$AgAsF_6/Sm(OTf)_3$ Promoted Reversal of Enantioselectivity for the Asymmetric Friedel-Crafts Alkylations of Indoles with β,γ-Unsaturated α-Ketoesters

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SUPPORTING INFORMATION

1. General

^{1}H NMR spectra were recorded on commercial instruments (400 MHz). Chemical shifts were reported in ppm from tetramethylsilane with the solvent resonance as the internal standard ($CDCl_3$, δ = 7.26). Spectra are reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz) and integration. ^{13}C NMR spectra were collected on commercial instruments (100 MHz) with complete proton decoupling. Chemical shifts are reported in ppm from the tetramethylsilane with the solvent resonance as internal standard ($CDCl_3$, δ = 77.0). The enantiomeric excesses were determined by HPLC analysis on chiral DAICEL CHIRALCEL AS-H, OD-H, AD, OJ and AS-H column. Optical rotations were measured on a commercial polarimeter and reported as follows: $[\alpha]^{T}_{D}$ (c = g/100 mL, solvent). Reagents obtained from commercial sources were used without further purification. CH_2Cl_2 were distilled over CaH_2 before use. The other solvents were distilled over metal sodium before use.

2. General procedure for the preparation of chiral ligands

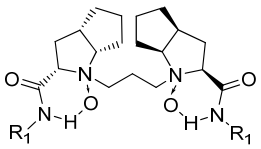
i) The *N,N'*-dioxdes were prepared according to the methods reported in the literature.[1-8]

3. Typical experimental procedures for the asymmetric Friedel-Crafts alkylation of indoles and *β,γ*-unsaturated *α*-ketoesters

Procedure A: The mixture of ligand **1d** (1.5 mg, 0.0025 mmol), $Sm(OTf)_3$ (1.5 mg, 0.0025 mmol) and *β,γ*-unsaturated *α*-ketoester **3a** (95.1 mg, 0.5 mmol) in CH_2Cl_2 (0.4 mL) was stirred at room temperature for 5 to 10 minutes under nitrogen atmosphere. Then the reaction mixture was cooled to -20 ^oC and indole **2a** (0.5 mmol, 58.6 mg in 0.2 mL CH_2Cl_2) was added under stirring. The reaction mixture was stirred at -20 ^oC for 15 minutes and directly purified by flash chromatography on silica gel to give (*R*)-**4a** in 96% yield with 98% ee.

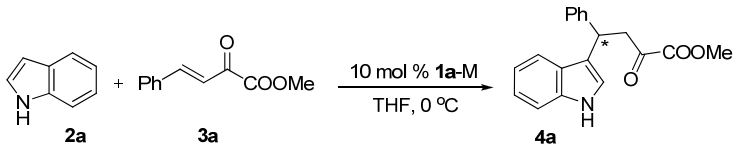
Procedure B: The mixture of ligand **1a** (17.8 mg, 0.025 mmol), AgAsF6 (7.5 mg, 0.025 mmol) and *β,γ*-unsaturated *α*-ketoester **3a** (47.6 mg, 0.25 mmol) in THF (1.9 mL) was stirred at room temperature for 5 to 10 minutes under nitrogen atmosphere. Then the reaction mixture was cooled to -20 ^oC and indole **2a** (0.25 mmol, 29.3 mg in 0.1 mL THF) was added under stirring. The reaction mixture was stirred at -20 ^oC for 68 hours and directly purified by flash chromatography on silica gel to give (*S*)-**4a** in 82% yield with 85% ee.

4. Some representative screening results for the Friedel-Crafts alkylation of indole 2a with *β,γ*-unsaturated *α*-ketoester 3a.



1a $R_1 = Ph_2CH$

Table 1: Catalytic enantioselective Friedel-Crafts alkylation of indole **2a** with *β,γ*-unsaturated *α*-ketoesters **3a** in the presence of **1a**-M.[a]



2a **3a** **4a**

Entry	M	Yield [%][b]	*ee* [%][c]
1	$Yb(OTf)_3$	87	7(*R*)
2	$Y(OTf)_3$	83	17(*R*)
3	$La(OTf)_3$	83	2
4	$InOTf)_3$	90	4(*R*)
5	$ScOTf)_3$	84	0
6	$CuOTf)_2$	11	11(*R*)
7	$ZnOTf)_2$	65	0

[a] Unless otherwise noted, reactions were carried out with **1a** (10 mol %), M (10 mol %)**, 2a** (0.25 mmol), and **3a** (0.25 mmol) in THF (0.3 mL) at 0 °C. [b] Isolated yield. [c] Determined by chiral HPLC analysis.

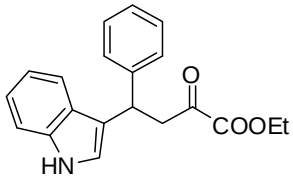
5. Experimental procedure for the scale-up Friedel-Crafts alkylations of indole 2a and *β,γ*-unsaturated *α*-ketoester 3a

i) Experimental procedure for the **mixture solution A:** The ligand **1d** (3.0 mg, 0.005 mmol), $Sm(OTf)_3$ (3.0 mg, 0.005 mmol) and *β,γ*-unsaturated *α*-ketoester **3a** (95.1 mg, 0.5 mmol) in CH_2Cl_2 (0.4 mL) was stirred at room temperature for 5 to 10 minutes under nitrogen atmosphere.

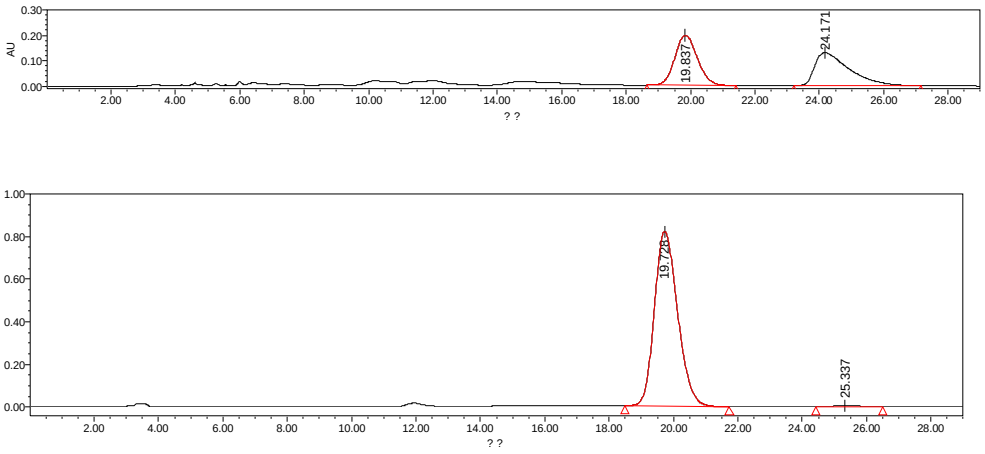
ii) To a solution of *β,γ*-unsaturated *α*-ketoester **3a** (4.71 g, 24.75 mmol) in CH_2Cl_2 (4 mL) was added the **mixture solution A** (0.2 mL) at room temperature. Then the reaction mixture was cooled to -20 °C and indole **2a** (25 mmol, 2.93 g in 3.8 mL CH_2Cl_2) was added under stirring. The reaction mixture was stirred at -20 °C for 43 hours and directly purified by flash chromatography on silica gel to give (*R*)-**4a** in 93% yield with 84% ee. After a simple single recrystallization, the enantiometric excess could be increased to 98% ee with 82% rescrystal yield (5.82 g).

6. Data for alkylation products

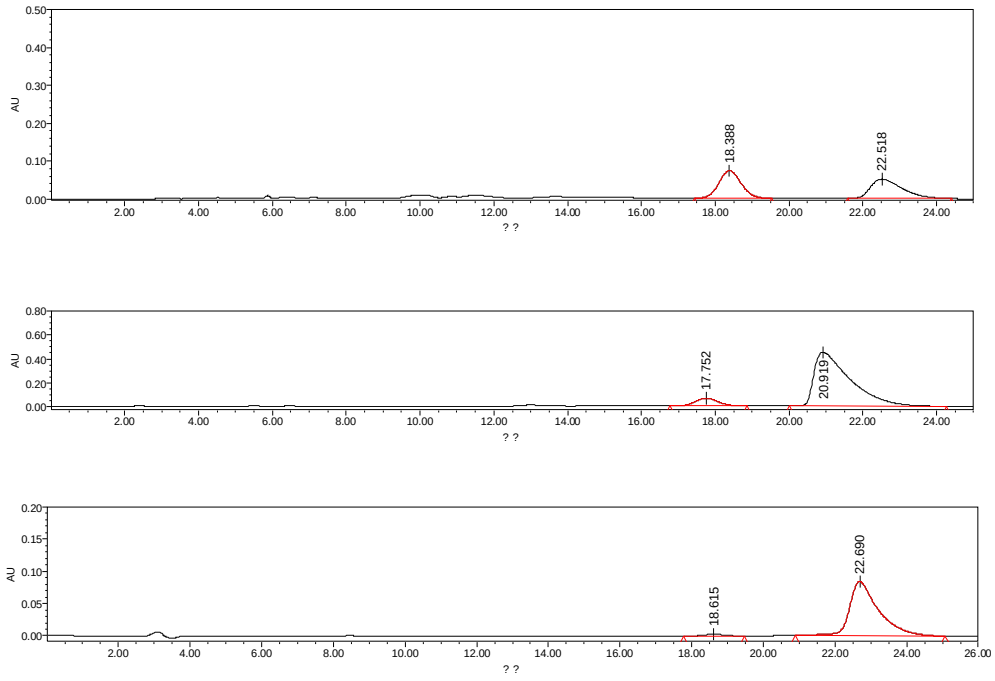
4-(1H-Indol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester[10]



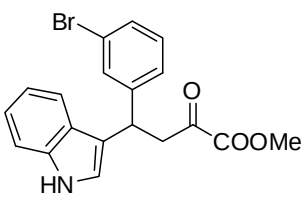
(*R*)-enantiomer (Table 3, entry 1): Prepared according to general **procedure A**. After 15 minutes, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 96% yield with 98% ee. $[\alpha]^{23}_{D}$ = - 24.0 (c = 0.680, $CHCl_3$); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 19.728 min, t_r (minor) = 25.337 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.40 (d, *J* = 8.0 Hz, 1H), 7.32-7.10 (m, 7H), 7.02-6.98 (m, 1H), 6.93 (d, *J* = 2.4 Hz, 1H), 4.90 (d, *J* = 7.6 Hz, 1H), 4.17 (dq, *J* = 7.6, 1.6 Hz, 2H), 3.66 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.57 (dd, *J* = 16.8, 7.6 Hz, 1H), 1.23 (t, *J* = 7.2 Hz, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.20, 159.93, 142.24, 135.52, 127.50, 126.74, 125.55, 125.35, 121.16, 120.61, 118.41, 118.29, 117.08, 110.20, 61.47, 44.61, 36.77, 12.84 ppm; ES-HRMS Calcd for $C_{20}H_{20}NO_3$ $[M + H]^+$ 322.1438, Found: 322.1439.



(*S*)-enantiomer (Table 2, entry 1): Prepared according to general **procedure B**. After 68 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 82% yield with 85% ee. After a simple recrystallization, the enantioselectivity could be increased to 95% ee. $[\alpha]^{23}_{D}$ = + 33.1 (c = 0.242, $CHCl_3$); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 17.752 min, t_r (major) = 20.919 min.

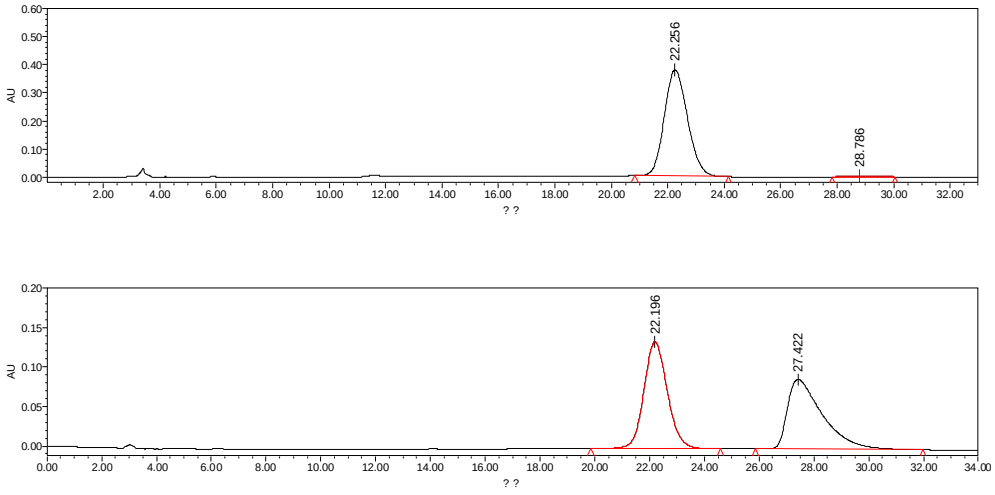


4-(1H-Indol-3-yl)-2-oxo-4-(3-bromophenyl)butyric acid methyl ester



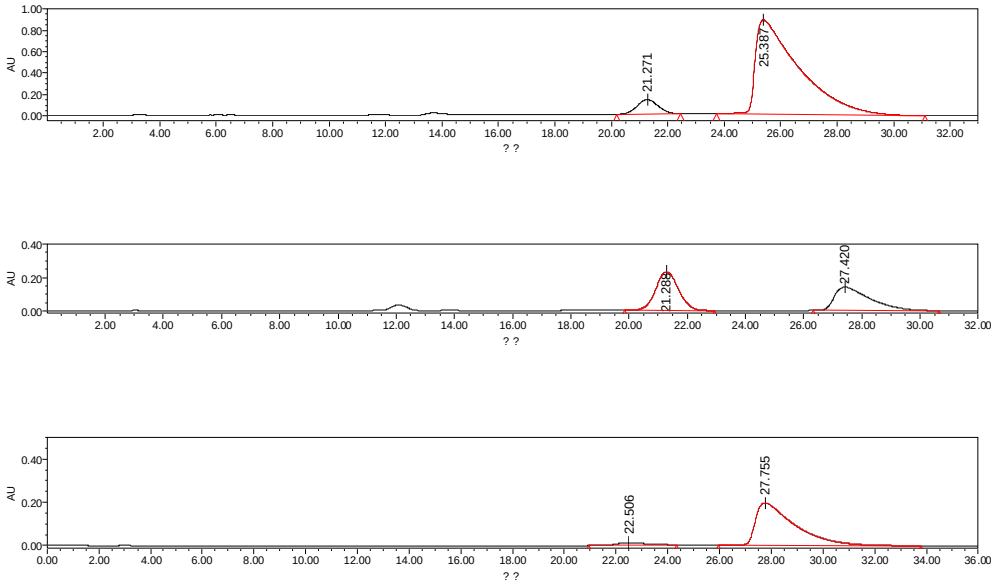
(-)-enantiomer (Table 3, entry 2): Prepared according to general **procedure A**. After 20 minutes, the crude material

was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 98% yield with 98% ee. M.p. 88-90 ^{o}C; $[\alpha]^{23}_{D}$ = - 26.3 (c = 0.320, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 22.256 min, tr (minor) = 28.786 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.46-7.26 (m, 5H), 7.19-7.02 (m, 4H), 4.88 (t, *J* = 7.2 Hz, 1H), 3.79 (s, 3H), 3.68 (dd, *J* = 17.2, 7.2 Hz, 1H), 3.56 (dd, *J* = 17.2, 7.6 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.10, 161.10, 145.68, 136.54, 130.80, 130.11, 129.80, 126.55, 126.21, 122.64, 122.50, 121.51, 119.72, 119.20, 117.58, 111.23, 53.03, 45.43, 37.30 ppm; ES-HRMS Calcd for $C_{19}H_{17}NBrNO_3$ $[M + H]^+$ 386.0386, Found: 386.0390.

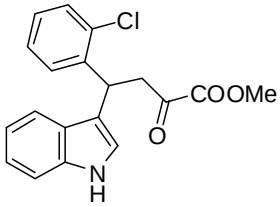


(+)-enantiomer (Table 2, entry 2): Prepared according to general **procedure B**. After 51 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 75% yield with 86% ee. After a simple recrystallization, the enantioselectivity could be increased to 92% ee. $[\alpha]^{23}_{D}$ = + 23.7 (c = 0.358, CH_2Cl_2); The ee was determined by

HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 21.271 min, t_r (major) = 25.387 min.

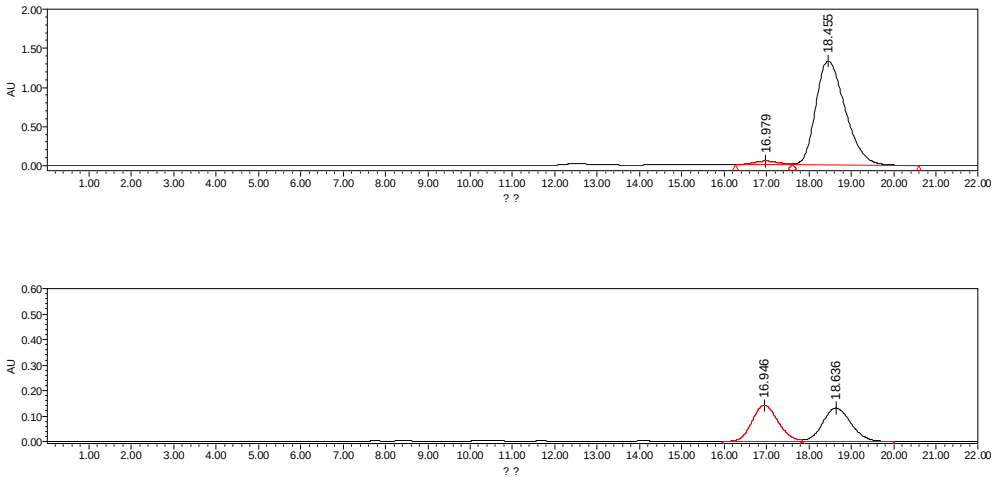


4-(1H-Indol-3-yl)-2-oxo-4-(2-chlorophenyl)butyric acid methyl ester

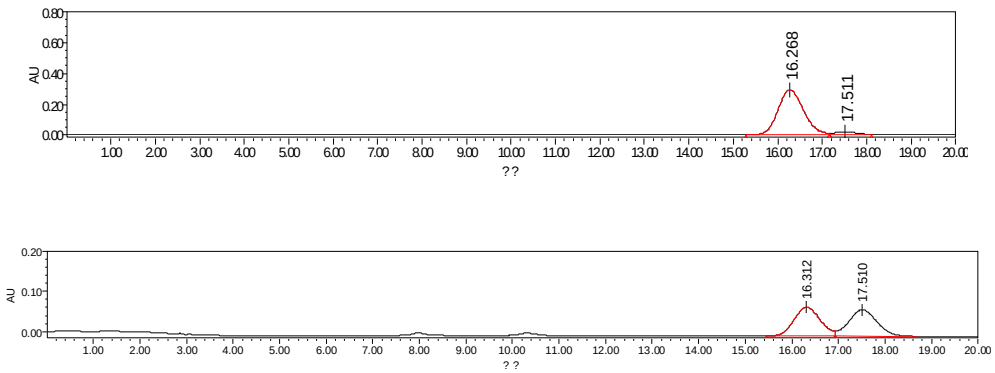


(-)-enantiomer (Table 3, entry 3): Prepared according to general **procedure A**. After 15 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 99% yield with 95% ee. M.p. 102-103 ^{o}C; $[\alpha]^{23}_{D}$ = - 95.9 (c = 0.296, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (minor) = 16.979 min, tr (major) = 18.455 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.07 (s, 1H), 7.42 (d, *J* = 8.0 Hz, 1H), 7.39-7.36 (m, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.20-7.08 (m, 5H), 7.05-7.01 (m, 2H), 5.45-5.41 (m, 1H), 3.79 (s, 3H), 3.72 (dd, *J* = 17.2, 8.8 Hz, 1H), 3.47 (dd, *J* = 17.2, 6.4 Hz, 1H) ppm. ^{13}C NMR (100

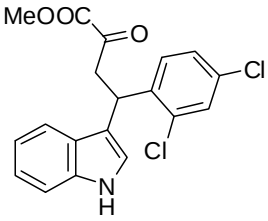
MHz, $CDCl_3$): δ = 192.20, 161.31, 140.49, 136.54, 133.52, 129.79, 129.04, 127.93, 127.08, 126.49, 122.44, 122.07, 119.67, 119.41, 116.94, 111.20, 53.01, 44.62, 34.24 ppm; ES-HRMS Calcd for $C_{19}H_{17}ClNO_3$ $[M + H]^+$ 342.0891, Found: 342.0906.



