04 (d, *J* = 1.9 Hz, 1H), 7.75 (d, *J* = 1.3 Hz, 1H), 7.71 (dd, *J* = 10.3, 2.3 Hz, 2H), 7.57 – 7.48 (m, 3H), 7.40 (s, 2H), 7.14 (d, *J* = 5.2 Hz, 2H), 5.50 (s, 1H), 4.52 (d, *J* = 11.5 Hz, 1H), 4.24 (d, *J* = 11.4 Hz, 1H), 2.41 (s, 2H), 1.25 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 159.5 (d, *J* = 240 Hz), 151.7, 143.7, 140.5, 139.8, 137.0, 133.4, 130.3, 129.5, 128.1, 127.2, 126.3, 125.0, 123.0, 115.8 (d, *J* = 30 Hz), 115.3 (d, *J* = 30 Hz), 83.6, 76.4, 50.8.

HRMS (EI) calcd for $C_{21}H_{18}FNO_2$ $[M+H]^+$:336.1400. Found: 336.1424. Anal.calcd for $C_{21}H_{18}FNO_2$: C, 75.21; H, 5.41; F, 5.66; N, 4.18. Found: C, 75.19; H, 5.46; F, 5.69; N, 4.12.

FT-IR (KBr disc): υ= 3742, 3385, 2713, 1596, 1494, 1397, 1247, 1185, 1054 cm^{-1}.

UV-vis spectra absorption peak: 273, 230 nm.



6t

Prepared according General Procedure D and E. White solid. m.p. 54.3 – 57.6 ℃.

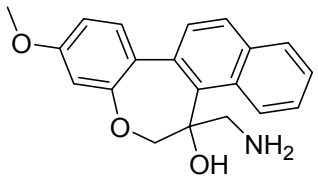
^{1}H NMR (400 MHz, DMSO) δ = 7.38 (s, 1H), 7.35 (s, 1H), 7.09 (d, *J* = 5.4 Hz, 2H), 7.02 (s, 1H), 4.46 (d, *J* = 11.3 Hz, 1H), 4.19 (d, *J* = 11.3 Hz, 1H), 3.84 (s, 6H), 2.32 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 159.0 (d, *J* = 240 Hz), 151.2, 148.1, 147.9, 136.9 (d, *J* = 10 Hz), 135.1, 125.6, 122.4 (d, *J* = 10 Hz), 114.8 (d, *J* = 20 Hz), 114.5 (d, *J* = 30 Hz), 113.0, 110.2, 83.1, 75.4, 55.7, 55.5, 50.4.

HRMS (EI) calcd for $C_{17}H_{18}FNO_4$ $[M+H]^+$: 320.1298. Found: 320.1269. Anal.calcd for C17H18FNO2: C, 63.94; H, 5.68; F, 5.95; N, 4.39. Found: C, 63.89; H, 5.69; F, 5.93; N, 4.41.

FT-IR (KBr disc): υ= 3773, 3367, 2954, 1581, 1484, 1265, 1142, 1027 cm^{-1}.

UV-vis spectra absorption peak: 297, 268, 234 nm.



6u

Prepared according General Procedure D and E. White solid. m.p. 164.3 – 166.3 ℃.

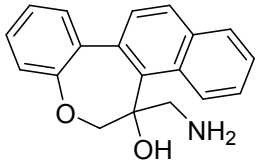
^{1}H NMR (400 MHz, $CDCl_3$) δ = 9.20 (d, *J* = 8.7 Hz, 1H), 7.79 (d, *J* = 8.5 Hz, 1H), 7.62 (d, *J* = 8.7 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.49 – 7.39 (m, 1H), 6.75 (dd, *J* = 8.8, 2.5 Hz, 1H), 6.62 (d, *J* = 2.5 Hz, 1H), 4.42 (dd, *J* = 33.7, 11.9 Hz, 1H), 3.84 (s, 2H), 3.22 (dd, *J* = 44.7, 13.4 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 160.2, 158.5, 136.6, 133.4, 133.0, 132.5, 130.2, 128.7, 128.5, 128.3, 128.0, 125.4, 125.2, 123.6, 110.2, 104.3, 80.4, 77.7, 55.4, 47.3.

HRMS (EI) calcd for $C_{20}H_{19}NO_3$ $[M+H]^+$:322.1443. Found: 322.1459. Anal.calcd for $C_{20}H_{19}NO_3$: C, 74.75; H, 5.96; N, 4.36. Found: C, 74.72; H, 5.89; N, 4.46.

FT-IR (KBr disc): υ= 3710, 3350, 2725, 1626, 1502, 1326, 1195, 1159, 1036 cm^{-1}.

UV-vis spectra absorption peak: 306, 269, 231 nm.



6v

Prepared according General Procedure D and E. White solid. m.p. 169.1 – 170.0 ℃.

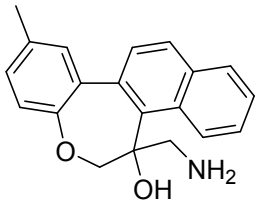
^{1}H NMR (400 MHz, DMSO) δ = 9.35 – 9.28 (m, 1H), 7.93 – 7.86 (m, 2H), 7.71 – 7.63 (m, 2H), 7.50 – 7.43 (m, 2H), 7.34 – 7.29 (m, 1H), 7.22 (td, *J* = 7.6, 1.4 Hz, 1H), 7.07 (dd, *J* = 7.9, 1.3 Hz, 1H), 5.95 (s, 1H), 4.51 (d, *J* = 11.8 Hz, 1H), 4.15 (d, *J* = 11.8 Hz, 1H), 3.08 (d, *J* = 13.6 Hz, 1H), 2.88 (d, *J* = 13.6 Hz, 1H), 1.54 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 158.6, 139.4, 133.8, 132.9, 132.7, 132.5, 131.8, 129.5, 129.4, 129.2, 128.8, 128.6, 125.9, 125.3, 124.0, 119.8, 80.3, 78.6, 48.9.

HRMS (EI) calcd for $C_{19}H_{17}NO_2$ $[M+H]^+$:292.1337. Found: 292.1398. Anal.calcd for $C_{19}H_{17}NO_2$: C, 78.33; H, 5.88; N, 4.81. Found: C, 78.32; H, 5.85; N, 4.85.