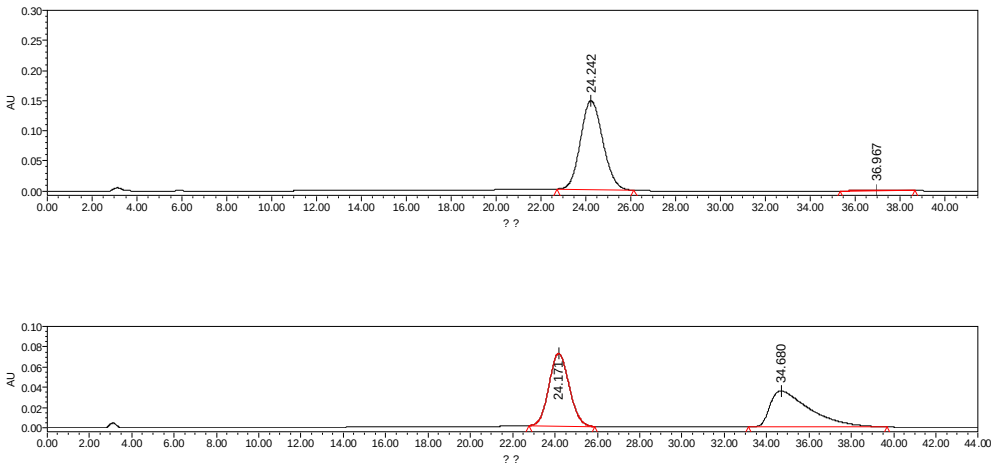
(+)-enantiomer (Table 2, entry 3): Prepared according to general **procedure B**. After 64 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 91% yield with 90% ee. $[\alpha]^{23}_D$ = + 87.0 (c = 0.208, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 16.268 min, t_r (minor) = 17.511 min.



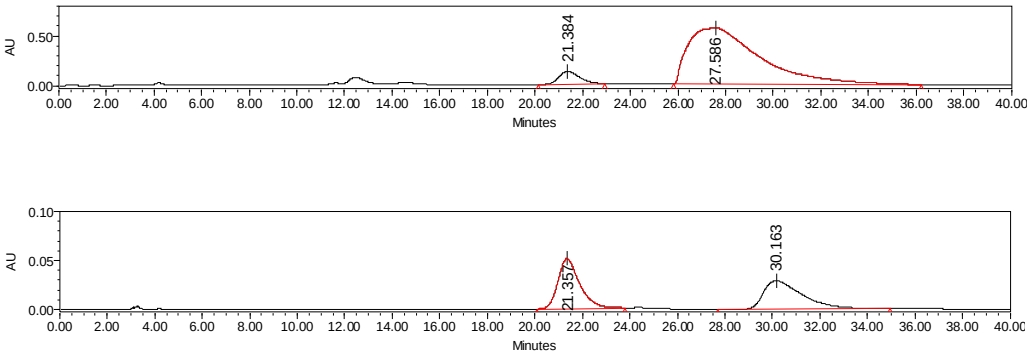
4-(1H-Indol-3-yl)-2-oxo-4-(2,4-dichlorophenyl)butyric acid methyl ester



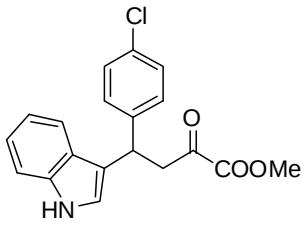
(-)-enantiomer (Table 3, entry 4): Prepared according to general procedure A. After 22 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the white solid in 94% yield with 97% ee. M.p. 126-128 ^{o}C; $[\alpha]^{23}_{D}$ = - 17.5 (c = 0.240, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 24.242 min, tr (minor) = 36.967 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.10 (s, 1H), 7.40-7.02 (m, 8H), 4.86 (t, *J* = 7.2 Hz, 1H), 3.79 (s, 3H), 3.66 (dd, *J* = 17.6, 7.2 Hz, 1H), 3.63 (dd, *J* = 17.6, 8.0 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 190.90, 160.05, 142.67, 135.54, 131.46, 129.54, 129.41, 128.73, 126.30, 125.02, 121.57, 120.47, 118.76, 118.05, 116.13, 110.31, 52.08, 52.72, 44.24, 35.74 ppm; ES-HRMS Calcd for $C_{19}H_{16}Cl_2NO_3$ $[M + H]^+$ 376.0502, Found: 376.0502.



(+)-enantiomer (Table 2, entry 4): Prepared according to general **procedure B**. After 51 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the white solid in 94% yield with 88% ee. $[\alpha]^{23}_{D}$ = + 18.2 (c = 0.672, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 21.384 min, t_r (major) = 27.586 min.

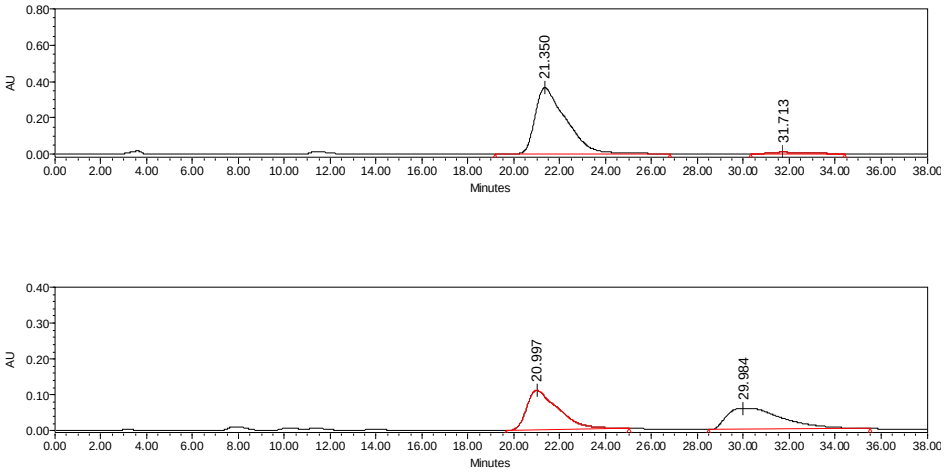


4-(1H-Indol-3-yl)-2-oxo-4-(4-chlorophenyl)butyric acid methyl ester

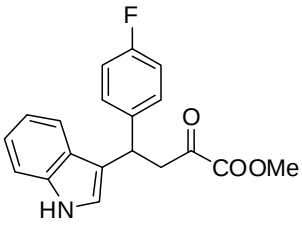


(+)-enantiomer (Table 3, entry 5): Prepared according to general **procedure A**. After 3 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 96% yield with 93% ee. M.p. 123-125 ^{o}C; $[\alpha]^{23}_{D}$ = + 10.1 (c = 0.240, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 21.350 min, tr (minor) = 31.713 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.37-7.00 (m, 9H), 4.88 (t, J = 7.6 Hz, 1H), 3.78 (s, 3H), 3.66 (dd, J = 17.2, 7.2 Hz, 1H), 3.56 (dd, J = 17.2, 8.0 Hz, 1H) ppm. ^{13}C

NMR (100 MHz, $CDCl_3$): δ = 192.33, 161.22, 141.78, 136.60, 132.32, 129.20, 128.68, 126.21, 122.48, 121.48, 119.67, 119.27, 117.84, 111.27, 53.04, 45.47, 37.09 ppm; ES-HRMS Calcd for $C_{19}H_{15}ClNO_3$ $[M - H]^-$ 340.0746, Found: 340.0749.

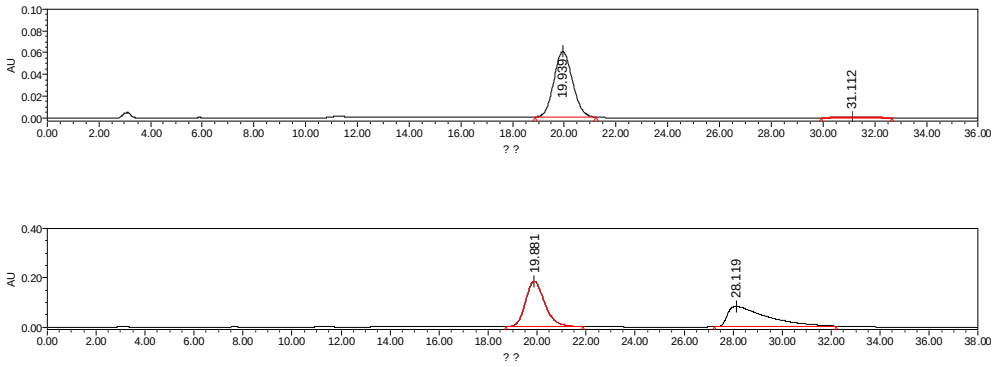


4-(1H-Indol-3-yl)-2-oxo-4-(4-florophenyl)butyric acid methyl ester

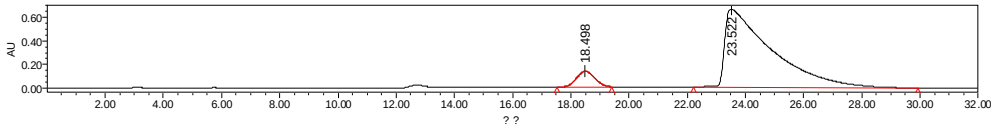


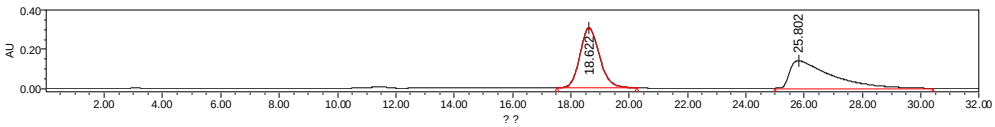
(-)-enantiomer (Table 3, entry 6): Prepared according to general **procedure A**. After 22 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 99% yield with 96% ee. $[\alpha]^{23}_D$ = - 43.6 (c = 0.220, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 19.939 min, tr (minor) = 31.112 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.04 (s, 1H), 7.38-6.89 (m, 9H), 4.90 (t, *J* = 7.6 Hz, 1H), 3.78 (s, 3H), 3.66 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.57 (dd, *J* = 17.2, 8.0

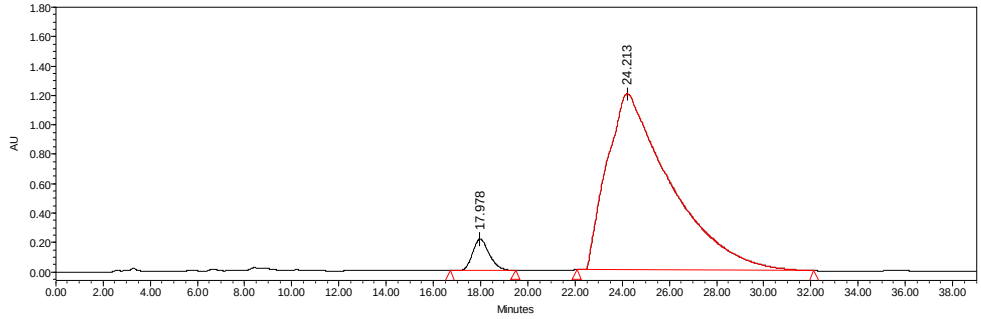
Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.44, 162.77, 161.26, 160.33, 138.93, 136.61, 129.32, 129.24, 126.26, 122.44, 121.40, 119.64, 119.32, 118.21, 115.43, 115.22, 111.22, 52.95, 45.69, 37.01 ppm; ES-HRMS Calcd for $C_{19}H_{15}FNO_3$ $[M - H]^-$ 324.1041, Found: 324.1044.

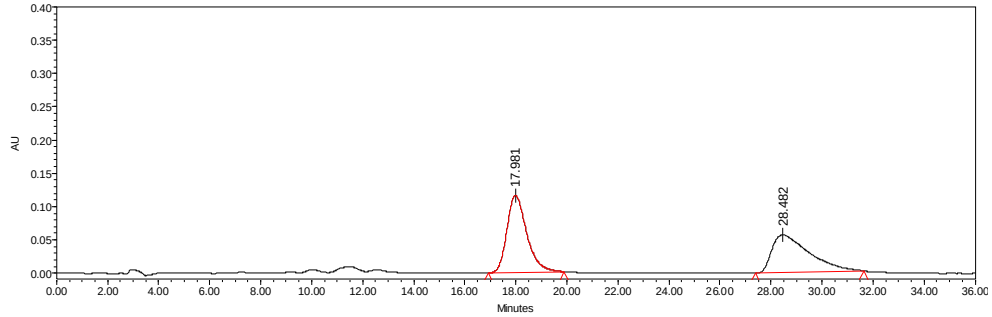


(+)-enantiomer (Table 2, entry 5): Prepared according to general **procedure B**. After 51 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 77% yield with 85% ee. After a simple recrystallization, the enantioselectivity could be increased to 91% ee. M.p. 142-143 ^oC; $[\alpha]^{23}_D$ = + 40.8 (c = 0.228, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 18.498 min, t_r (major) = 23.522 min.

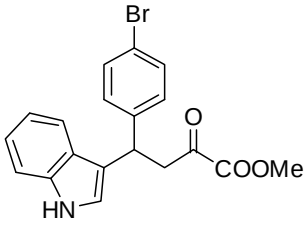






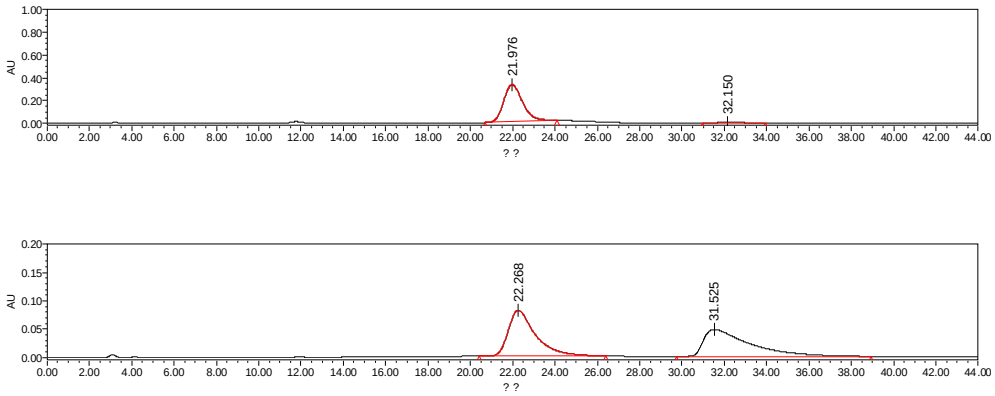


4-(1H-Indol-3-yl)-2-oxo-4-(4-bromophenyl)butyric acid methyl ester[10b]

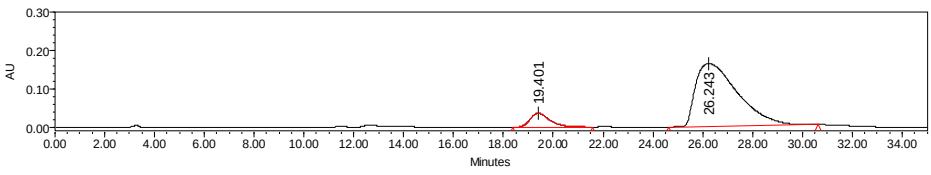


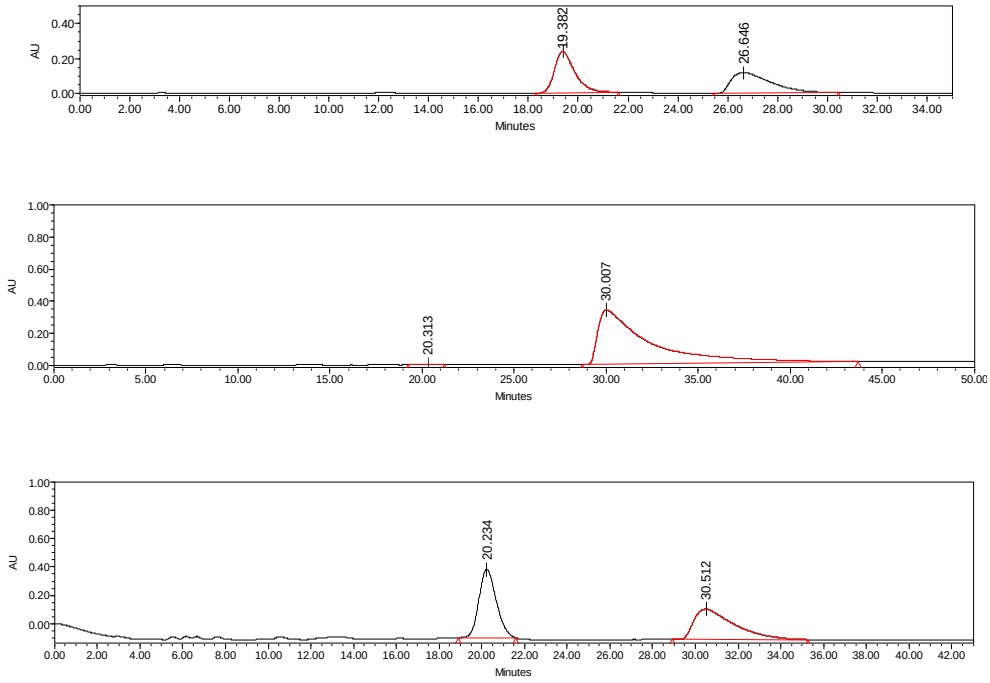
(*R*)-enantiomer (Table 3, entry 7): Prepared according to general **procedure A**. After 3 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 90% yield with 92% ee. M.p. 124-125 ^{o}C; $[\alpha]^{23}_{D}$ = - 5.1 (c = 0.812, $CHCl_3$); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 21.976 min, tr (minor) = 32.150 min. ^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.04 (s, 1H), 7.38-7.33 (m, 4H), 7.21-7.15 (m, 3H), 7.04-7.02 (m, 2H), 4.88 (t, *J* = 4.8 Hz, 1H), 3.79 (s, 3H), 3.66 (dd,

J = 11.6, 4.8 Hz, 1H), 3.57 (dd, *J* = 11.2, 5.2 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.24, 161.26, 142.29, 136.62, 131.63, 129.57, 126.23, 122.50, 121.46, 120.42, 119.70, 119.26, 117.82, 111.23, 52.96, 45.41, 37.18 ppm; ES-HRMS Calcd for $C_{19}H_{15}BrNO_3$ $[M - H]^-$ 384.0241, Found: 384.0231.

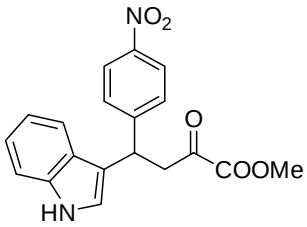


(*S*)-enantiomer (Table 2, entry 6): Prepared according to general **procedure B**. After 51 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 73% yield with 83% ee. After a simple recrystallization, the enantioselectivity could be increased to 99% ee. $[\alpha]^{23}_D$ = + 4.2 (c = 0.402, $CHCl_3$); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 19.401 min, t_r (major) = 26.243 min.