FT-IR (KBr disc): υ= 3777, 3377, 2752, 1599, 1432, 1282, 1062 cm^{-1}.

UV-vis spectra absorption peak: 296, 260 nm.



6w

Prepared according General Procedure D and E. White solid. m.p. 186.5 – 187.9 ℃.

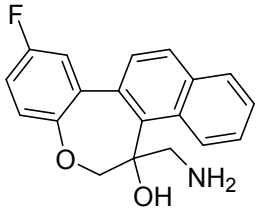
^{1}H NMR (400 MHz, DMSO) δ = 9.39 – 9.29 (m, 1H), 7.93 – 7.84 (m, 2H), 7.65 (d, *J* = 8.8 Hz, 1H), 7.53 – 7.42 (m, 3H), 7.11 (dd, *J* = 8.0, 1.4 Hz, 1H), 6.96 (d, *J* = 8.1 Hz, 1H), 5.94 (s, 1H), 4.47 (d, *J* = 11.8 Hz, 1H), 4.14 (d, *J* = 11.7 Hz, 1H), 3.04 (d, *J* = 13.5 Hz, 1H), 2.85 (d, *J* = 13.5 Hz, 1H), 2.36 (s, 3H), 1.53 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 156.4, 139.2, 133.9, 133.0, 132.9, 132.9, 132.6, 131.9, 129.8, 129.5, 129.4, 128.8, 128.6, 125.8, 125.3, 119.6, 80.6, 78.7, 49.1, 21.0.

HRMS (EI) calcd for $C_{20}H_{19}NO_2$ $[M+H]^+$:306.1494. Found: 306.1487. Anal.calcd for $C_{20}H_{19}NO_2$: C, 78.66; H, 6.27; N, 4.59. Found: C, 78.64; H, 6.36; N, 4.52.

FT-IR (KBr disc): υ= 3722, 3359, 2737, 1606, 1498, 1284, 1124, 1053 cm^{-1}.

UV-vis spectra absorption peak: 298, 261, 229 nm.



6x

Prepared according General Procedure D and E. White solid. m.p. 184.2 – 185.7 ℃.

^{1}H NMR (400 MHz, DMSO) δ = 9.39 – 9.34 (m, 1H), 7.95 – 7.87 (m, 2H), 7.65 (d, *J* = 8.8 Hz, 1H), 7.56 – 7.45 (m, 3H), 7.13 (ddd, *J* = 14.2, 8.3, 4.2 Hz, 2H), 4.51 (d, *J* =

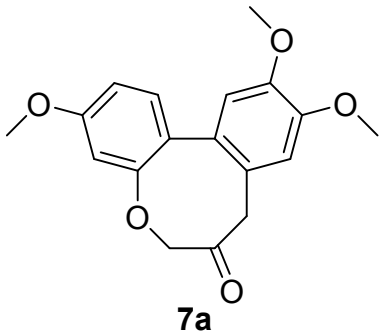
11.8 Hz, 1H), 4.16 (d, *J* = 11.8 Hz, 1H), 3.04 (d, *J* = 13.5 Hz, 1H), 2.86 (d, *J* = 13.5 Hz, 1H), 1.67 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 160.0, 157.7, 154.9, 139.6, 134.3 (d, *J* = 10 Hz), 134.1, 133.0, 131.7, 129.6, 129.2 (d, *J* = 10 Hz), 128.7, 126.2, 125.5, 121.4 (d, *J* = 10 Hz), 118.0 (d, *J* = 20 Hz), 117.9, 115.7 (d, *J* = 20 Hz), 81.0, 78.7, 49.4.

HRMS (EI) calcd for $C_{19}H_{16}FNO_2$ $[M+H]^+$:310.1243. Found: 310.1251. Anal.calcd fo r $C_{19}H_{16}FNO_2$: C, 73.77; H, 5.21; F, 6.14; N, 4.53. Found: C, 73.80; H, 5.19; F, 6.16; N, 4.50.

FT-IR (KBr disc): υ= 3752, 3298, 2716, 1512, 1168, 1054 cm^{-1}.

UV-vis spectra absorption peak: 295, 259, 227 nm.



7a

Prepared according General Procedure F. White solid. m.p. 108.2 – 111.2 ℃.

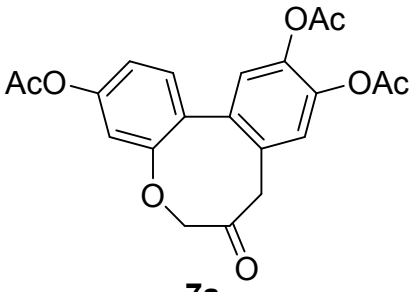
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.29 (d, *J* = 8.4 Hz, 1H), 6.88 – 6.83 (m, 3H), 6.78 (d, *J* = 2.5 Hz, 1H), 4.55 (s, 2H), 3.90 (s, 3H), 3.90 (s, 3H), 3.87 (s, 3H), 3.57 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.4, 160.9, 157.7, 148.5, 148.3, 130.7, 130.0, 126.9, 124.2, 112.8, 112.6, 111.1, 106.6, 77.9, 56.1, 56.1, 55.6, 49.0.

HRMS (EI) calcd for $C_{18}H_{18}O_5$ $[M+H]^+$: 315.1232. Found: 315.1247. Anal.calcd for $C_{18}H_{18}O_5$: C, 68.78; H, 5.77. Found: C, 68.69; H, 5.76.

FT-IR (KBr disc): υ= 2964, 1716, 1611, 1505, 1154, 1034 cm^{-1}.

UV-vis spectra absorption peak: 267 nm.



7a$_1$

White solid. m.p. 90.4 – 92.7 ℃.

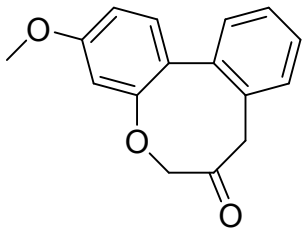
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.38 (d, *J* = 8.2 Hz, 1H), 7.19 (d, *J* = 3.2 Hz, 2H), 7.07 – 7.01 (m, 2H), 4.56 (s, 2H), 3.59 (s, 2H), 2.33 (s, 3H), 2.30 (d, *J* = 4.3 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 203.7, 169.2, 168.3, 168.2, 157.3, 152.1, 141.7, 141.5, 136.7, 130.8, 130.0, 124.8, 124.6, 124.4, 118.9, 114.9, 78.1, 49.1, 21.3, 20.8, 20.8.