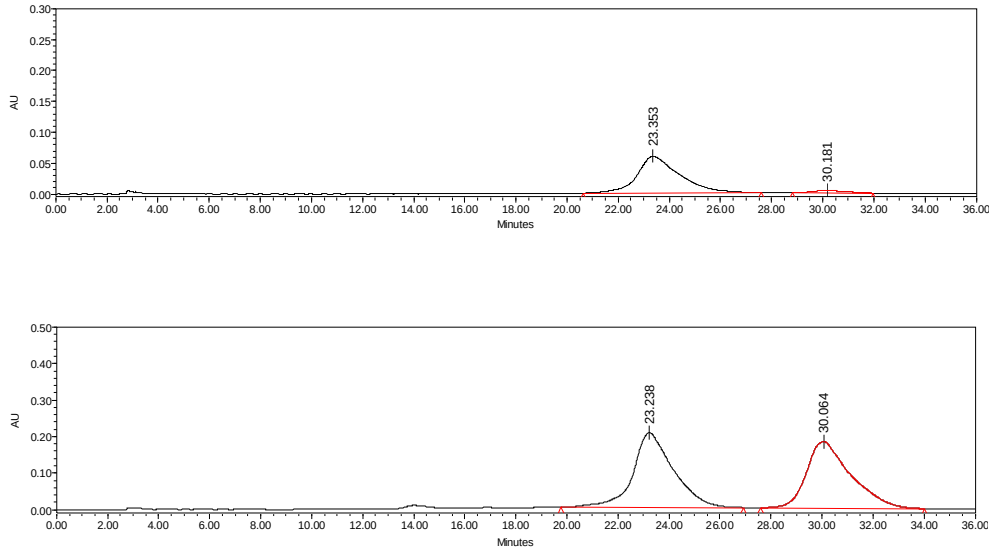


4-(1H-Indol-3-yl)-2-oxo-4-(4-nitrophenyl)butyric acid methyl ester

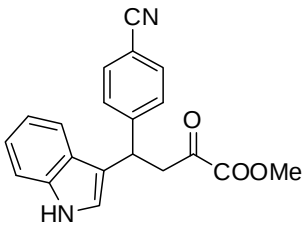


(-)-enantiomer (Table 3, entry 8): Prepared according to general **procedure A**. After 39 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 2:1) to afford the white solid in 77% yield with 90% ee. M.p. 118-119 ^{o}C; $[\alpha]^{23}_{D}$ = - 1.9 (c = 0.876, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel AD column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 23.353 min, tr (minor) = 30.181 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.25 (s, 1H), 8.12-8.07 (m, 2H), 7.50-7.00 (m, 7H), 5.01 (t, *J* = 7.6 Hz, 1H), 3.80 (s, 3H), 3.74 (dd, *J* = 18.0, 6.8 Hz, 1H), 3.63 (dd, *J* = 18.0, 8.0 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 191.79, 161.06, 151.07, 146.67, 136.62, 128.87, 128.78, 126.00, 123.85, 122.69, 121.65,

119.87, 118.94, 116.75, 111.48, 53.20, 45.07, 37.37 ppm; ES-HRMS Calcd for $C_{19}H_{17}N_2O_5$ $[M + H]^+$ 353.1132, Found: 353.1081.

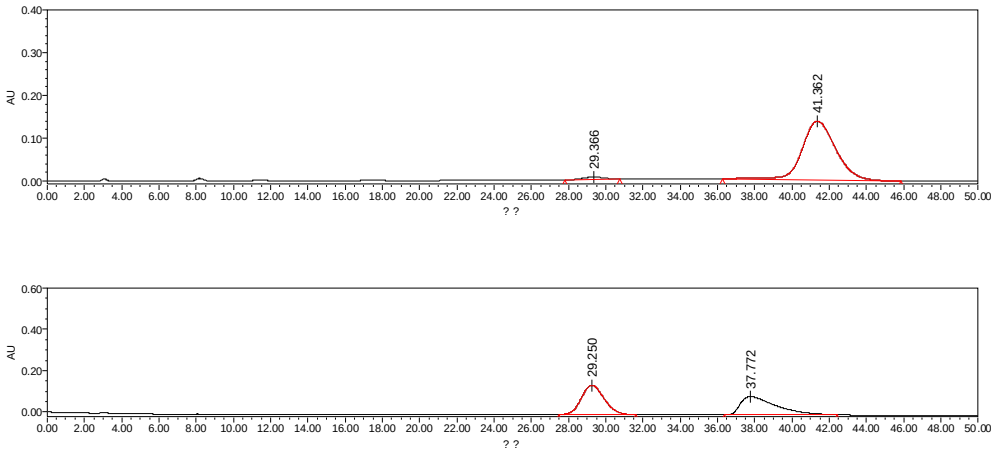


4-(1H-Indol-3-yl)-2-oxo-4-(4-cyanophenyl)butyric acid methyl ester

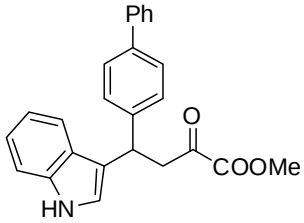


(-)-enantiomer (Table 3, entry 9): Prepared according to general **procedure A**. After 15 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the yellow solid in 92% yield with 95% ee. M.p. 121-123 ^oC; $[\alpha]^{23}_D$ = - 11.5 (c = 0.322, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (minor) = 29.366 min, tr (major) = 41.362 min. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.30 (d, *J* = 8.0 Hz, 1H), 7.20-6.99 (m, 7H), 4.91 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 3.70 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.61 (dd, *J* = 17.2, 8.0 Hz, 1H) ppm. ^{13}C NMR (100

MHz, $CDCl_3$): δ = 192.83, 161.37, 143.21, 138.13, 136.59, 128.59, 128.45, 127.44, 126.48, 124.78, 122.26, 121.62, 119.50, 119.41, 118.31, 111.24, 52.96, 45.79, 37.72, 21.52 ppm; ES-HRMS Calcd for $C_{20}H_{15}N_2O_3$ $[M - H]^-$ 331.1088, Found: 331.1081.

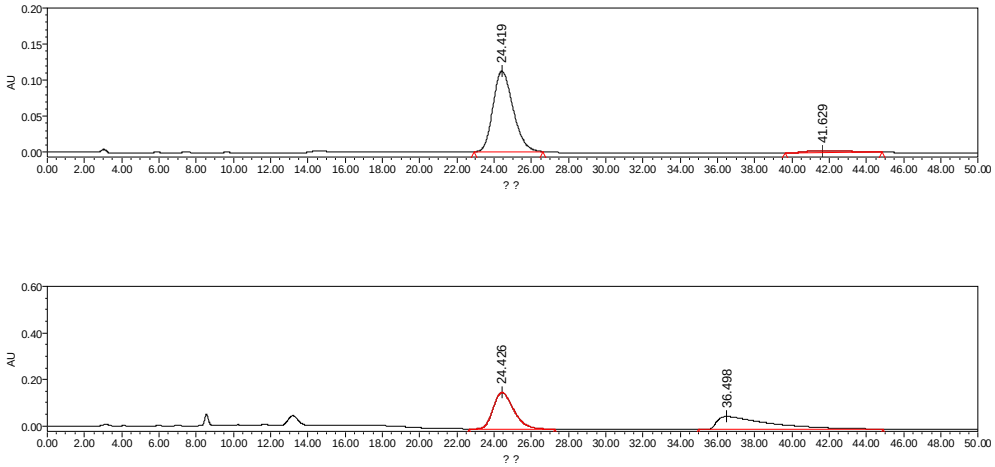


4-(1H-Indol-3-yl)-2-oxo-4-(4-phenylphenyl)butyric acid methyl ester

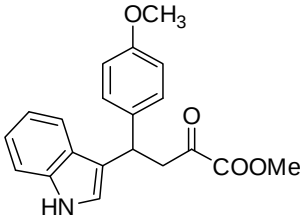


(+)-enantiomer (Table 3, entry 10): Prepared according to general **procedure A**. After 15 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the yellow solid in 91% yield with 90% ee. M.p. 107-108 ^oC; $[\alpha]^{23}_D$ = + 6.1 (c = 0.228, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 24.419 min, tr (major) = 41.629 min. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.04 (s, 1H), 7.54-7.28 (m, 12H), 7.17-7.13 (m, 1H), 7.06-7.02 (m, 2H), 4.96 (t, *J* = 7.6 Hz, 1H), 3.76 (s, 3H), 3.71 (dd, *J* = 17.2, 7.2 Hz, 1H), 3.63 (dd, *J* = 17.2, 8.0 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.65, 161.33, 142.32, 140.84, 139.47, 136.61, 128.74, 128.21, 127.29, 127.17, 127.01, 126.42, 122.38,

121.60, 119.60, 119.44, 118.24, 111.24, 53.00, 45.66, 37.41 ppm; ES-HRMS Calcd for $C_{25}H_{22}NO_3$ $[M + H]^+$ 384.1594, Found: 384.1594.

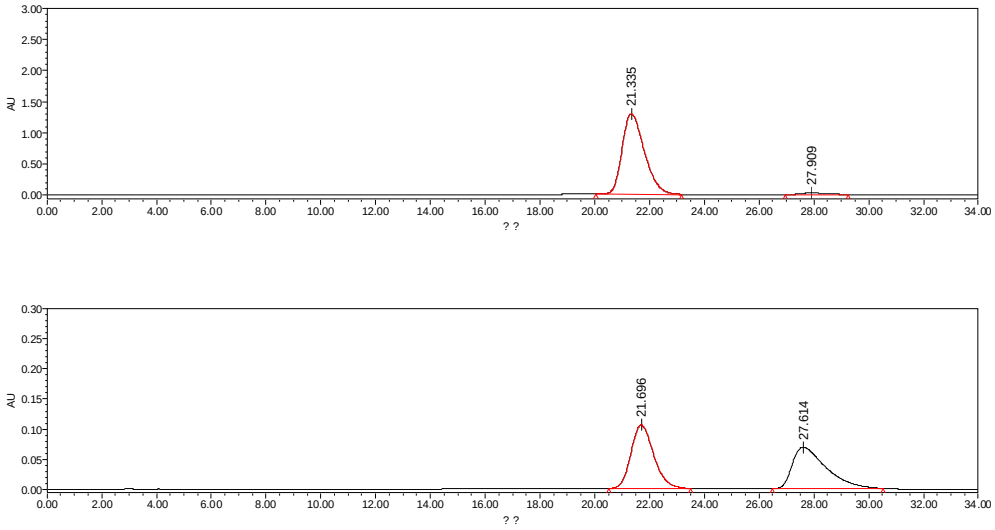


4-(1H-Indol-3-yl)-2-oxo-4-(4-methoxyphenyl)butyric acid methyl ester

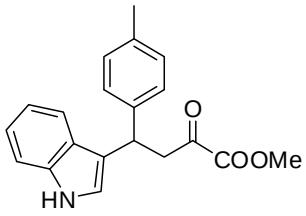


(-)-enantiomer (Table 3, entry 11): Prepared according to general **procedure A**. After 36 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 93% yield with 96% ee. $[\alpha]^{23}_D$ = - 31.2 (c = 0.852, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 21.335 min, tr (major) = 27.909 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.08 (s, 1H), 7.45 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.33 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.28-7.26 (m, 2H), 7.18 (dt, *J* = 6.8, 0.8 Hz, 1H), 7.08-7.04 (m, 1H), 7.01 (dd, *J* = 2.4, 0.8 Hz, 1H), 6.85-6.82 (m, 2H), 4.91 (t, *J* = 7.6 Hz, 1H), 3.80 (s, 3H), 3.78 (s, 3H), 3.69 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.61 (dd, *J* = 16.8, 8.0 Hz, 1H) ppm. ^{13}C

NMR (100 MHz, $CDCl_3$): δ = 192.84, 161.36, 158.21, 136.62, 135.32, 128.78, 126.40, 122.28, 121.44, 119.50, 119.45, 118.63, 113.92, 111.19, 55.23, 52.95, 45.85, 37.03 ppm; ES-HRMS Calcd for $C_{20}H_{18}NO_4$ $[M - H]^-$ 336.1241, Found: 336.1248.

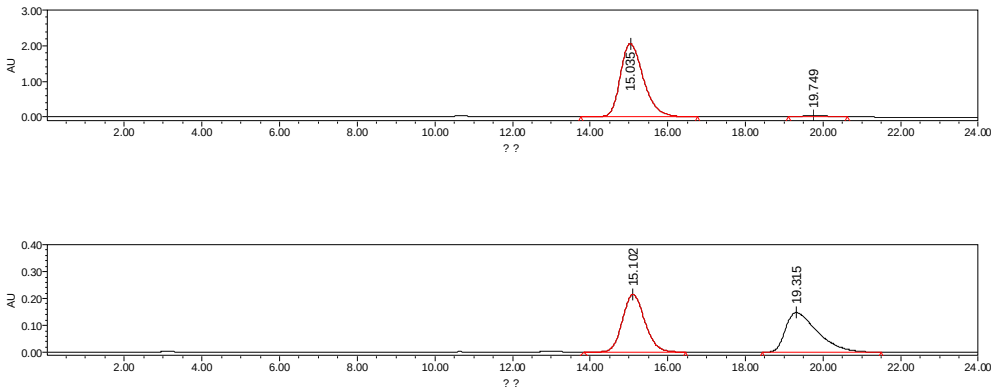


4-(1H-Indol-3-yl)-2-oxo-4-(4-methylphenyl)butyric acid methyl ester[10b]

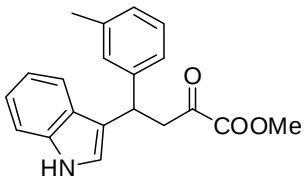


(-)-enantiomer (Table 3, entry 12): Prepared according to general **procedure A**. After 22 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 96% yield with 96% ee. M.p. 94-96 ^oC; $[\alpha]^{23}_D$ = - 21.6 (c = 0.306, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 15.035 min, tr (major) = 19.749 min. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.33 (dd, *J* = 8.4, 0.8 Hz, 1H), 7.28-7.25 (m, 2H), 7.19 (dt, *J* = 8.0, 1.2 Hz, 1H), 7.12-7.05 (m, 3H), 7.02 (d, *J* = 2.0 Hz, 1H), 4.93 (t, *J* = 7.6 Hz, 1H), 3.80 (s, 3H),

3.75-3.60 (m, 2H), 2.33 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.81, 161.36, 140.20, 136.59, 136.12, 129.25, 127.65, 126.44, 122.26, 121.52, 119.50, 119.43, 118.48, 111.19, 52.93, 45.79, 37.39, 21.02 ppm; ES-HRMS Calcd for $C_{20}H_{18}NO_3$ $[M - H]^-$ 320.1292, Found: 320.1288.

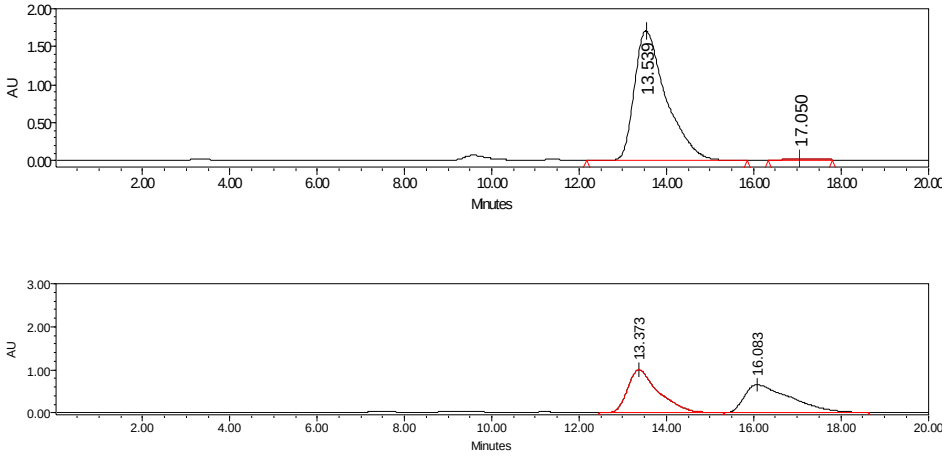


4-(1H-Indol-3-yl)-2-oxo-4-(3-methylphenyl)butyric acid methyl ester

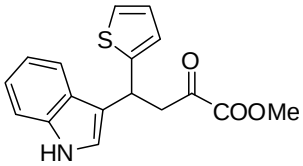


(-)-enantiomer (Table 3, entry 13): Prepared according to general **procedure A**. After 22 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 83% yield with 97% ee. M.p. 95-96 ^{o}C; $[\alpha]^{23}_{D}$ = - 36.6 (c = 0.399, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 13.539 min, tr (major) = 17.050 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.06 (s, 1H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.30 (d, *J* = 8.0 Hz, 1H), 7.20-6.99 (m, 7H), 4.91 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 3.70 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.61 (dd, *J* = 17.2, 8.0 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.83, 161.37, 143.21, 138.13, 136.59, 128.59, 128.45, 127.44, 126.48, 124.78, 122.26, 121.62, 119.50,

119.41, 118.31, 111.24, 52.96, 45.79, 37.72, 21.52 ppm; ES-HRMS Calcd for $C_{20}H_{20}NO_3$ $[M + H]^+$ 322.1438, Found: 322.1447.

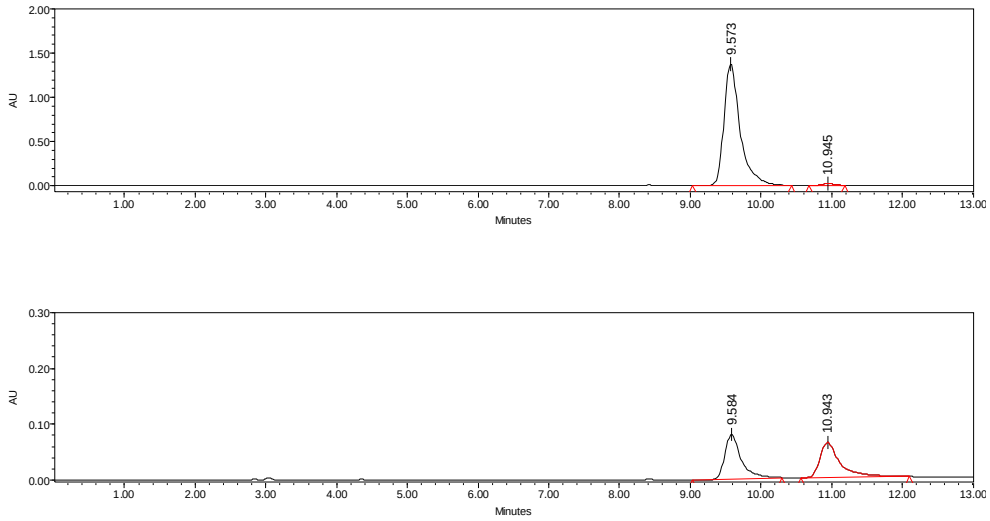


4-(1H-Indol-3-yl)-2-oxo-4-(2-thienyl)butyric acid methyl ester

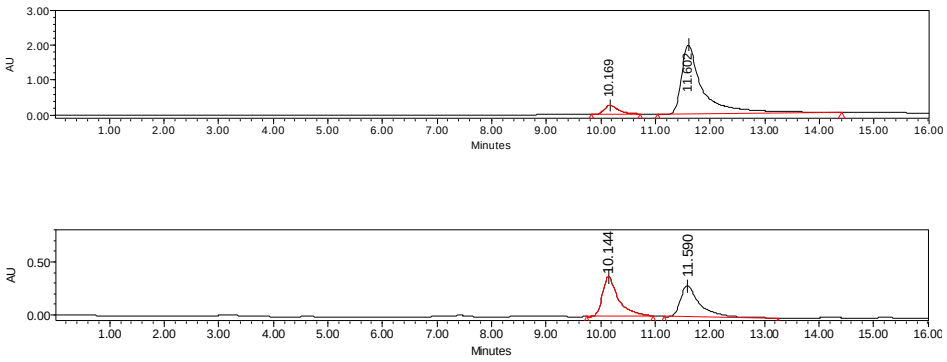


(-)-enantiomer (Table 3, entry 14): Prepared according to general **procedure A**. After 36 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 87% yield with 98% ee. M.p. 88-89 ^oC; $[\alpha]^{23}_D$ = - 17.7 (c = 0.940, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel IA column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, tr (major) = 9.573 min, tr (major) = 10.945 min. ^1H NMR (400 MHz, DMSO): δ = 10.94 (d, *J* = 1.6 Hz, 1H), 7.44 (d, *J* = 8.0 Hz, 1H), 7.36-7.33 (m, 1H), 7.28 (d, *J* = 2.4 Hz, 1H), 7.24 (dd, *J* = 5.2, 1.2 Hz, 1H), 7.08-7.04 (m, 1H), 6.98 (dt, *J* = 6.4, 0.8 Hz, 1H), 6.96-6.92 (m, 1H), 6.88 (dd, *J* = 3.6, 5.2 Hz, 1H), 5.03 (t, *J* = 7.6 Hz, 1H), 3.74 (s, 3H), 3.78-3.65 (m, 2H), ppm. ^{13}C NMR (100 MHz, DMSO): δ = 192.20, 161.24, 149.32, 136.88, 127.03, 126.35, 124.45, 124.36, 122.73, 121.64, 119.13, 118.97,

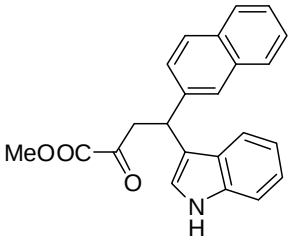
117.39, 112.01, 53.12, 46.41, 32.66 ppm; ES-HRMS Calcd for $C_{17}H_{16}NO_3S$ $[M + H]^+$ 314.0845, Found: 314.0858.