HRMS (EI) calcd for $C_{21}H_{18}O_8$ $[M+H]^+$: 399.1080. Found: 399.1088. Anal.calcd for $C_{21}H_{18}O_8$: C, 63.32; H, 4.55. Found: C, 63.45; H, 4.42.

FT-IR (KBr disc): υ= 2875, 1765, 1706, 1483, 1200, 1097 cm^{-1}.

UV-vis spectra absorption peak: 239 nm.



7b

Prepared according General Procedure F. White solid. m.p. 89.7 – 92.3 ℃.

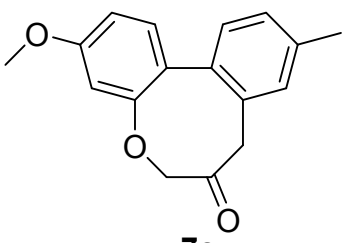
^{1}H NMR (400 MHz, DMSO) δ = 7.40 – 7.34 (m, 1H), 7.34 – 7.27 (m, 4H), 6.98 (d, *J* = 2.4 Hz, 1H), 6.91 (dd, *J* = 8.4, 2.5 Hz, 1H), 4.60 (s, 2H), 3.83 (s, 3H), 3.53 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.7, 160.6, 157.4, 138.4, 132.6, 129.5, 129.4, 129.1, 127.6, 127.4, 126.3, 111.2, 106.9, 77.6, 55.5, 48.9.

HRMS (EI) calcd for $C_{16}H_{14}O_3$ $[M+H]^+$: 258.1021. Found: 258.1006. Anal.calcd for $C_{16}H_{14}O_3$: C, 75.58; H, 5.55. Found: C, 75.49; H, 5.64.

FT-IR (KBr disc): υ= 2930, 1717, 1476, 1285, 1162, 1045 cm^{-1}.

UV-vis spectra absorption peak: 256 nm.



7c

Prepared according General Procedure F. White solid. m.p. 88.4 – 90.2 ℃.

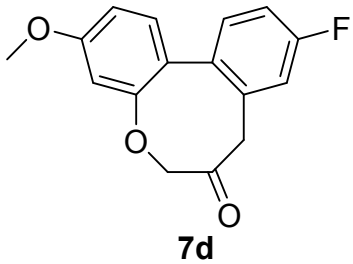
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.32 – 7.27 (m, 1H), 7.26 – 7.21 (m, 1H), 7.20 – 7.08 (m, 2H), 6.84 (dd, *J* = 8.4, 2.5 Hz, 1H), 6.77 (d, *J* = 2.4 Hz, 1H), 4.66 – 4.43 (m, 2H), 3.86 (s, 3H), 3.67 (d, *J* = 8.7 Hz, 2H), 2.40 (d, *J* = 15.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.2, 161.2, 157.8, 139.3, 137.6, 130.7, 130.0, 129.8, 128.0, 127.5, 127.2, 111.0, 106.9, 78.2, 55.7, 46.4, 20.4.

HRMS (EI) calcd for $C_{17}H_{16}O_3$ $[M+H]^+$: 269.1177. Found: 269.1198. Anal.calcd for $C_{17}H_{16}O_3$: C, 76.10; H, 6.01. Found: C, 76.05; H, 6.06.

FT-IR (KBr disc): υ= 2895, 1716, 1484, 1178, 1034 cm^{-1}.

UV-vis spectra absorption peak: 249, 279 nm.



7d

Prepared according General Procedure F. White solid. m.p. 116.9 – 119.0 ℃.

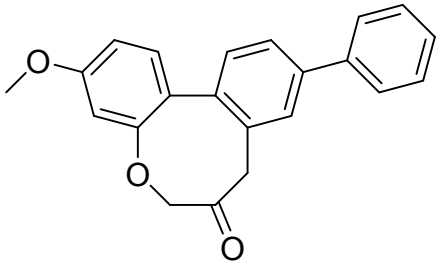
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.30 (d, *J* = 5.2 Hz, 2H), 7.09 (d, *J* = 8.8 Hz, 2H), 6.87 (dd, *J* = 8.5, 2.5 Hz, 1H), 6.80 (d, *J* = 2.5 Hz, 1H), 4.58 (s, 2H), 3.89 (s, 3H), 3.62 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.3, 162.4 (d, *J* = 200 Hz), 161.0, 157.8, 134.7, 134.4 (d, *J* = 10 Hz), 130.9 (d, *J* = 10 Hz), 130.1, 126.2 , 116.7 (d, *J* = 20 Hz), 114.7 (d, *J* = 20 Hz), 111.3, 106.8, 78.1, 55.7, 49.7.

HRMS (EI) calcd for $C_{16}H_{13}FO_3$ $[M+H]^+$: 273.0927. Found: 276.0941. Anal.calcd for $C_{16}H_{13}FO_3$: C, 70.58; H, 4.81. Found: C, 70.63; H, 4.86.

FT-IR (KBr disc): υ= 2913, 1752, 1472, 1251, 1194, 1036 cm^{-1}.

UV-vis spectra absorption peak: 276 nm.



7e

Prepared according General Procedure F. Light yellow solid. m.p. 155.0 – 157.7 ℃.

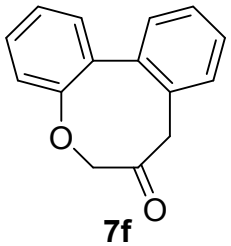
^{1}H NMR (400 MHz, DMSO) δ = 7.70 (d, *J* = 7.3 Hz, 2H), 7.66 (dd, *J* = 7.9, 1.8 Hz, 1H), 7.60 (d, *J* = 1.6 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.40 (dd, *J* = 7.6, 2.9 Hz, 2H), 7.36 (d, *J* = 8.4 Hz, 1H), 7.02 (d, *J* = 2.4 Hz, 1H), 6.94 (dd, *J* = 8.4, 2.5 Hz, 1H), 4.64 (s, 2H), 3.84 (s, 3H), 3.62 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.7, 160.7, 157.5, 139.6, 139.2, 137.6, 133.3, 129.7, 129.6, 129.0, 127.8, 127.6, 126.7, 125.9, 125.8, 111.2, 106.9, 77.6, 55.5, 49.0.

HRMS (EI) calcd for $C_{22}H_{18}O_3$ $[M+H]^+$: 331.1334. Found: 331.1312. Anal.calcd for $C_{22}H_{18}O_3$: C, 79.98; H, 5.49. Found: C, 79.79; H, 5.68.

FT-IR (KBr disc): υ= 2928, 1705, 1476, 1309, 1168, 1027 cm^{-1}.

UV-vis spectra absorption peak: 277, 247 nm.



7f

Prepared according General Procedure F. White solid. m.p. 80.8 – 83.6 ℃.

^{1}H NMR (400 MHz, DMSO) δ = 7.52 – 7.48 (m, 1H), 7.41 – 7.32 (m, 7H), 4.60 (s, 2H), 3.53 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.9, 157.0, 138.9, 134.4, 133.0, 130.6, 129.9, 129.5, 129.5, 128.2, 128.2, 125.7, 121.8, 78.3, 49.3.

HRMS (EI) calcd for $C_{15}H_{12}O_2$ $[M+H]^+$: 225.0915. Found: 255.0324. Anal.calcd for $C_{15}H_{12}O_2$: C, 80.34; H, 5.39. Found: C, 80.45; H, 5.28.

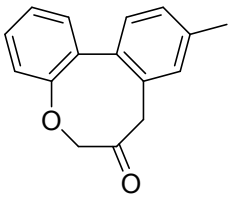
FT-IR (KBr disc): υ= 2884, 1714, 1484, 1274, 1195, 1054 cm^{-1}.

UV-vis spectra absorption peak: 310 nm.

HRMS (EI) calcd for $C_{16}H_{14}O_2$ $[M+H]^+$:239.1072. Found: 239.1085. Anal.calcd for $C_{16}H_{14}O_2$: C, 80.65; H, 5.92. Found: C, 80.73; H, 5.84.

FT-IR (KBr disc): υ= 2912, 1710, 1479, 1262, 1200, 1021 cm^{-1}.

UV-vis spectra absorption peak: 299 nm.



7g

Prepared according General Procedure F. Yellow solid. m.p. 84.2 – 85.7 ℃.

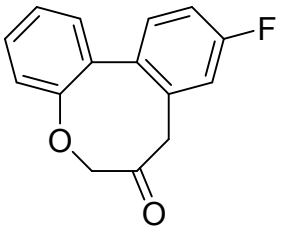
^{1}H NMR (400 MHz, DMSO) δ = 7.47 (ddd, *J* = 8.9, 7.2, 2.0 Hz, 1H), 7.33 (dtd, *J* = 18.2, 7.5, 1.6 Hz, 3H), 7.24 – 7.18 (m, 2H), 7.14 (d, *J* = 1.6 Hz, 1H), 4.59 (s, 2H), 3.48 (s, 2H), 2.33 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 205.0, 157.1, 137.5, 136.0, 134.4, 132.7, 130.5, 130.4, 129.5, 129.4, 128.7, 125.6, 121.8, 78.3, 49.2, 21.1.

HRMS (EI) calcd for $C_{16}H_{14}O_2$ $[M+H]^+$: 239.1072. Found: 239.1063. Anal.calcd for $C_{16}H_{14}O_2$: C, 80.65; H, 5.92. Found: C, 80.59; H, 5.97.

FT-IR (KBr disc): υ= 2959, 1723, 1502, 1290, 1211, 1042 cm^{-1}.

UV-vis spectra absorption peak: 295 nm.



7h

Prepared according General Procedure F. White solid. m.p. 97.9 – 99.2 ℃.

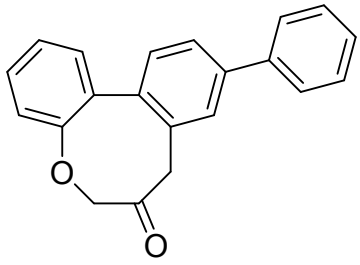
^{1}H NMR (400 MHz, DMSO) δ = 7.53 (td, *J* = 7.7, 1.8 Hz, 1H), 7.45 – 7.32 (m, 4H), 7.24 – 7.14 (m, 2H), 4.62 (s, 2H), 3.49 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 204.7, 161.9 (d , *J* = 240 Hz), 156.8, 141.1 (d , *J* = 10 Hz), 133.4, 131.7 (d , *J* = 20 Hz), 131.1, 129.5, 129.3, 125.7, 121.9, 116.3 (d , *J* = 20 Hz), 114.7 (d , *J* = 20 Hz), 78.2, 48.4.

HRMS (EI) calcd for $C_{15}H_{11}FO_2$ $[M+H]^+$: 243.0821. Found: 243.0846. Anal.calcd for $C_{15}H_{11}FO_2$: C, 74.37; H, 4.58; F, 7.84. Found: C, 74.29; H, 4.62; F, 7.88.

FT-IR (KBr disc): υ= 2876, 1731, 1492, 1435, 1267, 1041 cm^{-1}.

UV-vis spectra absorption peak: 261 nm.



7i

Prepared according General Procedure F. White solid. m.p. 124.6 – 128.4 ℃.

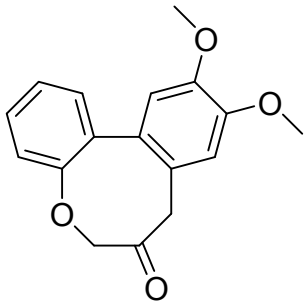
^{1}H NMR (400 MHz, DMSO) δ = 7.75 – 7.66 (m, 3H), 7.62 (d, *J* = 1.9 Hz, 1H), 7.55 – 7.42 (m, 5H), 7.42 – 7.33 (m, 3H), 4.64 (s, 2H), 3.62 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 205.0, 157.1, 140.1, 139.9, 138.1, 134.1, 133.7, 130.7, 130.2, 129.5, 129.5, 128.3, 128.1, 127.2, 126.4, 125.7, 121.9, 78.3, 49.4.