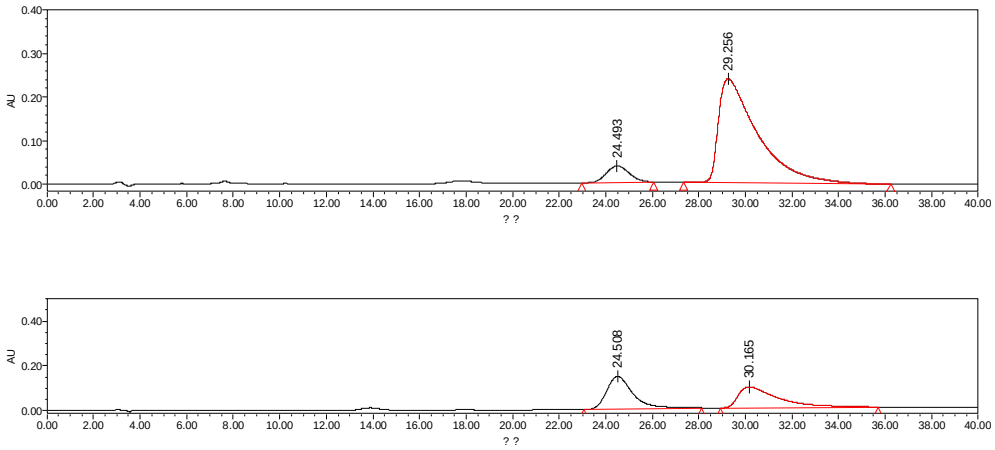
(+)-enantiomer (Table 2, entry 7): Prepared according to general **procedure B**. After 93 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 51% yield with 84% ee. $[\alpha]^{23}_D$ = + 13.4 (c = 0.186, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel IA column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 10.169 min, t_r (major) = 11.602 min.

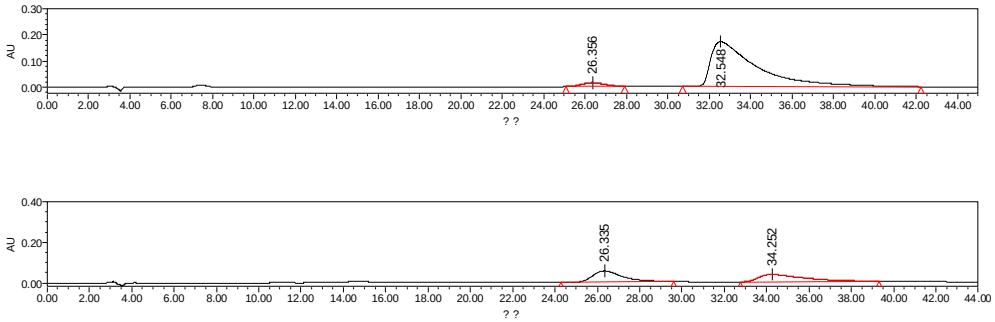


4-(1H-Indol-3-yl)-2-oxo-4-(2-naphthyl)butyric acid methyl ester

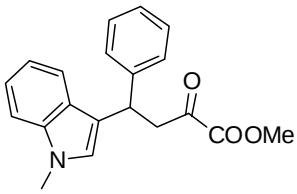


(+)-enantiomer (Table 2, entry 8): Prepared according to general **procedure B**. After 93 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 62% yield with 84% ee. After a simple recrystallization, the enantioselectivity could be increased to 90% ee. M.p. 140-141 ^{o}C; $[\alpha]^{23}_{D}$ = + 16.3 (c = 0.208, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 22.517 min, t_r (major) = 27.885 min. ^{1}H NMR (400 MHz, DMSO): δ = 10.96 (s, 1H), 7.90 (s, 1H), 7.85-7.76 (m, 3H), 7.52-7.32 (m, 6H), 7.04-7.00 (dt, *J* = 6.8, 1.2 Hz, 1H), 6.89-6.85 (dt, *J* = 7.2, 0.8 Hz, 1H), 4.91 (t, *J* = 6.8 Hz, 1H), 3.84 (ddd, *J* = 17.6, 7.2, 1.2 Hz, 1H), 3.75-3.68 (m, 1H) ppm. ^{13}C NMR (100 MHz, DMSO): δ = 192.75, 161.42, 142.39, 136.91, 133.45, 132.21, 128.21, 128.01, 127.85, 126.97, 126.69, 125.88, 122.65, 121.57, 119.08, 118.84, 117.49, 111.91, 53.08, 45.34, 37.57 ppm; ES-HRMS Calcd for $C_{23}H_{20}NO_3$ $[M + H]^+$ 358.1438, Found: 358.1442.

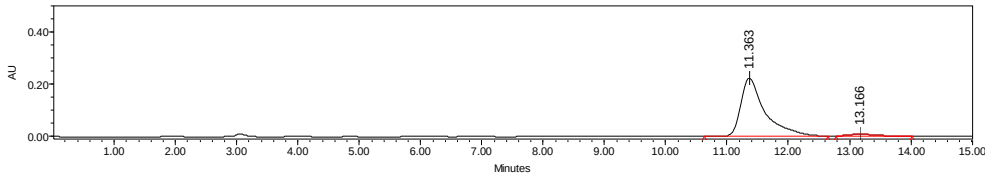


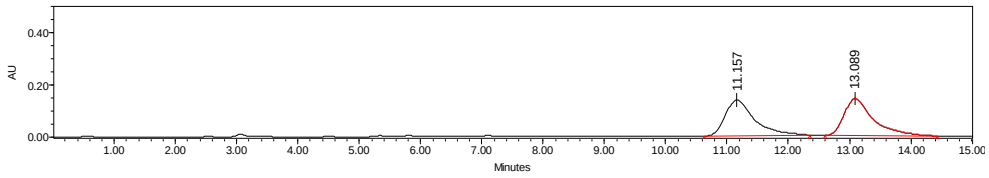


4-(1-Methylindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester[10,11]

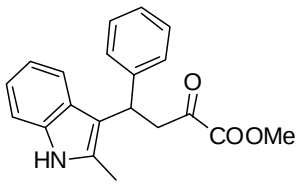


(-)-enantiomer (Table 3, entry 15): Prepared according to general **procedure A**. After 1 hour, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the yellow solid in 86% yield with 93% ee. $[\alpha]^{23}_{D}$ = - 47.1 (c = 0.350, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel AS-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 11.363 min, t_r (major) = 13.166 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.44-6.88 (m, 10H), 4.93-4.90 (m, 1H), 3.76 (d, *J* = 1.6 Hz, 3H), 3.73 (s, 3H), 3.68-3.58 (m, 2H) ppm. ^{13}C NMR (150 MHz, $CDCl_3$): δ = 192.15, 160.85, 142.91, 136.84, 128.07, 127.29, 126.35, 126.09, 125.85, 121.37, 119.00, 118.54, 116.32, 108.78, 52.42, 45.32, 37.22, 32.23 ppm; ES-HRMS Calcd for $C_{20}H_{19}NO_3$ $[M - H]^-$ 320.1292, Found: 320.1285.

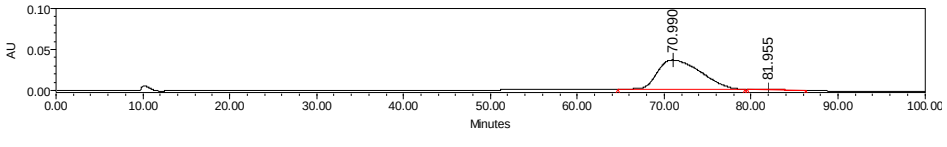


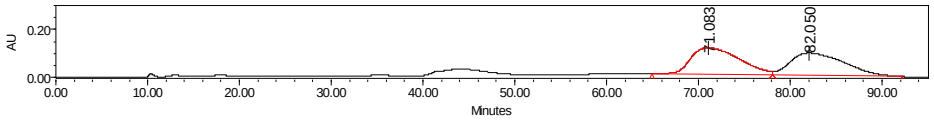


4-(2-Methylindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester[10b]

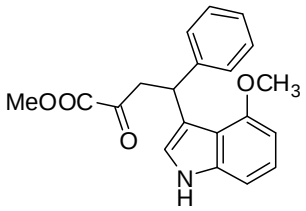


(+)-enantiomer (Table 3, entry 16): Prepared according to general **procedure A**. After 1 hour, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the yellow oil in 99% yield with 98% ee. $[\alpha]^{23}_{D}$ = + 37.5 (c = 0.296, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OJ column (hexane/2-propanol 60:40, 0.3 mL/min, 220 nm, t_r (major) = 70.990 min, t_r (major) = 82.067 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.81 (s, 1H), 7.41 (d, *J* = 7.6 Hz, 1H), 7.31 (d, *J* = 7.6 Hz, 2H), 7.26-7.13 (m, 4H), 7.07-6.96 (m, 2H), 4.90 (dd, *J* = 9.2, 6.0 Hz, 1H), 3.90 (dd, *J* = 17.2, 9.2 Hz, 1H), 3.69 (dd, *J* = 17.2, 6.0 Hz, 1H), 3.62 (s, 3H), 2.37 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 193.10, 161.06, 143.16, 135.45, 132.20, 128.44, 127.35, 127.16, 126.24, 120.95, 119.33, 119.10, 112.28, 110.47, 52.79, 44.01, 36.27, 12.14 ppm; ES-HRMS Calcd for $C_{20}H_{18}NO_3$ $[M - H]^-$ 320.1292, Found: 320.1297.

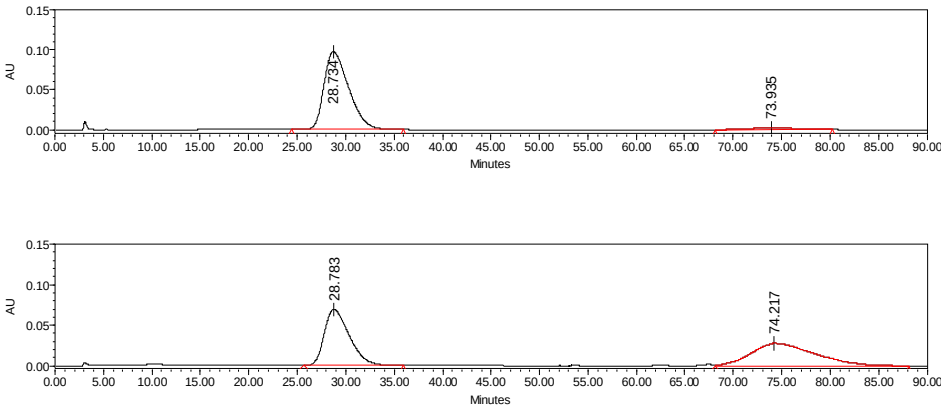




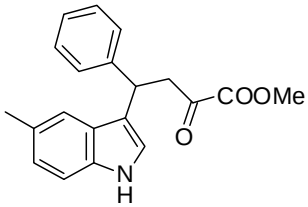
4-(4-Methoxyindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester[10b]



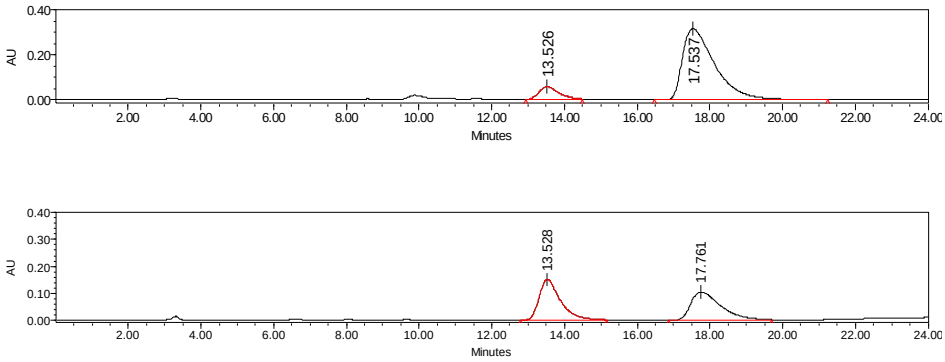
(+)-enantiomer (Table 3, entry 17): Prepared according to general **procedure A**. After 27 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the yellow oil in 83% yield with 92% ee. $[\alpha]^{23}_{D}$ = + 30.6 (c = 0.222, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OJ column (hexane/2-propanol 60:40, 1.0 mL/min, 220 nm, t_r (major) = 28.734 min, t_r (major) = 73.935 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.95 (s, 1H), 7.32 (d, *J* = 7.6 Hz, 2H), 7.28-7.14 (m, 3H), 7.06 (t, *J* = 8.0 Hz, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.68 (d, *J* = 2.0 Hz, 1H), 6.44 (d, *J* = 7.6 Hz, 1H), 5.25 (t, *J* = 8.0 Hz, 1H), 3.80 (s, 3H), 3.75 (s, 3H), 3.69 (dd, *J* = 17.2, 7.2 Hz, 1H), 3.63 (dd, *J* = 17.2, 8.8 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 191.11, 161.67, 154.57, 143.86, 138.21, 128.22, 128.05, 126.21, 123.16, 120.69, 119.59, 116.63, 104.41, 99.84, 54.96, 52.72, 46.65, 38.41 ppm; ES-HRMS Calcd for $C_{20}H_{18}NO_4$ $[M - H]^-$ 336.1241, Found: 336.1241.



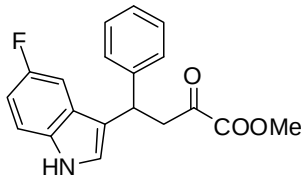
4-(5-Methylindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester



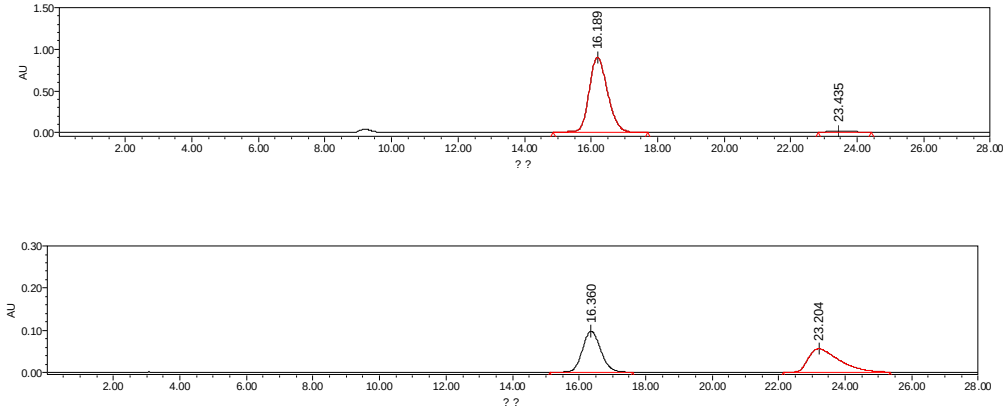
(+)-enantiomer (Table 2, entry 9): Prepared according to general **procedure B**. After 64 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 70% yield with 81% ee. M.p. 112-114 ^{o}C; $[\alpha]^{23}_{D}$ = + 10.4 (c = 0.278, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 13.526 min, t_r (major) = 17.537 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.91 (s, 1H), 7.32 (d, *J* = 7.6 Hz, 2H), 7.28-7.17 (m, 5H), 6.98-6.95 (m, 2H), 4.89 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 3.66 (dd, *J* = 17.2, 7.6 Hz, 1H), 3.58 (dd, *J* = 16.8, 8.0 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.70, 161.35, 143.26, 134.89, 128.78, 128.54, 127.77, 126.66, 126.57, 123.96, 121.72, 118.94, 117.81, 110.84, 52.93, 45.77, 37.70, 21.53 ppm; ES-HRMS Calcd for $C_{20}H_{18}NO_3$ $[M - H]^-$ 320.1292, Found: 320.1296.



4-(5-floroindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester

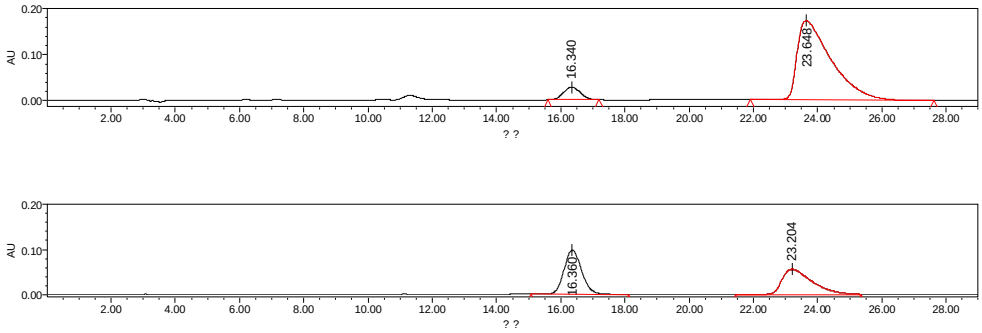


(-)-enantiomer (Table 3, entry 18): Prepared according to general **procedure A**. After 58 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the yellow soild in 90% yield with 95% ee. M.p. 129-130 ^{o}C; $[\alpha]^{23}_{D}$ = - 30.4 (c = 0.388, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 16.189 min, t_r (major) = 23.435 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.04 (s, 1H), 7.35-7.16 (m, 6H), 7.08 (d, *J* = 2.8 Hz, 1H), 7.02 (dd, *J* = 9.6, 2.4 Hz, 1H), 6.92-6.86 (m, 1H), 4.83 (t, *J* = 7.6 Hz, 1H), 3.78 (s, 3H), 3.66 (dd, *J* = 17.2, 7.6 Hz, 1H), 3.57 (dd, *J* = 17.2, 7.6 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.47, 161.27, 158.80, 156.47, 142.84, 133.05, 128.65, 127.70, 126.78, 123.19, 118.47, 118.43, 111.84, 111.74, 110.90, 110.63, 104.49, 104.26, 52.99, 45.51, 37.66 ppm; ES-HRMS Calcd for $C_{19}H_{15}FNO_3$ [M - H]$^-$ 324.1041, Found: 324.1033.

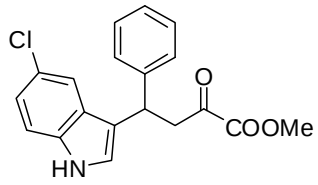


(+)-enantiomer (Table 2, entry 10): Prepared according to general **procedure B**. After 64 hours, the crude material was directly purified by flash chromatography

on silica gel (petroleum ether/ethyl acetate, 3:1) to afford the white solid in 68% yield with 85% ee. $[\alpha]^{23}_{D}$ = + 29.6 (c = 0.260, $CHCl_3$); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 16.340 min, t_r (major) = 23.648 min.