HRMS (EI) calcd for $C_{21}H_{16}O_2$ $[M+H]^+$: 301.1222. Found: 301.1241. Anal.calcd for $C_{21}H_{16}O_2$: C, 83.98; H, 5.37. Found: C, 83.86; H, 5.49.

FT-IR (KBr disc): υ= 2894, 1721, 1453, 1229, 1067 cm^{-1}.

UV-vis spectra absorption peak: 263 nm.



7j

Prepared according General Procedure F. White solid. m.p. 140.1 – 141.9 ℃.

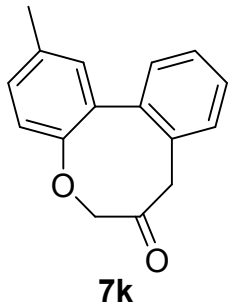
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.45 – 7.37 (m, 1H), 7.29 (td, *J* = 7.5, 1.1 Hz, 0H), 7.23 (d, *J* = 8.0 Hz, 0H), 6.88 (s, 0H), 6.87 (s, 0H), 4.56 (s, 2H), 3.91 (s, 3H), 3.90 (s, 3H), 3.56 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.3, 156.9, 148.6, 148.6, 134.6, 130.8, 129.9, 129.5, 125.3, 124.2, 121.1, 112.8, 112.5, 78.2, 56.1, 56.1, 49.1.

HRMS (EI) calcd for $C_{17}H_{16}O_4$ $[M+H]^+$: 285.1127. Found: 285.1134. Anal.calcd for $C_{17}H_{16}O_4$: C, 71.82; H, 5.67. Found: C, 71.69; H, 5.80.

FT-IR (KBr disc): υ= 2923, 1719, 1514, 1266, 1216, 1025 cm^{-1}.

UV-vis spectra absorption peak: 266 nm.



7k

Prepared according General Procedure F. White solid. m.p. 80.2 – 81.5 ℃.

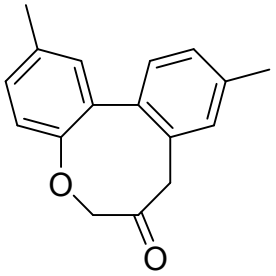
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (dt, *J* = 4.3, 1.8 Hz, 4H), 7.22 (d, *J* = 1.7 Hz, 1H), 7.18 (d, *J* = 2.0 Hz, 1H), 7.11 (d, *J* = 8.2 Hz, 1H), 4.53 (s, 2H), 3.62 (s, 2H), 2.41 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.3, 154.8, 139.1, 135.0, 134.5, 132.3, 130.7, 130.1, 129.7, 129.4, 128.0, 120.7, 78.4, 49.8, 21.0.

HRMS (EI) calcd for $C_{16}H_{14}O_2$ $[M+H]^+$: 239.1072. Found: 239.1059. Anal.calcd for $C_{16}H_{14}O_2$: C, 80.65; H, 5.92. Found: C, 80.59; H, 5.98.

FT-IR (KBr disc): υ= 2963, 1715, 1496, 1280, 1205, 1038 cm^{-1}.

UV-vis spectra absorption peak: 310 nm.



7l

Prepared according General Procedure F. White solid. m.p. 75.8 – 76.5 ℃.

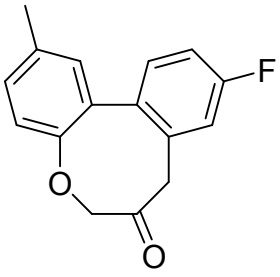
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25 – 7.15 (m, 5H), 7.10 (d, *J* = 8.1 Hz, 1H), 4.52 (s, 2H), 3.59 (s, 2H), 2.40 (s, 3H), 2.37 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.6, 154.8, 137.8, 136.0, 134.9, 134.3, 131.9, 130.5, 130.5, 130.0, 129.2, 128.7, 120.6, 78.4, 49.6, 21.2, 21.1.

HRMS (EI) calcd for $C_{17}H_{16}O_2$ $[M+H]^+$: 253.1228. Found: 253.1241. Anal.calcd for $C_{17}H_{16}O_2$: C, 80.93; H, 6.39. Found: C, 80.79; H, 6.53.

FT-IR (KBr disc): υ= 2894, 1707, 1495, 1262, 1209, 1057 cm^{-1}.

UV-vis spectra absorption peak: 283 nm.



7m

Prepared according General Procedure F. White solid. m.p. 143.0 – 144.2 ℃.

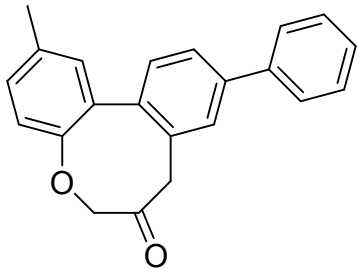
^{1}H NMR (400 MHz, DMSO) δ = 7.39 – 7.30 (m, 2H), 7.27 (d, *J* = 8.2 Hz, 1H), 7.25 – 7.13 (m, 3H), 4.57 (s, 2H), 3.49 (s, 2H), 2.36 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 204.9, 162.9 (d , *J* = 240 Hz), 154.7, 141.2 (d , *J* = 10 Hz), 134.8, 133.1 (d , *J* = 10 Hz), 131.7 (d , *J* = 10 Hz), 131.5, 129.8, 129.2, 121.6, 116.2 (d , *J* = 20 Hz), 114.6 (d , *J* = 20 Hz), 78.2, 48.4, 20.9.

HRMS (EI) calcd for $C_{16}H_{13}FO_2$ $[M+H]^+$: 257.0978. Found: 257.0953. Anal.calcd for $C_{16}H_{13}FO_2$: C, 74.99; H, 5.11; F, 7.41. Found: C, 74.91; H, 5.15; F, 7.45.

FT-IR (KBr disc): υ= 2895, 1725, 1497, 1280, 1214, 1030 cm^{-1}.

UV-vis spectra absorption peak: 251 nm.



7n

Prepared according General Procedure F. Light yellow solid. m.p. 152.7 – 154.0 ℃.