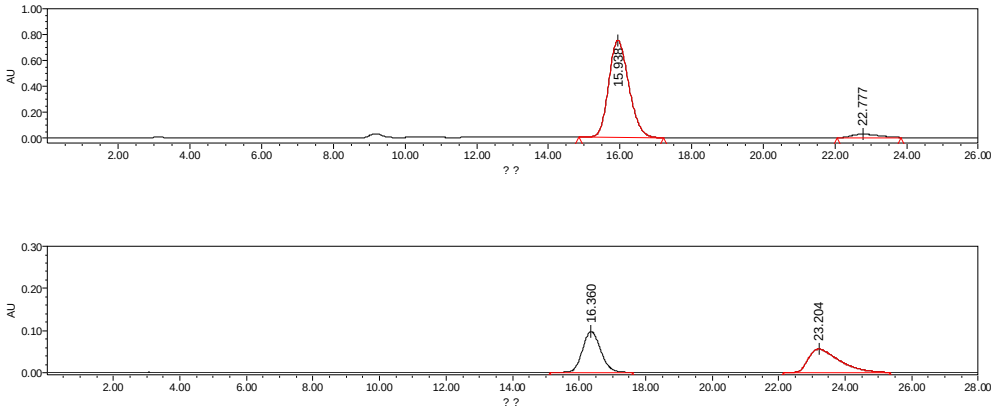


4-(1H-5-chloroindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester[10b]

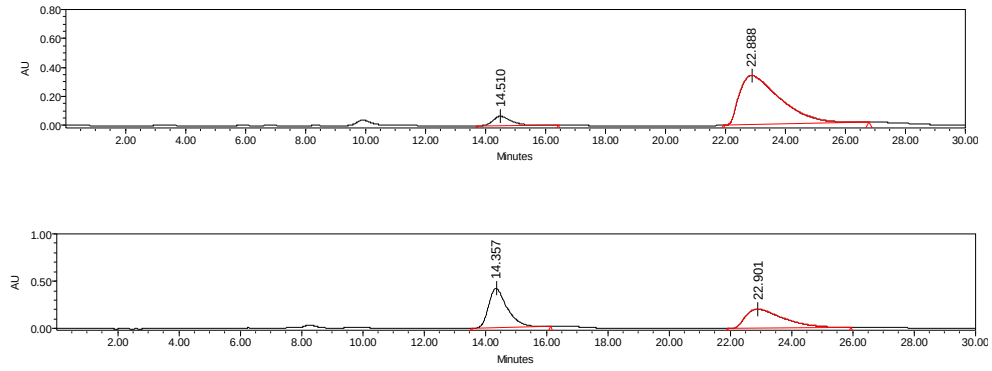


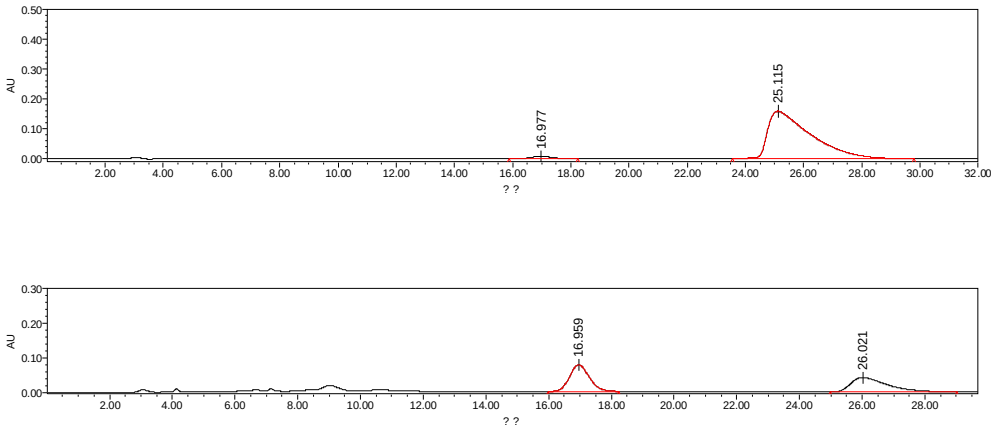
(+)-enantiomer (Table 3, entry 19): Prepared according to general **procedure A**. After 58 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the yellow soild in 82% yield with 90% ee. $[\alpha]^{23}_{D}$ = + 29.4 (c = 0.286, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 15.938 min, t_r (major) = 22.777 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.16 (s, 1H), 7.37 (d, *J* = 1.6 Hz, 1H), 7.32-7.07 (m, 8H), 4.85 (t, *J* = 7.6 Hz, 1H), 3.79 (s, 3H), 3.65 (dd, *J* = 16.8, 7.6 Hz, 1H), 3.58 (dd, *J* = 17.2, 7.6 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.38, 161.24, 142.75, 134.90, 128.67, 127.66, 127.51, 126.80, 122.85, 122.69, 118.83, 118.08, 112.17,

53.00, 45.60, 37.52 ppm; ES-HRMS Calcd for $C_{19}H_{16}ClNO_3$ $[M - H]^-$ 340.0746, Found: 340.0744.

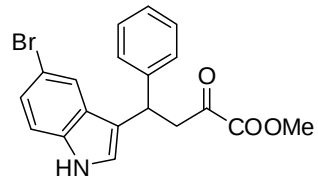


(+)-enantiomer (Table 2, entry 11): Prepared according to general **procedure B**. After 68 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 80% yield with 85% ee. After a simple recrystallization, the enantioselectivity could be increased to 96% ee. $[\alpha]^{23}_D$ = - 10.1 (c = 0.198, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 14.510 min, t_r (major) = 22.888 min.

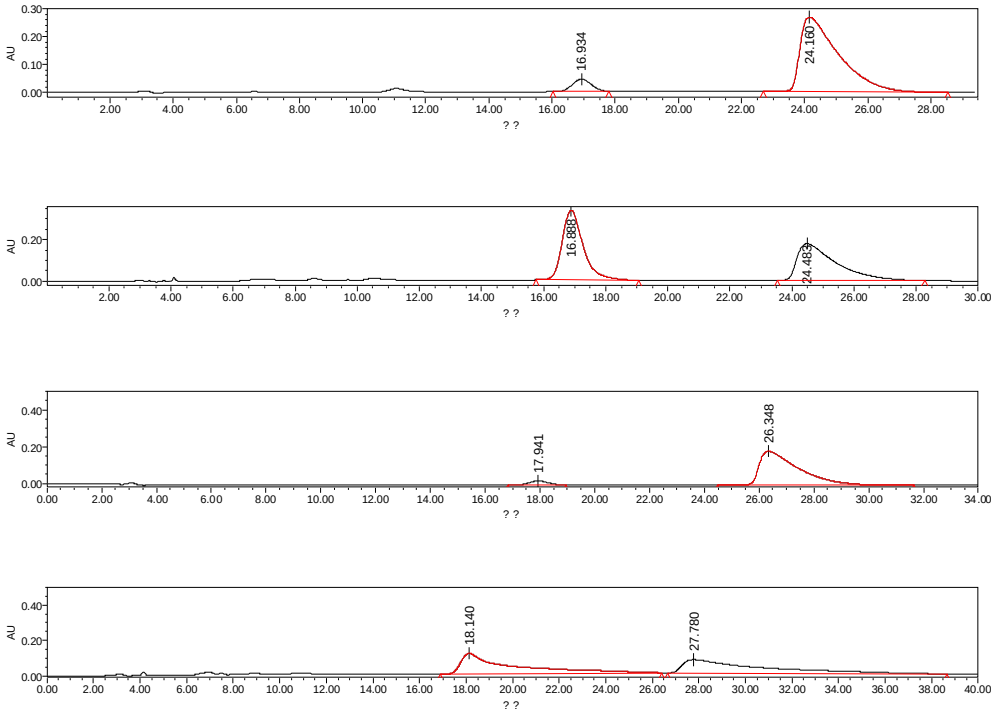




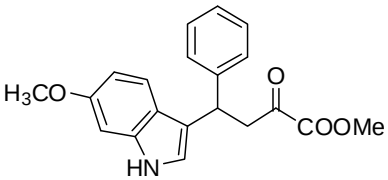
4-(1H-5-bromoindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester



(+)-enantiomer (Table 2, entry 12): Prepared according to general **procedure B**. After 68 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the white solid in 75% yield with 85% ee. M.p. 78-80 ^{o}C; After a simple recrystallization, the enantioselectivity could be increased to 90% ee. $[\alpha]^{23}_{D}$ = + 23.1 (c = 0.208, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (minor) = 16.481 min, t_r (major) = 23.123 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.08 (s, 1H), 7.53 (d, *J* = 1.6 Hz, 1H), 7.32-7.16 (m, 7H), 7.03 (d, *J* = 2.4 Hz, 1H), 4.85 (t, *J* = 7.6 Hz, 1H), 3.78 (s, 3H), 3.64 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.57 (dd, *J* = 17.2, 7.6 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.37, 161.24, 142.72, 135.16, 128.69, 128.18, 127.65, 126.83, 125.27, 122.70, 121.91, 118.03, 112.88, 112.62, 53.01, 45.64, 37.49 ppm; ES-HRMS Calcd for $C_{19}H_{17}BrNO_3$ $[M + H]^+$ 386.0386, Found: 386.0394.

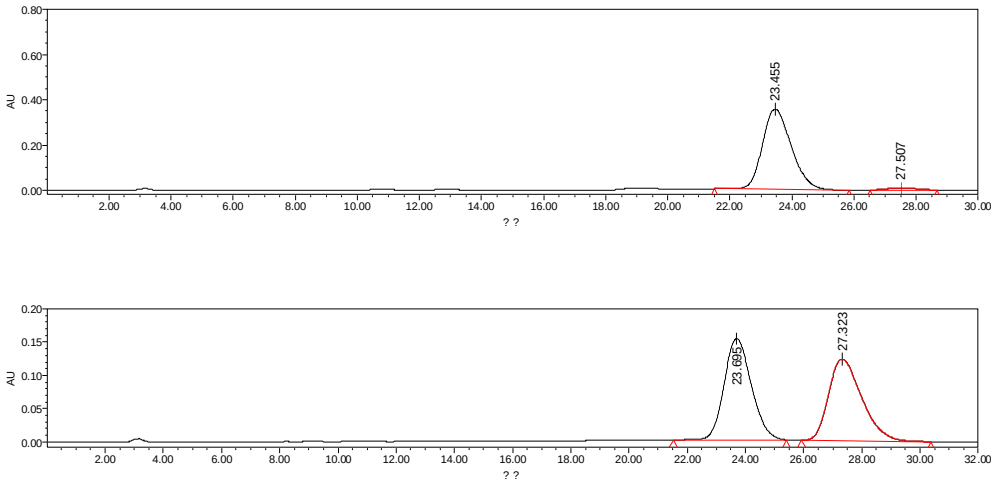


4-(6-Methoxyindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester

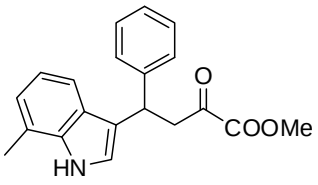


(-)-enantiomer (Table 3, entry 20): Prepared according to general **procedure A**. After 30 minutes, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 2:1) to afford the yellow soild in 99% yield with 95% ee. M.p. 118-119 ^{o}C; $[\alpha]^{23}_{D}$ = - 23.3 (c = 0.240, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 23.455 min, t_r (major) = 27.507 min.^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.92 (s, 1H), 7.32-7.15 (m, 6H), 6.88 (dd, *J* = 2.4, 0.8 Hz, 1H), 6.78 (d, *J* = 2.0 Hz, 1H), 6.67 (dd, *J* = 8.8, 2.4 Hz, 1H), 4.86 (t, *J* = 7.6 Hz, 1H), 3.78 (s, 3H), 3.75 (s, 3H), 3.65 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.56 (dd, *J* = 16.8, 7.6 Hz, 1H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 192.71, 161.34, 156.61,

143.28, 137.38, 128.55, 127.76, 126.62, 120.87, 120.32, 120.01, 118.25, 109.48, 94.68, 55.63, 52.95, 45.69, 37.82 ppm; ES-HRMS Calcd for $C_{20}H_{20}NO_4$ $[M + H]^+$ 338.1387, Found: 338.1397.

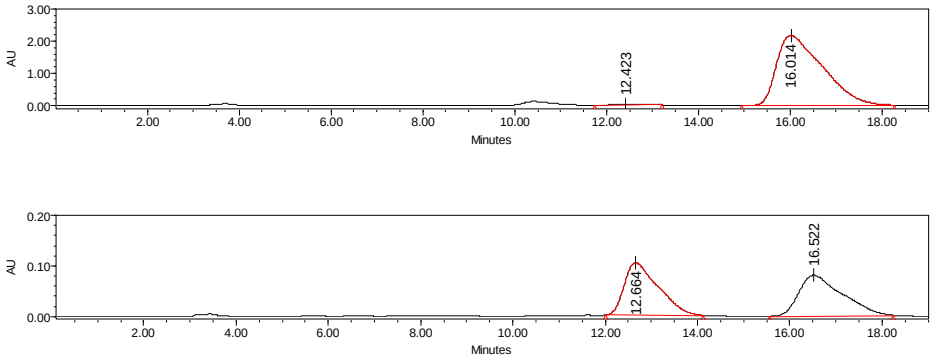


4-(7-methylindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester

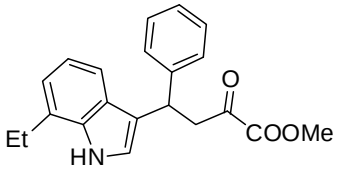


(-)-enantiomer (Table 3, entry 21): Prepared according to general **procedure A**. After 27 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the yellow soild in 99% yield with 98% ee. M.p. 97-99 ^oC; $[\alpha]^{23}_D$ = - 53.6 (c = 0.302, CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 12.423 min, t_r (major) = 16.014 min. ^1H NMR (600 MHz, $CDCl_3$): δ = 7.95 (s, 1H), 7.32-7.15 (m, 6H), 7.01 (d, *J* = 1.6 Hz, 1H), 6.95-6.93 (m, 2H), 4.91 (t, *J* = 4.8 Hz, 1H), 3.75 (s, 3H), 3.67 (dd, *J* = 11.2, 4.8 Hz, 1H), 3.60 (dd, *J* = 11.2, 5.2 Hz, 1H), 2.43 (s, 3H) ppm. ^{13}C NMR (150 MHz, $CDCl_3$): δ = 192.65, 161.31, 143.22, 136.13, 128.51, 127.76, 126.56, 125.93, 122.82,

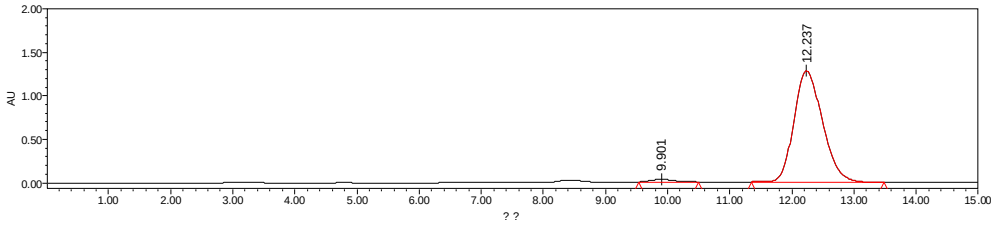
121.24, 120.32, 119.76, 118.79, 117.12, 52.91, 45.65, 37.83, 16.51 ppm; ES-HRMS Calcd for $C_{20}H_{20}NO_3$ $[M + H]^+$ 322.1438, Found: 322.1449.

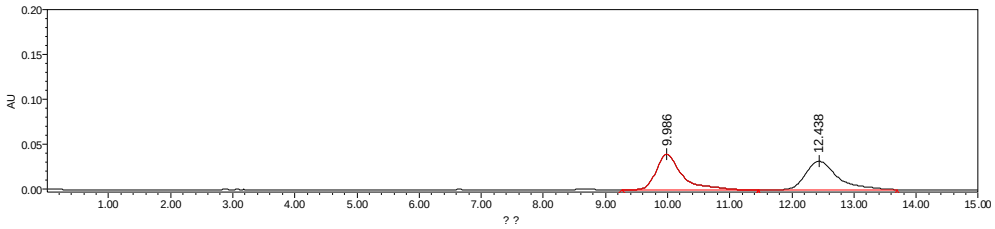


4-(7-ethylindol-3-yl)-2-oxo-4-phenylbutyric acid methyl ester



(-)-enantiomer (Table 3, entry 22): Prepared according to general **procedure A**. After 10 hours, the crude material was directly purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, 4:1) to afford the yellow soild in 99% yield with 96% ee. $[\alpha]^{23}_D$ = - 35.3 (c = 0.238 CH_2Cl_2); The ee was determined by HPLC analysis using a chiralcel OD-H column (hexane/2-propanol 80:20, 1.0 mL/min, 220 nm, t_r (major) = 9.901 min, t_r (major) = 12.237 min. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.99 (s, 1H), 7.32-7.15 (m, 6H), 6.98-6.95 (m, 3H), 4.90 (t, *J* = 7.6 Hz, 1H), 3.73 (s, 3H), 3.67 (dd, *J* = 16.8, 7.2 Hz, 1H), 3.59 (dd, *J* = 16.8, 7.6 Hz, 1H), 2.77 (q, *J* = 7.6 Hz, 2H), 1.30 (t, *J* = 7.6 Hz, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 191.67, 160.28, 142.20, 134.38, 127.48, 125.51, 125.10, 120.18, 119.71, 118.76, 117.65, 116.06, 51.86, 44.64, 36.80, 22.83, 12.69 ppm; ES-HRMS Calcd for $C_{21}H_{20}NO_3$ $[M - H]^-$ 334.1449, Found: 334.1436.


AU
2.00
1.50
1.00
0.50
0.00
9.901
12.237
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
? ?


AU
0.20
0.15
0.10
0.05
0.00
9.986
12.438
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
? ?

7. Reference:

(1) Y. H. Wen, X. Huang, J. L. Huang, Y. Xiong, B. Qin, X. M. Feng, *Synlett* **2005**, 2445-2448.

(2) J. L. Huang, J. Wang, X. H. Chen, Y. H. Wen, X. H. Liu, X. M. Feng, *Adv. Synth. Catal.* **2008**, *350*, 287-294.

(3) D. J. Shang, J. G. Xin, Y. L. Liu, X. Zhou, X. H. Liu, X. M. Feng, *J. Org. Chem.* **2008**, *73*, 630-637.

(4) X. Li, X. H. Liu, Y. Z. Fu, L. J. Wang, L. Zhou, X. M. Feng, *Chem. Eur. J.* **2008**, *14*, 4796-4798.

(5) Huang, J. L.; Liu, X. H.; Wen, Y. H.; Qin, B.; Feng, X. M. *J. Org. Chem*. **2007**, *72*, 204-208.

(6) X. Yang, X. Zhou, L. L. Lin, L. Chang, X. H. Liu, X. M. Feng, *Angew. Chem. Int. Ed*. **2008**, *47*, 7079-7081.

(7) Y. L. Liu, D. J. Shang, X. Zhou, X. H. Liu, X. M. Feng, *Chem. Eur. J.* **2009**, *15*, 2055-2058.

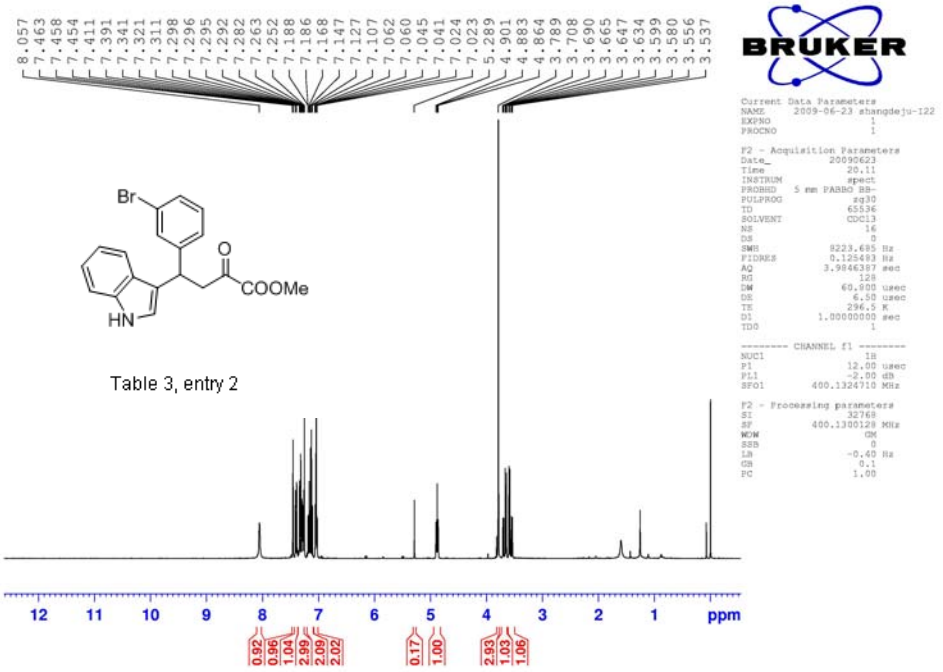
(8) D. J. Shang, Y. L. Liu, X. Zhou, X. H. Liu, X. M. Feng, *Chem. Eur. J.* **2009,** *15*, 3678-3681.