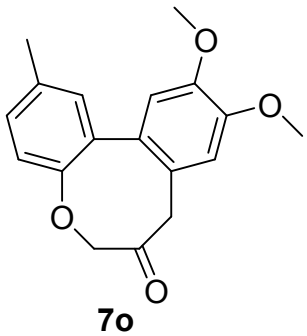
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.63 – 7.59 (m, 3H), 7.57 (d, *J* = 1.7 Hz, 1H), 7.44 (td, *J* = 7.5, 3.3 Hz, 3H), 7.38 – 7.33 (m, 1H), 7.25 – 7.21 (m, 2H), 7.13 (d, *J* = 8.0 Hz, 1H), 4.56 (s, 2H), 3.68 (s, 2H), 2.41 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.3, 154.8, 141.0, 140.5, 138.0, 135.1, 134.1, 132.7, 130.8, 130.1, 129.8, 129.0, 128.6, 127.7, 127.3, 126.7, 120.7, 78.4, 49.9, 21.1.

HRMS (EI) calcd for $C_{22}H_{18}O_2$ $[M+H]^+$: 315.1385. Found: 315.1379. Anal.calcd for $C_{22}H_{18}O_2$: C, 84.05; H, 5.77. Found: C, 84.21; H, 5.61.

FT-IR (KBr disc): υ= 2920, 1711, 1479, 1417, 1206, 1056 cm^{-1}.

UV-vis spectra absorption peak: 246, 268 nm.



7o

Prepared according General Procedure F. White solid. m.p. 119.3 – 121.0 ℃.

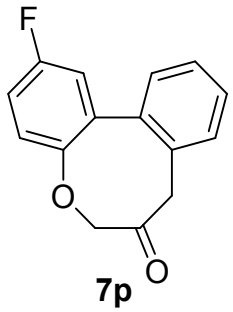
^{1}H NMR (400 MHz, DMSO) δ = 7.25 – 7.19 (m, 3H), 6.91 (s, 1H), 6.90 (s, 1H), 4.52 (s, 2H), 3.79 (d, *J* = 1.0 Hz, 6H), 3.44 (s, 2H), 2.36 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ = 205.5, 154.9, 148.6, 148.5, 134.5, 134.2, 131.1, 130.6, 130.0, 124.9, 121.5, 113.8, 113.5, 78.2, 56.2, 48.7, 20.9.

HRMS (EI) calcd for $C_{18}H_{18}O_2$ $[M+H]^+$: 299.1283. Found: 299.1297. Anal.calcd for $C_{18}H_{18}O_2$: C, 72.47; H, 6.08. Found: C, 72.44; H, 6.11.

FT-IR (KBr disc): υ= 2919, 1714, 1520, 1203, 1142, 1045 cm^{-1}.

UV-vis spectra absorption peak: 279 nm.



7p

Prepared according General Procedure F. White solid. m.p. 114.0 – 115.7 ℃.

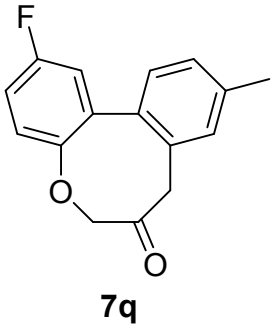
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.47 – 7.29 (m, 4H), 7.19 (dd, *J* = 8.5, 4.8 Hz, 1H), 7.16 – 7.05 (m, 2H), 4.53 (s, 2H), 3.63 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.5, 159.8 (d, *J* = 240 Hz), 153.0, 137.9, 136.4 (d, *J* = 10 Hz), 132.1, 129.9, 129.3, 128.6, 128.2, 122.4 (d, *J* = 10 Hz), 116.6 (d, *J* = 20 Hz), 116.1 (d, *J* = 20 Hz), 78.6, 49.7.

HRMS (EI) calcd for $C_{15}H_{11}FO_2$ $[M+H]^+$: 243.0821. Found: 243.0839. Anal.calcd for $C_{15}H_{11}FO_2$: C, 74.37; H, 4.58; F, 7.84. Found: C, 74.51; H, 4.51; F, 7.77.

FT-IR (KBr disc): υ= 2891, 1729, 1487, 1426, 1267, 1036 cm^{-1}.

UV-vis spectra absorption peak: 276 nm.



7q

Prepared according General Procedure F. White solid. m.p. 95.8 – 97.4 ℃.

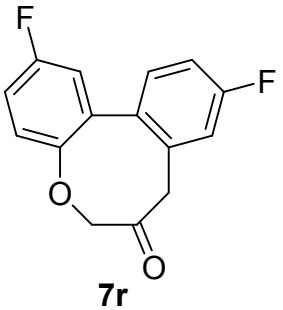
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.47 – 7.29 (m, 4H), 7.19 (dd, *J* = 8.5, 4.8 Hz, 1H), 7.16 – 7.05 (m, 2H), 4.53 (s, 2H), 3.63 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.9, 159.7 (d, *J* = 240 Hz), 153.0, 138.5, 136.3 (d, *J* = 10 Hz), 134.9, 131.7, 130.7, 129.1, 128.9, 122.4 (d, *J* = 10 Hz), 116.4 (d, *J* = 20 Hz), 116.2 (d, *J* = 20 Hz), 78.6, 49.6, 21.2.

HRMS (EI) calcd for $C_{16}H_{13}FO_2$ $[M+H]^+$: 257.0978. Found: 257.0951. Anal.calcd for $C_{16}H_{13}FO_2$: C, 74.99; H, 5.11; F, 7.41. Found: C, 74.92; H, 5.14; F, 7.45.

FT-IR (KBr disc): υ= 2894, 1725, 1486, 1180, 1033 cm^{-1}.

UV-vis spectra absorption peak: 247, 278 nm.



7r

Prepared according General Procedure F. White solid. m.p. 58.7 – 61.2 ℃.

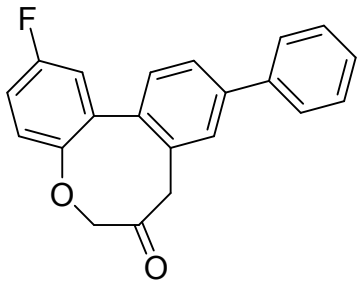
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (dd, *J* = 6.3, 4.9 Hz, 1H), 7.45 (dd, *J* = 15.0, 7.2 Hz, 1H), 7.41 – 7.30 (m, 1H), 7.24 – 7.19 (m, 1H), 7.18 – 7.11 (m, 1H), 7.10 – 7.01 (m, 1H), 4.55 (d, *J* = 14.4 Hz, 2H), 3.70 (s, 1H), 3.58 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.3 (d, *J* = 40 Hz), 153.0 (d, *J* = 20 Hz), 141.0 (d, *J* = 170 Hz), 132.6, 131.5 (d, *J* = 10 Hz), 129.4 (d, *J* = 70 Hz), 127.9 (d, *J* = 10 Hz), 127.3, 122.5 (dd, *J* = 10, 10 Hz), 117.2 (d, *J* = 24.2 Hz), 116.6 (d, *J* = 10 Hz), 116.1 (dd, *J* = 10, 10 Hz), 115.2 (d, *J* = 20 Hz), 78.5, 49.3 (d, *J* = 100 Hz).

HRMS (EI) calcd for $C_{15}H_{10}F_2O_2$ $[M+H]^+$: 261.0727. Found: 261.0711. Anal.calcd for $C_{15}H_{10}F_2O_2$: C, 69.23; H, 3.87; F, 14.60. Found: C, 69.12; H, 3.91; F, 14.67.

FT-IR (KBr disc): υ= 2894, 1719, 1617, 1465, 1196, 1043 cm^{-1}.

UV-vis spectra absorption peak: 251 nm.



7s

Prepared according General Procedure F. White solid. m.p. 126.7 – 128.1 ℃.

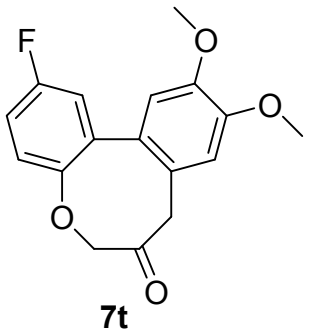
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.66 – 7.58 (m, 4H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.43 – 7.35 (m, 2H), 7.21 (dd, *J* = 9.7, 4.8 Hz, 1H), 7.14 (t, *J* = 7.3 Hz, 2H), 4.57 (s, 2H), 3.70 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.6, 159.8 (d, *J* = 250 Hz), 152.9, 141.5, 140.2, 136.7, 135.9, 132.5, 129.7, 129.0, 128.7, 127.8, 127.3, 126.8, 122.5 (d, *J* = 10 Hz), 116.7 (d, *J* = 20 Hz), 116.1 (d, *J* = 30 Hz), 78.5, 49.8.

HRMS (EI) calcd for $C_{21}H_{15}FO_2$ $[M+H]^+$:319.1134. Found: 319.1129. Anal.calcd for $C_{21}H_{15}FO_2$: C, 79.23; H, 4.75; F, 5.97. Found: C, 79.33; H, 4.63; F, 5.99.

FT-IR (KBr disc): υ= 2887, 1715, 1482, 1268, 1171, 1057 cm^{-1}.

UV-vis spectra absorption peak: 268 nm.



7t

Prepared according General Procedure F. White solid. m.p. 176.7 – 179.2 ℃.

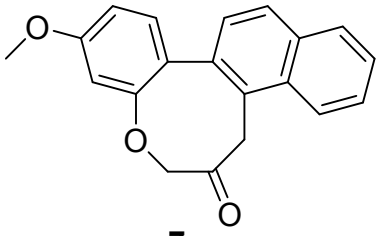
^{1}H NMR (400 MHz, DMSO) δ = 7.39 (dd, *J* = 8.0, 5.0 Hz, 1H), 7.28 (t, *J* = 8.4 Hz, 2H), 6.95 (s, 1H), 6.92 (s, 1H), 4.56 (s, 2H), 3.79 (s, 6H), 3.47 (s, 2H).

^{13}C NMR (100 MHz, DMSO) δ = 205.1, 159.2 (d, *J* = 240 Hz), 153.3, 148.9, 148.6, 136.2 (d, *J* = 10 Hz), 129.9, 124.9, 123.5, 116.5 (d, *J* = 20 Hz), 116.1 (d, *J* = 20 Hz), 113.9, 113.6, 78.4, 56.2, 48.7.

HRMS (EI) calcd for $C_{17}H_{15}FO_4$ $[M+H]^+$: 303.1032 Found: 303.1019. Anal.calcd for $C_{17}H_{15}FO_4$: C, 67.54; H, 5.00; F, 6.28. Found: C, 67.50; H, 5.15; F, 6.17.

FT-IR (KBr disc): υ= 2936, 1722, 1484, 1265, 1185, 1054 cm^{-1}.

UV-vis spectra absorption peak: 284 nm.



7u

Prepared according General Procedure F. White solid. m.p. 200.7 – 203.3 ℃.

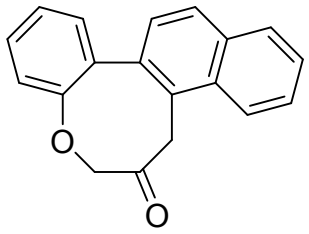
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.24 (d, *J* = 8.5 Hz, 1H), 7.87 (d, *J* = 8.3 Hz, 2H), 7.79 (s, 1H), 7.58 (dd, *J* = 11.3, 4.0 Hz, 1H), 7.49 (t, *J* = 7.7 Hz, 2H), 7.42 (d, *J* = 8.5 Hz, 1H), 6.90 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.82 (d, *J* = 2.4 Hz, 1H), 4.55 (d, *J* = 6.1 Hz, 2H), 4.25 (d, *J* = 13.0 Hz, 1H), 3.98 (d, *J* = 13.0 Hz, 1H), 3.88 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.2, 161.2, 158.0, 135.9, 133.0, 132.4, 129.9, 128.5, 128.0, 128.0, 127.8, 127.2, 127.0, 125.7, 124.5, 111.2, 106.8, 77.7, 55.6, 45.6.

HRMS (EI) calcd for $C_{20}H_{16}O_3$ $[M+H]^+$: 305.1177. Found: 305.1164. Anal.calcd for $C_{20}H_{16}O_3$: C, 78.93; H, 5.30. Found: C, 79.79; H, 5.44.

FT-IR (KBr disc): υ= 2928, 1714, 1608, 1494, 1318, 1230, 1159, 1027 cm^{-1}.

UV-vis spectra absorption peak: 263 nm.



7v

Prepared according General Procedure F. White solid. m.p. 100.5 – 102.7 ℃.