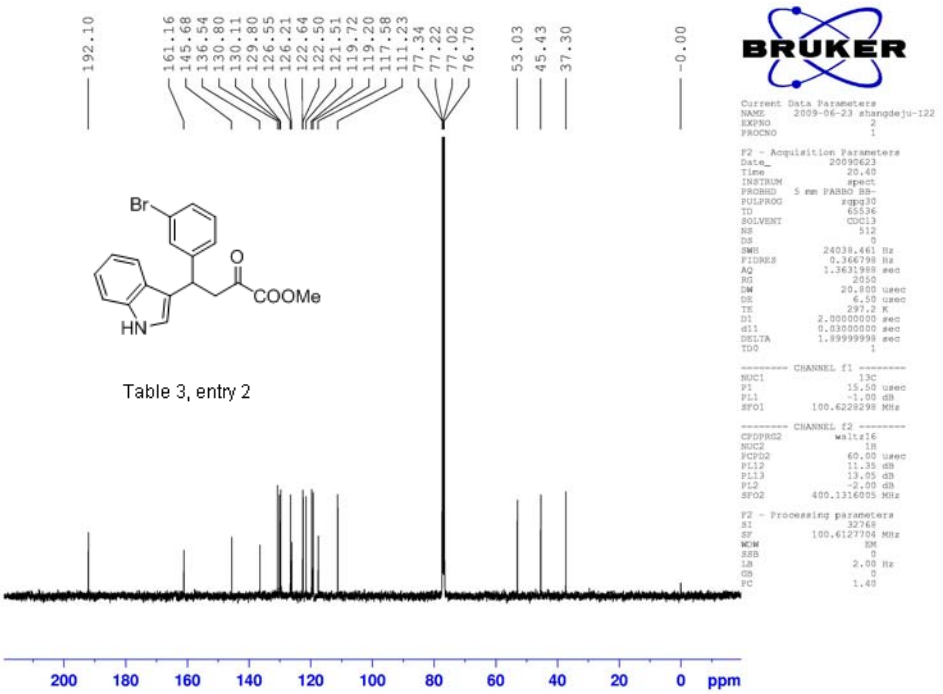
(9) L. Bernardi, A. S. Gothelf, R. G. Hazell, K. A. Jørgensen, *J. Org. Chem.* **2003**, *68*, 2583-2591.

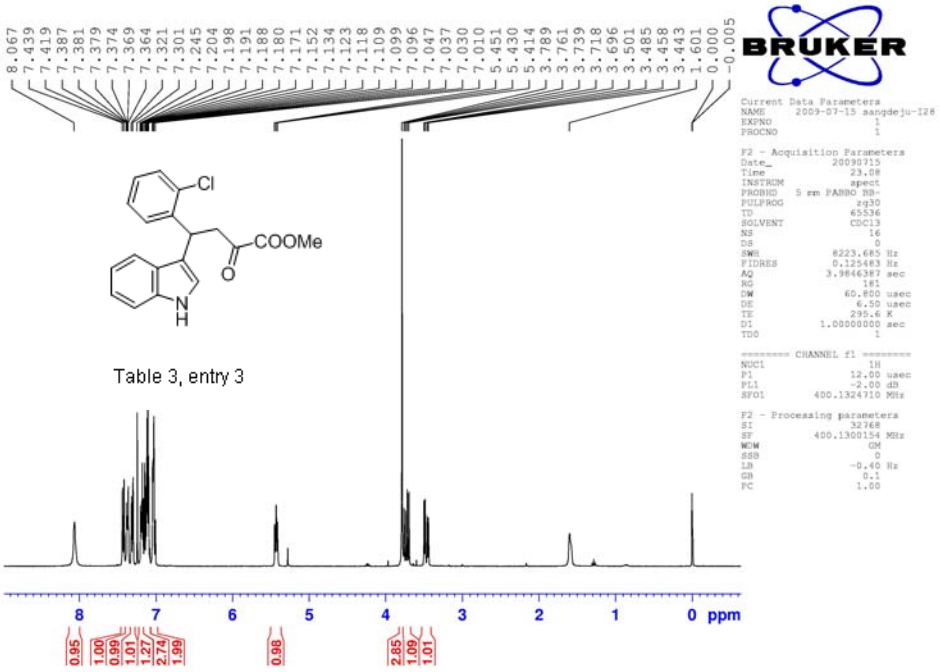
(10) a) K. B. Jensen, J. Thorhauge, R. G. Hazell, K. A. Jørgensen, *Angew. Chem. Int. Ed.* **2001**, *40*, 160; b) G. Desimoni, G. Faita, M. Toscanini, M. Boiocchi, *Chem. Eur. J.* **2008**, *14*, 3630.

(11) M. Rueping, B. J. Nachtsheim, S. A. Moreth, M. Bolte, *Angew. Chem. Int. Ed.* **2008**, *47*, 593.

8. Copy of ^{1}H NMR and ^{13}C NMR spectra for products:



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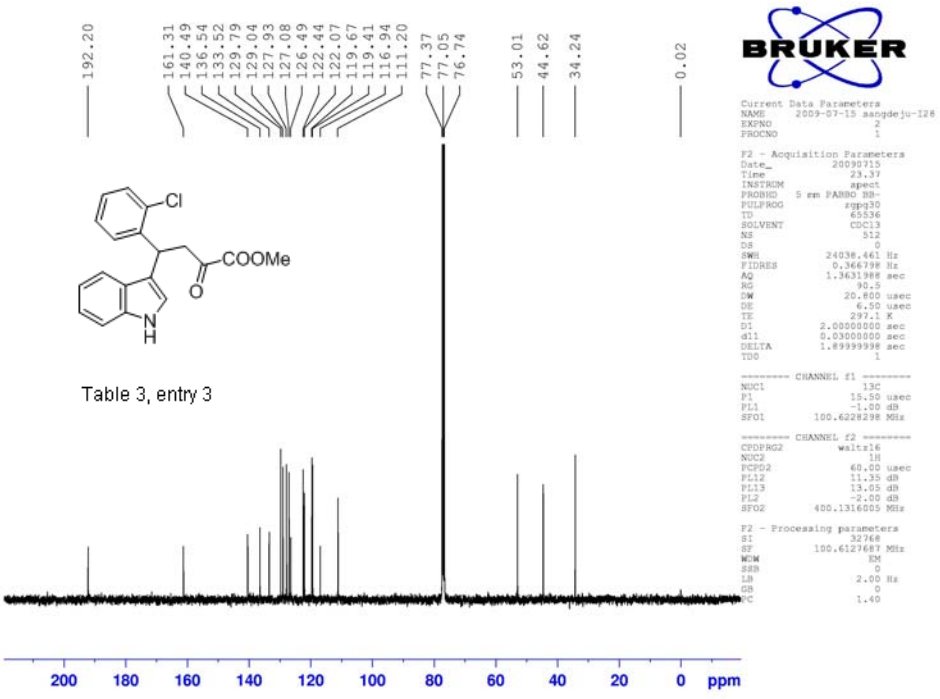
7.439
7.419
7.387
7.381
7.379
7.374
7.369
7.364
7.321
7.301
7.245
7.204
7.198
7.191
7.188
7.180
7.171
7.152
7.134
7.123
7.118
7.109
7.099
7.096
7.047
7.037
7.030
7.010
5.451
5.430
5.414
3.789
3.761
3.739
3.718
3.696
3.501
3.485
3.458
3.443
1.601
0.000
-0.005
Cl
COOMe
O
N
H
Table 3, entry 3
8
7
6
5
4
3
2
1
0 ppm
0.95
1.00
0.99
1.01
1.27
2.74
1.99
0.98
2.85
1.09
1.01
BRUKER
Current Data Parameters
NAME 2009-07-15 sangdeju-I26
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090715
Time 23.08
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 181
DW 60.800 usec
DE 6.50 usec
TE 295.6 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300154 MHz
WDW EM
SSB 0
LB -0.40 Hz
GB 0.1
PC 1.00


192.20
161.31
140.49
136.54
133.52
129.79
129.04
127.93
127.08
126.49
122.44
122.07
119.67
119.41
116.94
111.20
77.37
77.05
76.74
53.01
44.62
34.24
0.02
Cl
COOMe
O
N
H
Table 3, entry 3
200
180
160
140
120
100
80
60
40
20
0 ppm
BRUKER
Current Data Parameters
NAME 2009-07-15 sangdeju-I26
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090715
Time 23.37
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 90.5
DW 20.800 usec
DE 6.50 usec
TE 297.1 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127687 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40

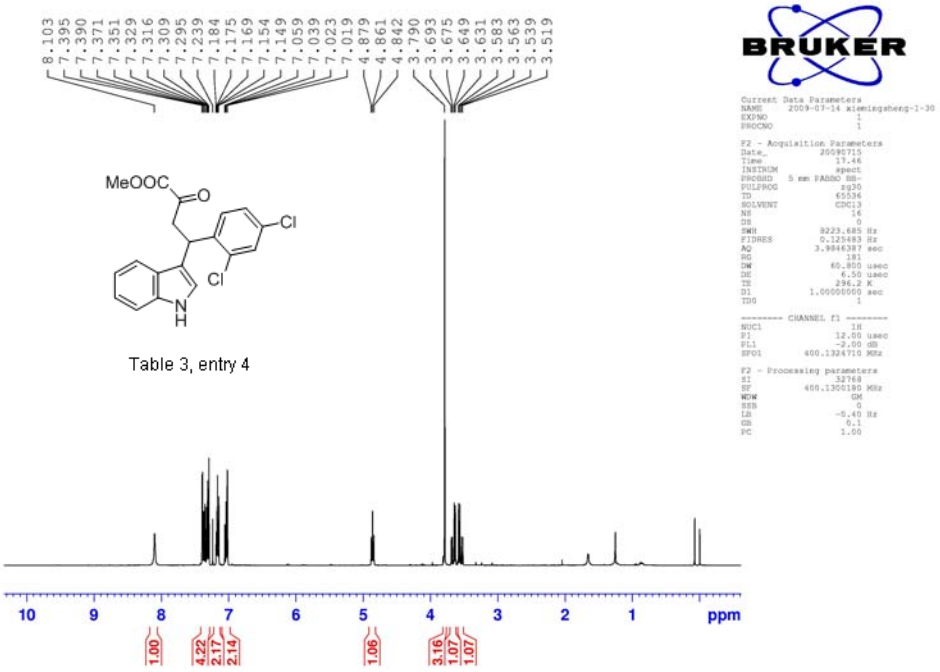


Table 3, entry 4

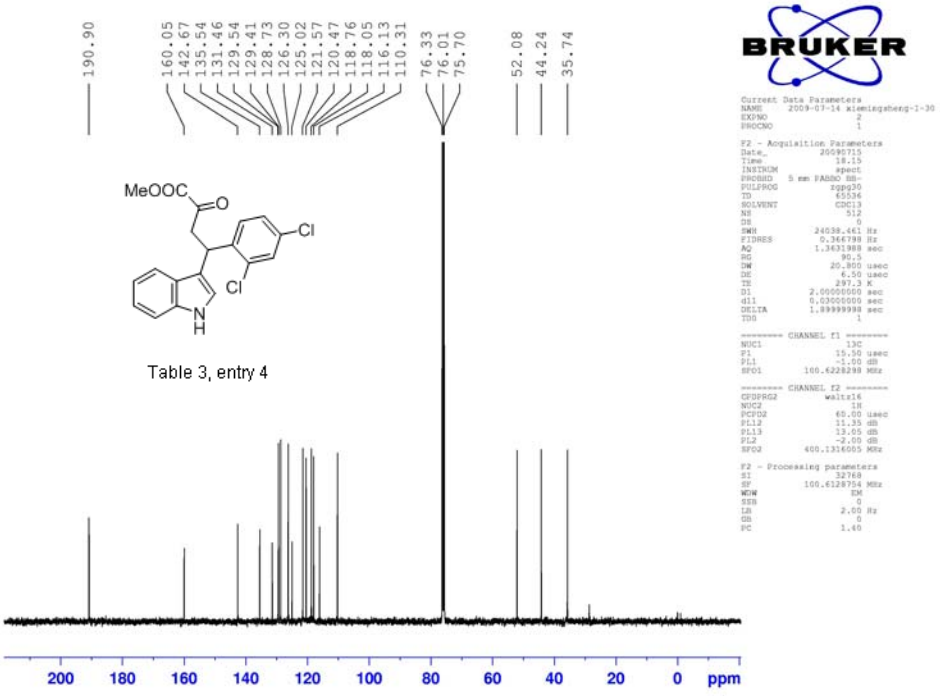
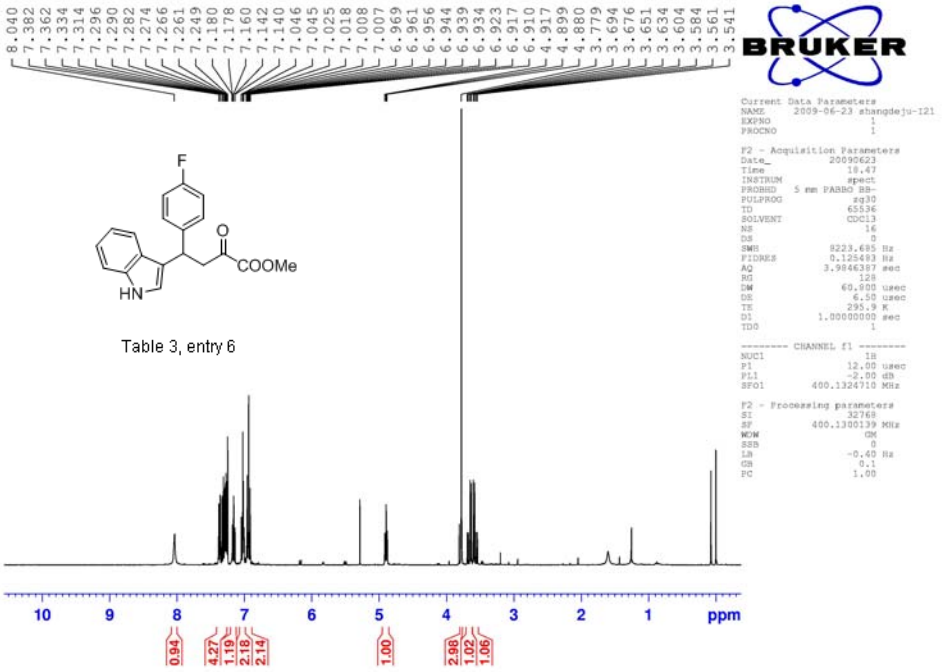