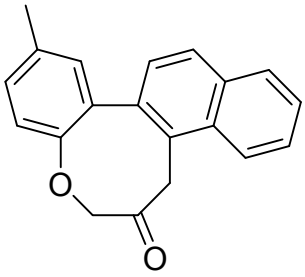
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.5 Hz, 1H), 7.90 (dd, *J* = 8.1, 3.4 Hz, 2H), 7.60 (dd, *J* = 11.3, 4.1 Hz, 1H), 7.54 – 7.50 (m, 3H), 7.48 (dd, *J* = 7.8, 1.6 Hz, 1H), 7.36 (dd, *J* = 10.8, 4.2 Hz, 1H), 7.29 (d, *J* = 8.0 Hz, 1H), 4.65 – 4.51 (m, 2H), 4.27 (d, *J* = 13.1 Hz, 1H), 3.97 (d, *J* = 13.1 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.3, 157.2, 136.1, 135.7, 133.2, 132.5, 130.4, 129.5, 128.7, 128.3, 128.0, 127.3, 127.1, 126.0, 125.6, 124.7, 121.3, 78.1, 45.8.

HRMS (EI) calcd for $C_{19}H_{14}O_2$ $[M+H]^+$: 275.1072. Found: 275.1061. Anal.calcd for $C_{19}H_{14}O_2$: C, 83.19; H, 5.14. Found: C, 83.09; H, 5.24.

FT-IR (KBr disc): υ= 2921, 1719, 1487, 1280, 1202, 1048 cm^{-1}.

UV-vis spectra absorption peak: 250, 281, 291 nm.



7w

Prepared according General Procedure F. White solid. m.p. 125.1 – 127.0 ℃.

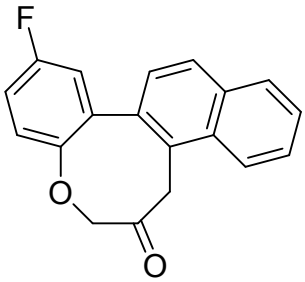
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.25 (d, *J* = 8.4 Hz, 1H), 7.89 (d, *J* = 8.1 Hz, 2H), 7.63 – 7.57 (m, 1H), 7.57 – 7.46 (m, 2H), 7.30 (d, *J* = 11.8 Hz, 2H), 7.17 (d, *J* = 8.1 Hz, 1H), 4.54 (d, *J* = 9.3 Hz, 2H), 4.25 (d, *J* = 13.1 Hz, 1H), 4.00 (s, 1H), 2.44 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 205.6, 155.0, 136.3, 135.3, 135.1, 133.2, 132.5, 130.8, 129.9, 128.7, 128.2, 127.9, 127.2, 127.1, 126.0, 124.7, 121.0, 78.1, 45.7, 21.1.

HRMS (EI) calcd for $C_{20}H_{16}O_2$ $[M+H]^+$: 289.1228. Found: 289.1246. Anal.calcd for $C_{20}H_{16}O_2$: C, 83.31; H, 5.59. Found: C, 83.53; H, 5.37.

FT-IR (KBr disc): υ= 2895, 1724, 1487, 1279, 1214, 1030 cm^{-1}.

UV-vis spectra absorption peak: 246, 268 nm.



7x

Prepared according General Procedure F. White solid. m.p. 165.6–167.7 ℃.

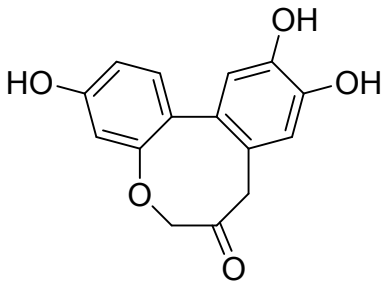
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.26 (d, *J* = 8.5 Hz, 1H), 7.94 – 7.85 (m, 2H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.53 (t, *J* = 7.3 Hz, 1H), 7.47 (d, *J* = 8.4 Hz, 1H), 7.25 – 7.19 (m, 2H), 7.16 (td, *J* = 8.4, 3.1 Hz, 1H), 4.53 (q, *J* = 16.7 Hz, 2H), 4.28 (d, *J* = 13.2 Hz, 1H), 3.95 (d, *J* = 13.2 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ = 204.8, 159.8 (d, *J* = 250.0 Hz), 153.2, 137.1, 135.1, 133.4, 132.4, 128.7, 128.5, 128.0, 127.4, 126.7, 127.3, 124.7, 122.7 (d, *J* = 10 Hz), 116.8 (d, *J* = 20 Hz), 116.0 (d, *J* = 20 Hz), 78.2, 45.7.

HRMS (EI) calcd for $C_{19}H_{13}FO_2$ $[M+H]^+$: 293.0978. Found: 293.0961. Anal.calcd for $C_{19}H_{13}FO_2$: C, 78.07; H, 4.48; F, 6.50. Found: C, 78.15; H, 4.52; F, 7.62.

FT-IR (KBr disc): υ= 2905, 1736, 1470, 1249, 1171, 1055 cm^{-1}.

UV-vis spectra absorption peak: 264 nm.



Protosappanin A

White solid. m.p. 253.7–254.9 ℃.

^{1}H NMR (400 MHz, DMSO) δ = 9.68 (s, 1H), 8.93 (s, 1H), 8.91 (s, 1H), 7.07 (d, *J* = 8.2 Hz, 1H), 6.68 (dd, *J* = 8.2, 2.3 Hz, 1H), 6.67 – 6.61 (m, 3H), 4.47 (s, 2H), 3.32 (s, 2H).

^{13}C NMR (101 MHz, DMSO) δ = 205.9, 158.7, 157.8, 145.0, 144.7, 130.0, 130.0, 125.5, 123.3, 117.1, 117.0, 112.7, 108.4, 78.0, 48.4.

HRMS (EI) calcd for $C_{15}H_{12}FO_5$ $[M+H]^+$: 273.0765. Found: 273.0749. Anal.calcd for $C_{19}H_{13}FO_2$: C, 66.17; H, 4.44. Found: C, 66.42; H, 4.19.

FT-IR (KBr disc): υ= 3306, 2928, 1705, 1599, 1502, 1450, 1318, 1256, 1151, 1062, 948, 860, 817 cm^{-1}.

UV-vis spectra absorption peak: 259, 283 nm.