Table 3, entry 4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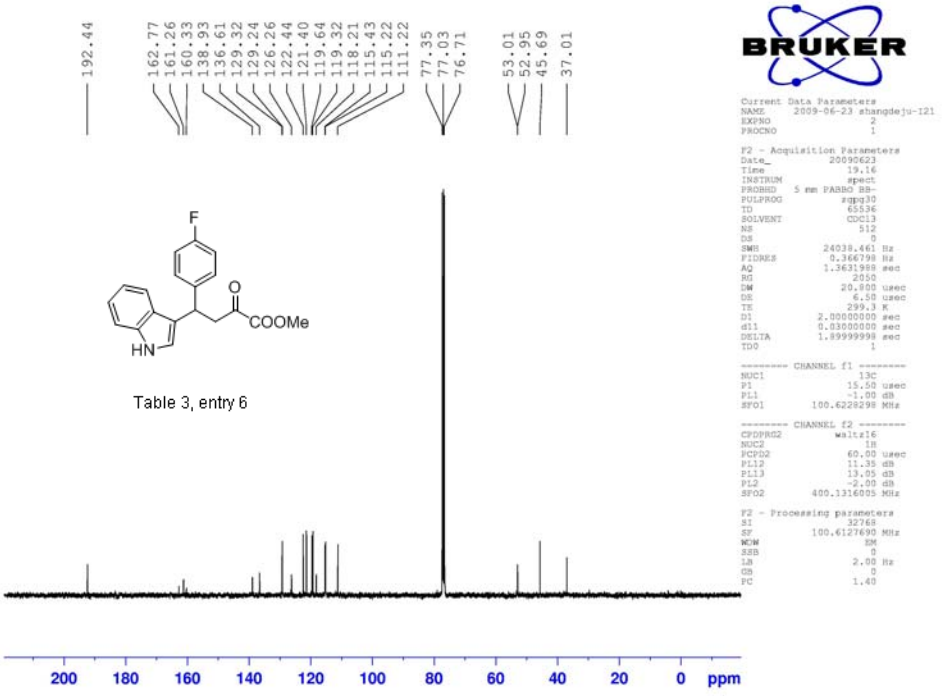
7.362
7.334
7.314
7.296
7.290
7.282
7.274
7.266
7.261
7.249
7.180
7.178
7.160
7.142
7.140
7.046
7.045
7.025
7.018
7.008
7.007
6.969
6.961
6.956
6.944
6.939
6.934
6.923
6.917
6.910
4.917
4.899
4.880
3.779
3.694
3.676
3.651
3.634
3.604
3.584
3.561
3.541
F
O
COOMe
HN
Table 3, entry 6
BRUKER
Current Data Parameters
NAME 2009-06-23 shangdeju-I21
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090623
Time 18.47
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 295.9 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300139 MHz
WDW EM
SSB 0
LB -0.40 Hz
GB 0.1
PC 1.00
10
9
8
7
6
5
4
3
2
1
ppm
0.94
4.27
1.19
2.18
2.14
1.00
2.98
1.02
1.06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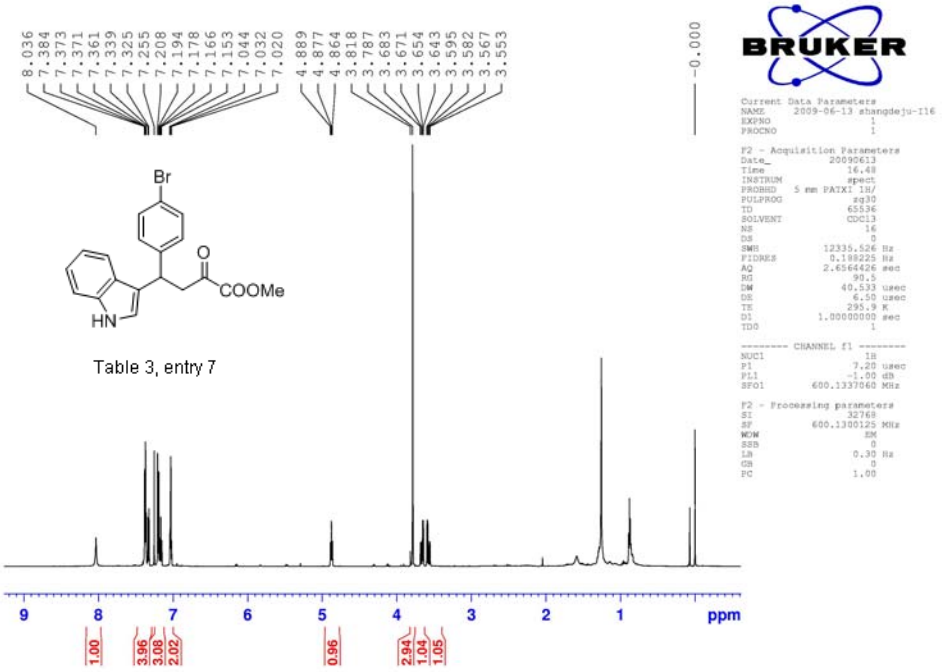
162.77
161.26
160.33
138.93
136.61
129.32
129.24
126.26
122.44
121.40
119.64
119.32
118.21
115.43
115.22
111.22
77.35
77.03
76.71
53.01
52.95
45.69
37.01
F
O
COOMe
HN
Table 3, entry 6
BRUKER
Current Data Parameters
NAME 2009-06-23 shangdeju-I21
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090623
Time 19.16
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631989 sec
RG 2050
DW 20.800 usec
DE 6.50 usec
TE 299.3 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40
200
180
160
140
120
100
80
60
40
20
0
ppm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7.384
7.373
7.371
7.361
7.339
7.325
7.255
7.208
7.194
7.178
7.166
7.153
7.044
7.032
7.020
4.889
4.877
4.864
3.818
3.787
3.683
3.671
3.654
3.643
3.595
3.582
3.567
3.553
-0.000
Br
O
COOMe
HN
Table 3, entry 7
9
8
7
6
5
4
3
2
1
ppm
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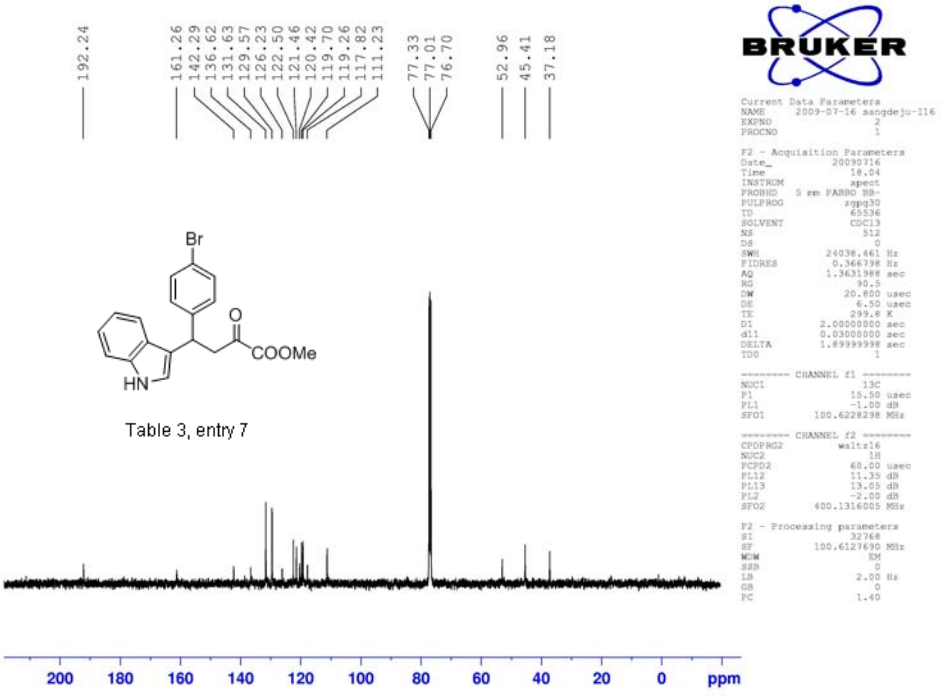
3.96
3.08
2.02
0.96
2.94
1.04
1.05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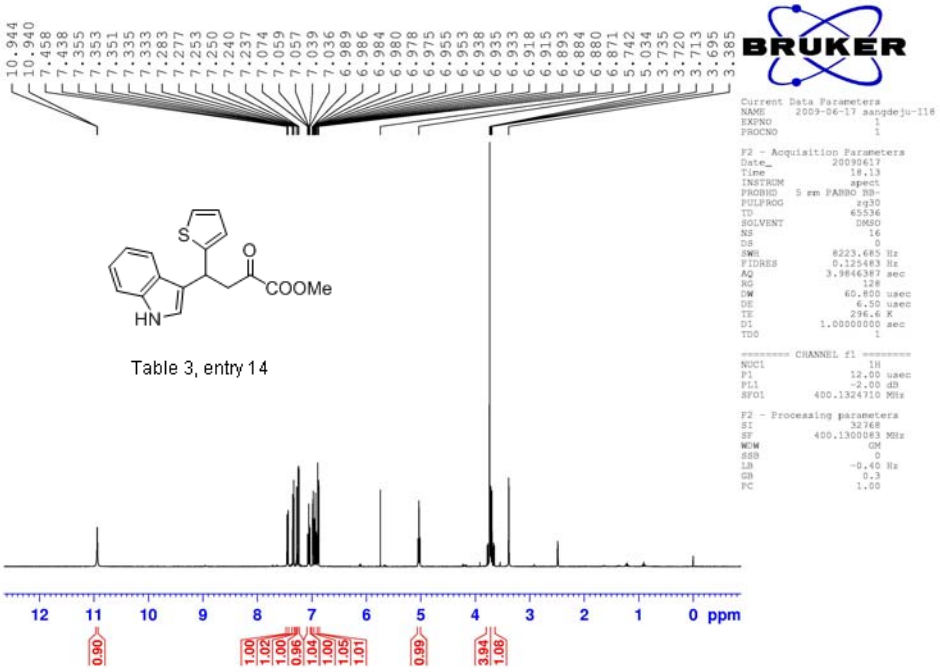
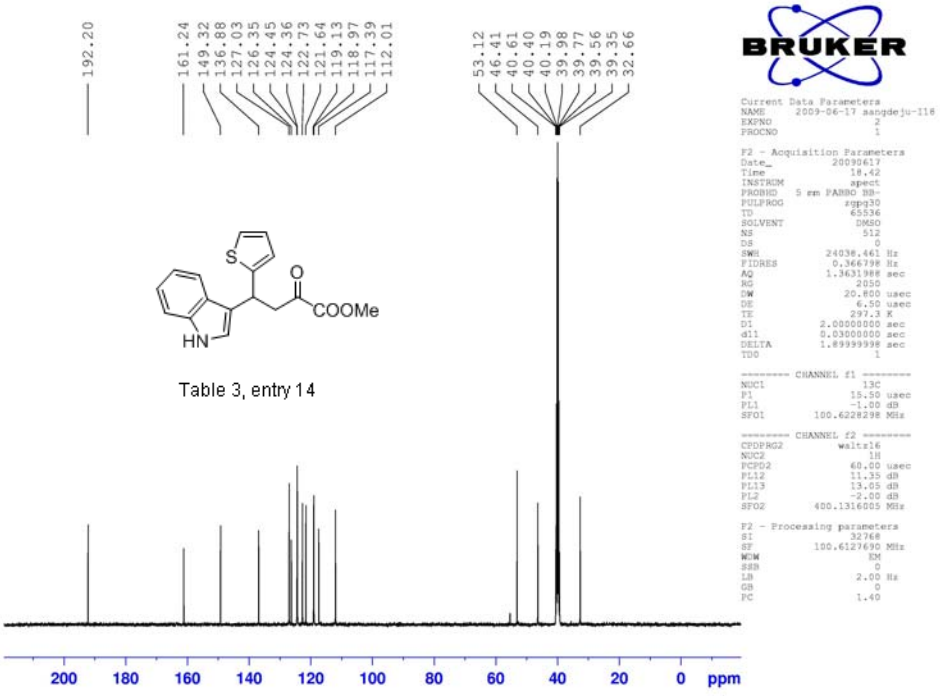
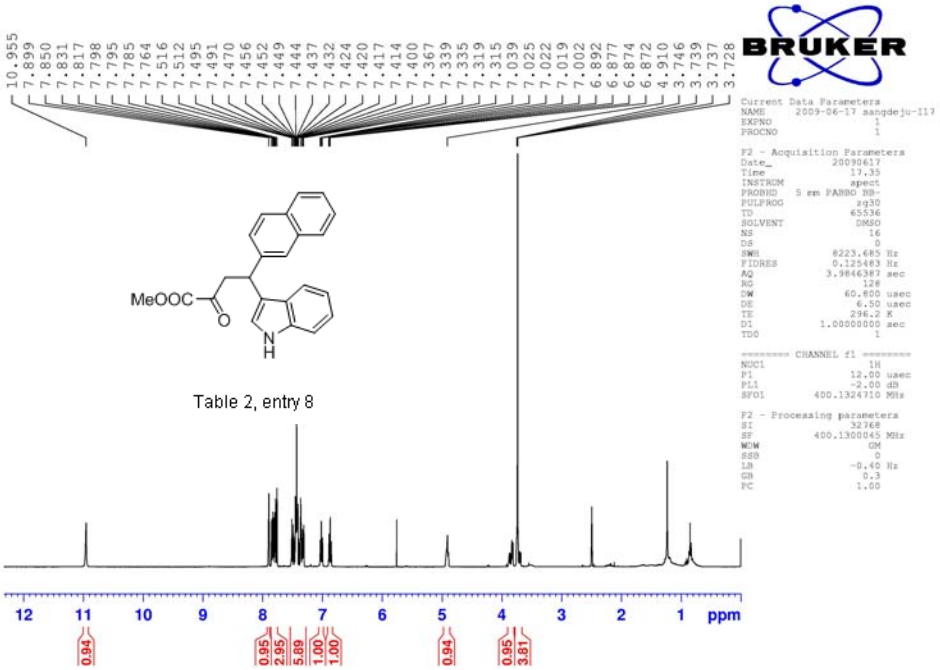
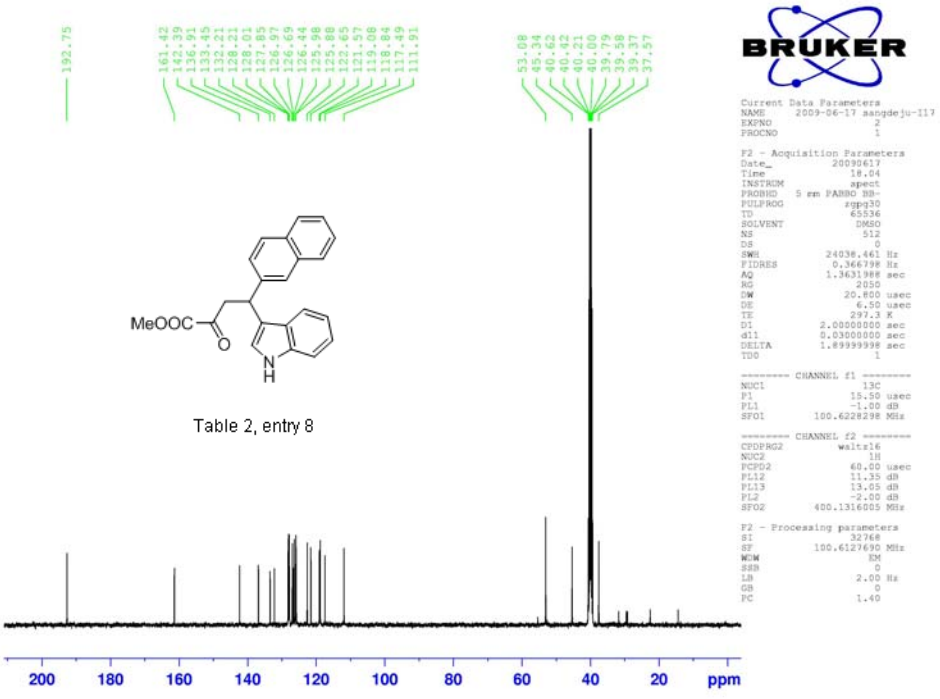
161.26
142.29
136.62
131.63
129.57
126.23
122.50
121.46
120.42
119.70
119.26
117.82
111.23
77.33
77.01
76.70
52.96
45.41
37.18
Br
O
COOMe
HN
Table 3, entry 7
200
180
160
140
120
100
80
60
40
20
0
ppm


10.944
10.940
7.458
7.438
7.355
7.353
7.351
7.335
7.333
7.283
7.277
7.253
7.250
7.240
7.237
7.074
7.059
7.057
7.039
7.036
6.989
6.986
6.984
6.980
6.978
6.975
6.955
6.953
6.938
6.935
6.933
6.918
6.915
6.893
6.884
6.880
6.871
5.742
5.034
3.735
3.720
3.713
3.695
3.385
S
O
COOMe
HN
Table 3, entry 14
12
11
10
9
8
7
6
5
4
3
2
1
0 ppm
0.90
1.00
1.02
1.00
0.96
1.04
1.00
1.05
1.01
0.99
3.94
1.06


192.20
161.24
149.32
136.88
127.03
126.35
124.45
124.36
122.73
121.64
119.13
118.97
117.39
112.01
53.12
46.41
40.61
40.40
40.19
39.98
39.77
39.56
39.35
32.66
S
O
COOMe
HN
Table 3, entry 14
200
180
160
140
120
100
80
60
40
20
0 ppm


10.955
7.899
7.850
7.831
7.817
7.798
7.795
7.785
7.764
7.516
7.512
7.495
7.491
7.470
7.456
7.452
7.449
7.444
7.437
7.432
7.424
7.420
7.417
7.414
7.400
7.367
7.339
7.335
7.319
7.315
7.039
7.025
7.022
7.019
7.002
6.892
6.877
6.874
6.872
4.910
3.746
3.739
3.737
3.728
BRUKER
MeOOC
O
N
H
Table 2, entry 8
12
11
10
9
8
7
6
5
4
3
2
1
ppm
0.94
0.95
2.95
5.89
1.00
1.00
0.94
0.95
3.81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161.42
142.39
136.91
133.45
132.21
128.21
128.01
127.85
126.97
126.69
126.44
125.98
125.88
122.65
121.57
119.08
118.84
117.49
111.91
53.08
45.34
40.62
40.42
40.21
40.00
39.79
39.58
39.37
37.57
BRUKER
MeOOC
O
N
H
Table 2, entry 8
200
180
160
140
120
100
80
60
40
20
ppm

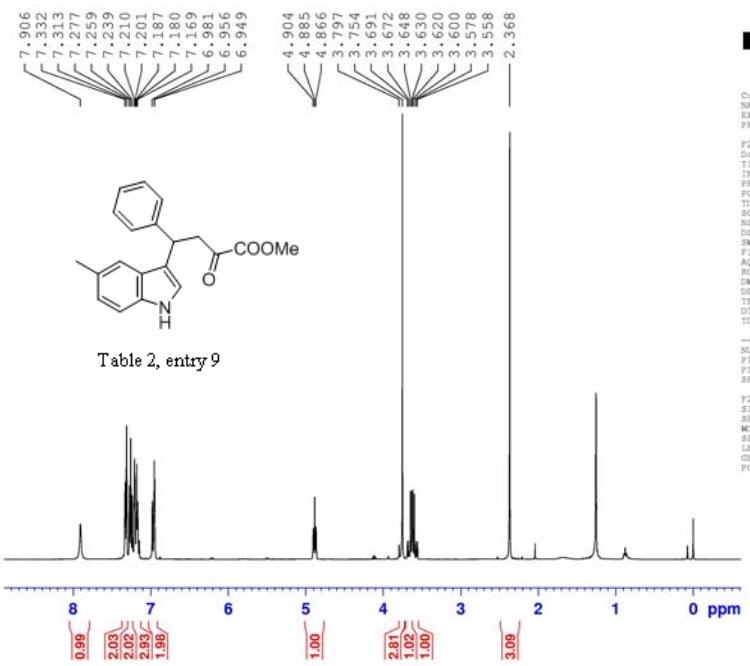


Table 2, entry 9

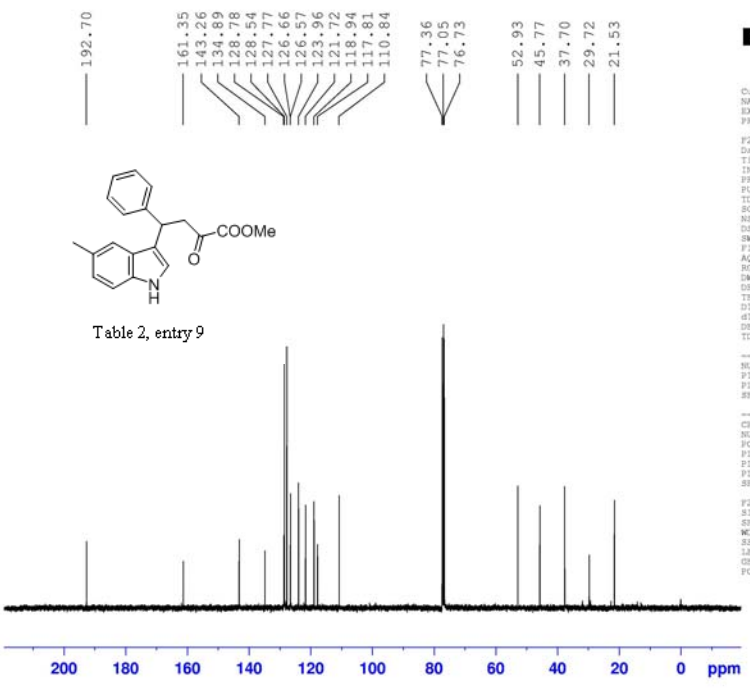


Table 2, entry 9

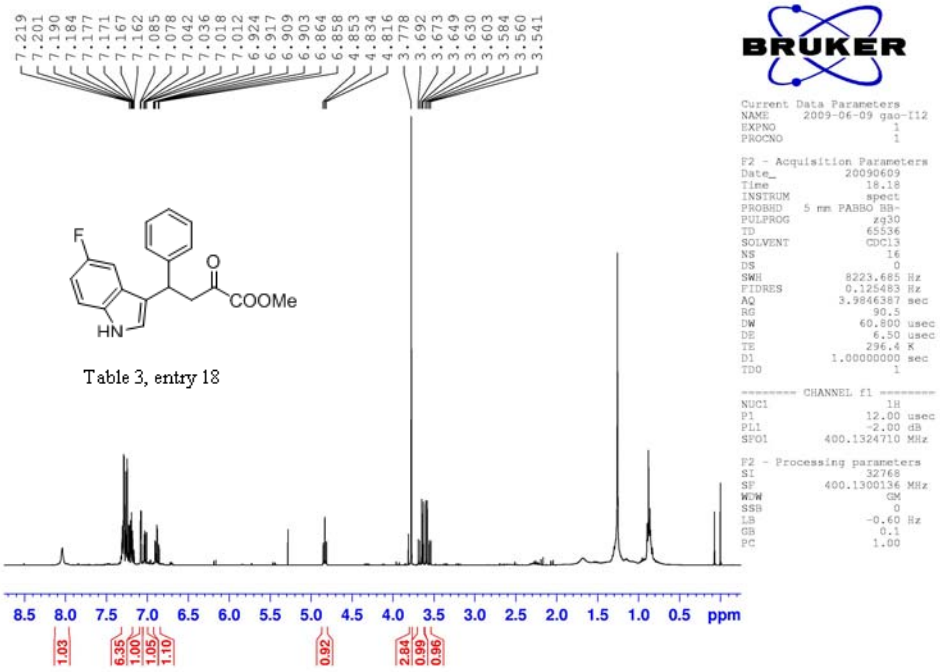


Table 3, entry 18


```
Current Data Parameters
NAME        2009-06-09 gao-I12
EXPNO                        1
PROCNO                       1

F2 - Acquisition Parameters
Date_              20090609
Time                 18.18
INSTRUM              spect
PROBHD    5 mm PABBO BB-
PULPROG              zg30
TD                  65536
SOLVENT              CDCl3
NS                      16
DS                       0
SWH               8223.685 Hz
FIDRES            0.125483 Hz
AQ                3.9846387 sec
RG                    90.5
DW                  60.800 usec
DE                   6.50 usec
TE                  296.4 K
D1                1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                    1H
P1                   12.00 usec
PL1                  -2.00 dB
SFO1           400.1324710 MHz

F2 - Processing parameters
SI                   32768
SF               400.1300136 MHz
WDW                     EM
SSB                      0
LB                   -0.60 Hz
GB                     0.1
PC                    1.00
```

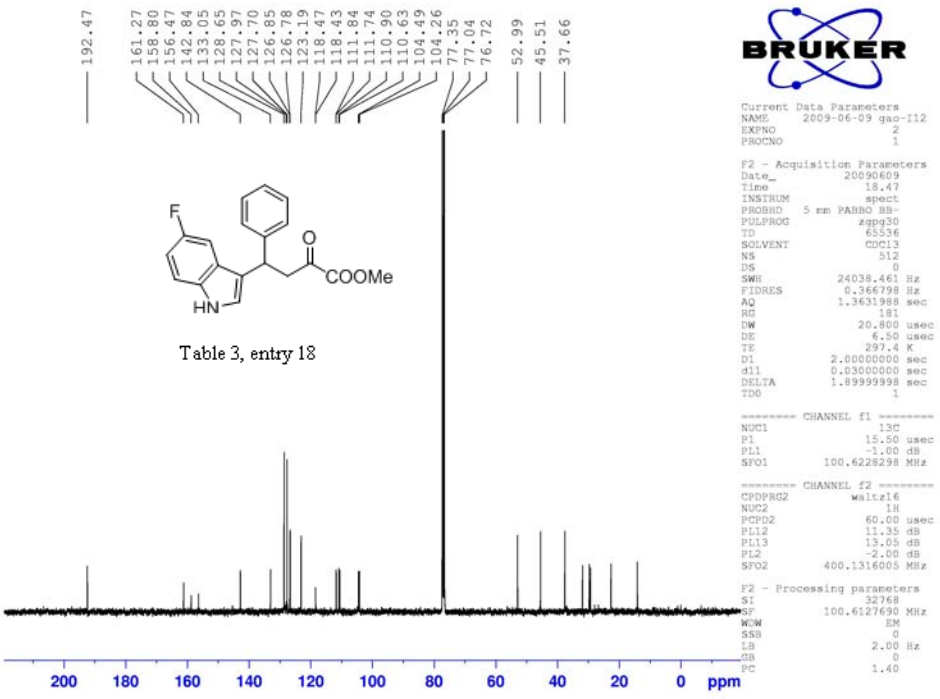


Table 3, entry 18


```
Current Data Parameters
NAME        2009-06-09 gao-I12
EXPNO                        2
PROCNO                       1

F2 - Acquisition Parameters
Date_              20090609
Time                 18.47
INSTRUM              spect
PROBHD    5 mm PABBO BB-
PULPROG            zgpg30
TD                  65536
SOLVENT              CDCl3
NS                     512
DS                       0
SWH              24038.461 Hz
FIDRES            0.366798 Hz
AQ                1.3631988 sec
RG                     181
DW                  20.800 usec
DE                   6.50 usec
TE                  297.4 K
D1                2.00000000 sec
d11               0.03000000 sec
DELTA             1.89999998 sec
TD0                      1

======== CHANNEL f1 ========
NUC1                   13C
P1                   15.50 usec
PL1                  -1.00 dB
SFO1           100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG2            waltz16
NUC2                    1H
PCPD2                60.00 usec
PL12                 11.35 dB
PL13                 13.05 dB
PL2                  -2.00 dB
SFO2           400.1316005 MHz

F2 - Processing parameters
SI                   32768
SF               100.6127690 MHz
WDW                     EM
SSB                      0
LB                    2.00 Hz
GB                       0
PC                    1.40
```

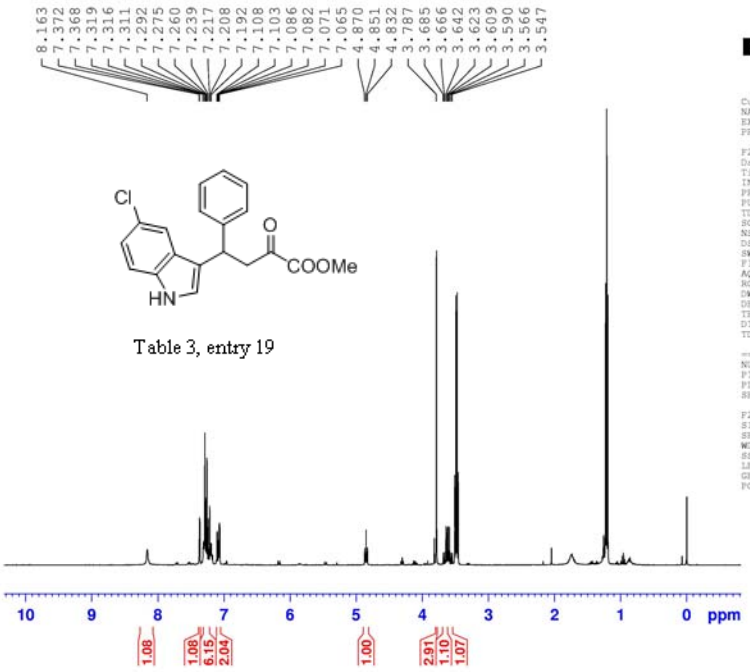


Table 3, entry 19

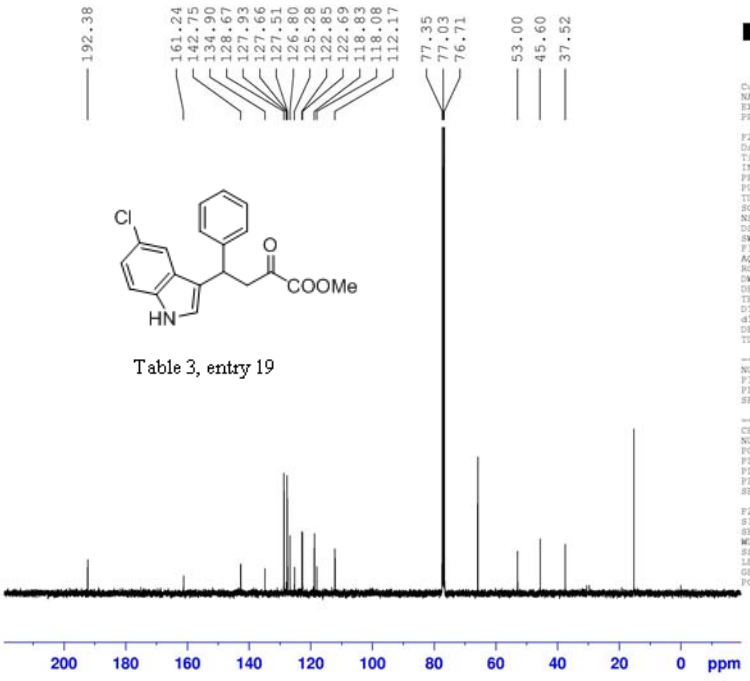
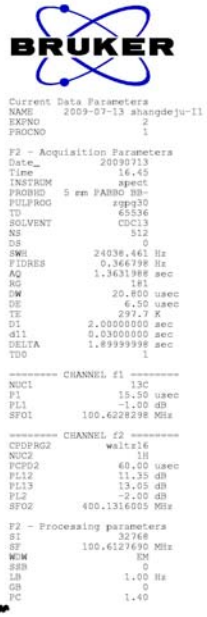
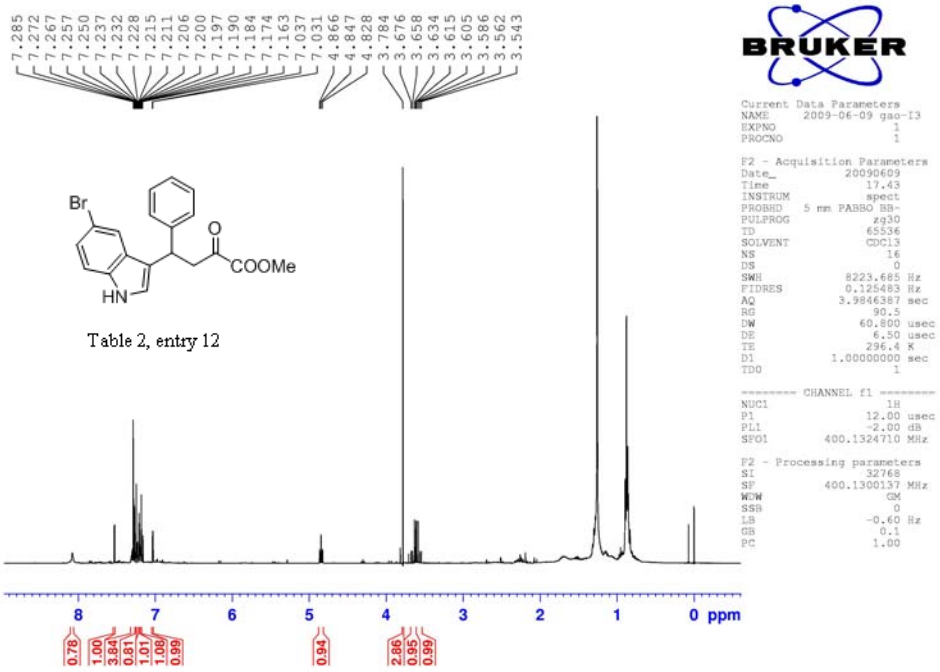
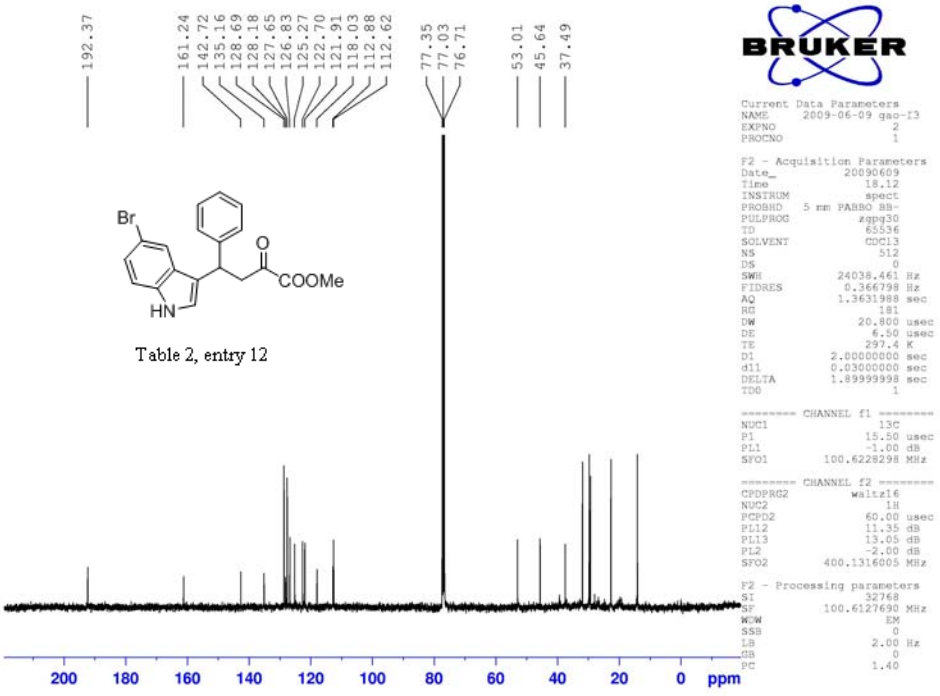


Table 3, entry 19

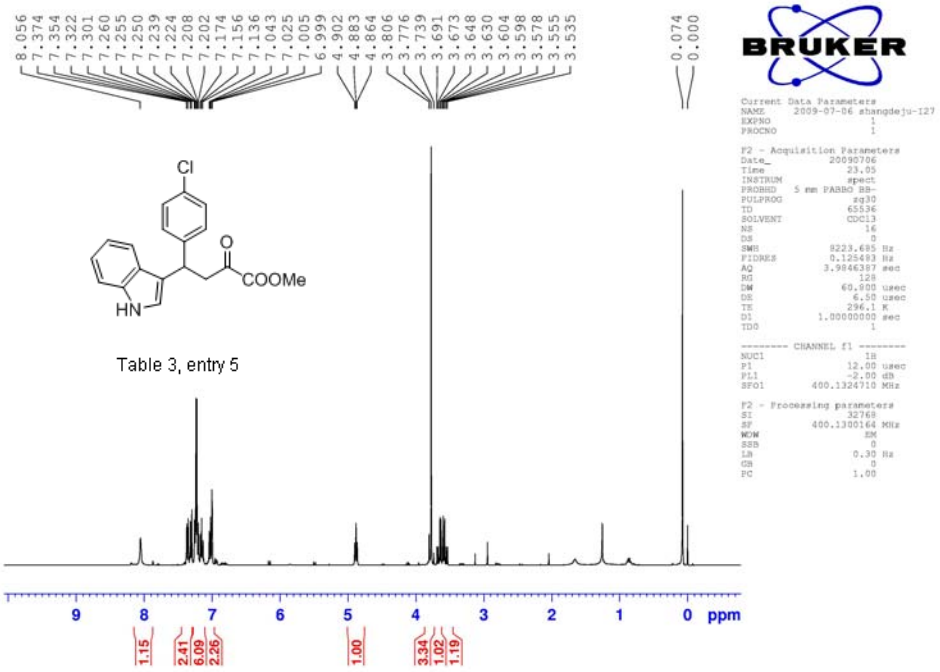


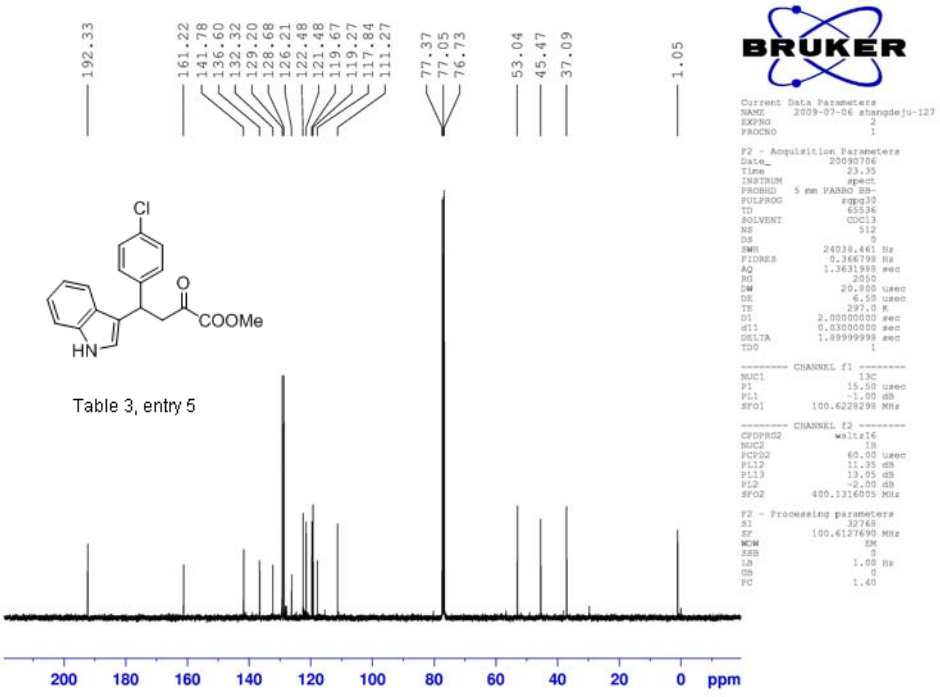


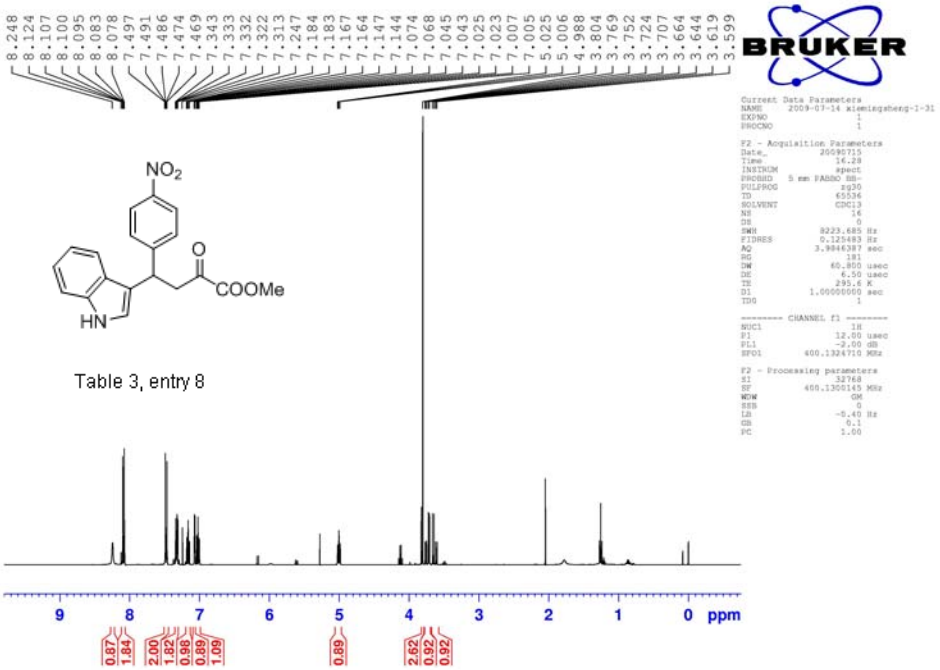

```
Current Data Parameters
NAME      2009-06-09 gao-I3
EXPNO                    1
PROCNO                   1

F2 - Acquisition Parameters
Date_              20090609
Time                  17.43
INSTRUM                spect
PROBHD   5 mm PABBO BB-
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                       16
DS                        0
SWH                8223.685 Hz
FIDRES            0.125483 Hz
AQ                3.9846387 sec
RG                      90.5
DW                  60.800 usec
DE                   6.50 usec
TE                  296.4 K
D1                1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
NUC1                     1H
P1                   12.00 usec
PL1                  -2.00 dB
SFO1           400.1324710 MHz

F2 - Processing parameters
SI                       32768
SF                400.1300137 MHz
WDW                         EM
SSB                          0
LB                       -0.60 Hz
GB                         0.1
PC                        1.00
```

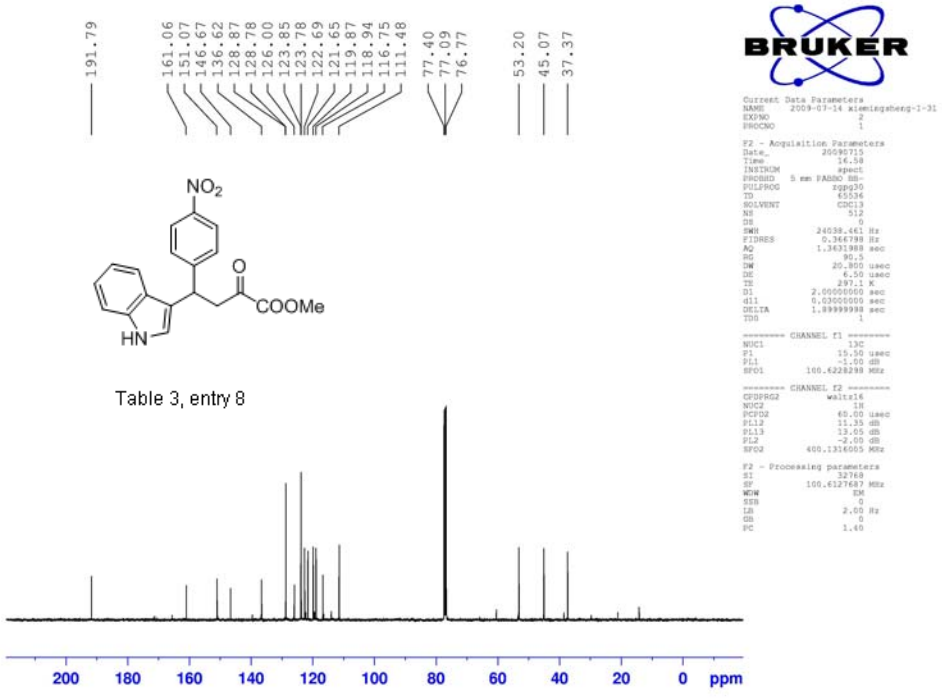


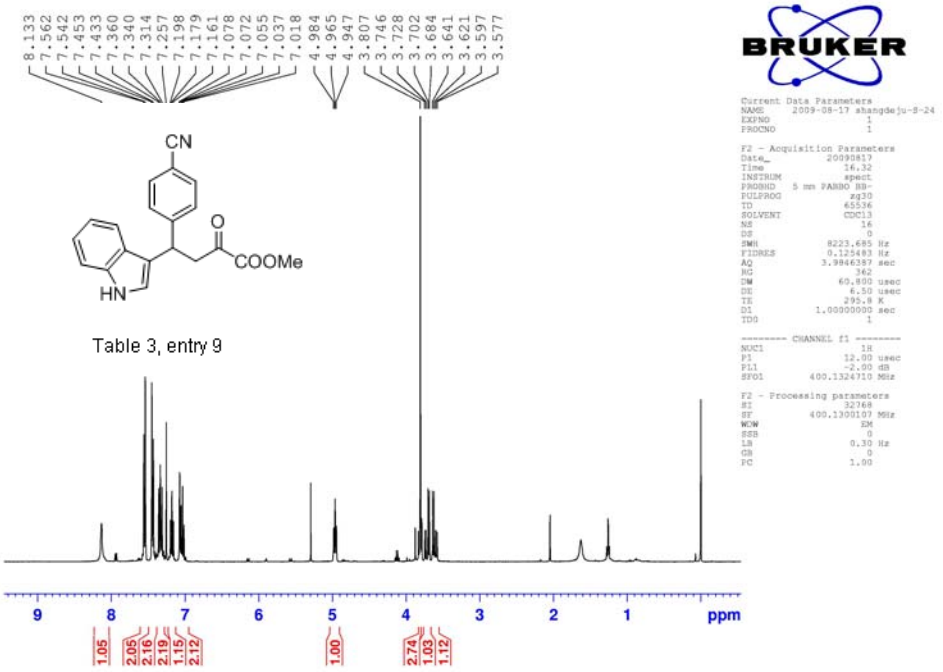

```
Current Data Parameters
NAME      2009-06-09 gao-I3
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_              20090609
Time                  18.12
INSTRUM                spect
PROBHD   5 mm PABBO BB-
PULPROG             zgpg30
TD                    65536
SOLVENT               CDCl3
NS                      512
DS                        0
SWH               24038.461 Hz
FIDRES            0.366798 Hz
AQ                1.3631988 sec
RG                      181
DW                  20.800 usec
DE                   6.50 usec
TE                  297.4 K
D1                2.00000000 sec
d11               0.03000000 sec
DELTA             1.89999998 sec
TD0                       1

======== CHANNEL f1 ========
NUC1                    13C
P1                   15.50 usec
PL1                  -1.00 dB
SFO1           100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG2             waltz16
NUC2                     1H
PCPD2                60.00 usec
PL12                 11.35 dB
PL13                 13.05 dB
PL2                  -2.00 dB
SFO2           400.1316005 MHz

F2 - Processing parameters
SI                       32768
SF                100.6127690 MHz
WDW                         EM
SSB                          0
LB                        2.00 Hz
GB                           0
PC                        1.40
```

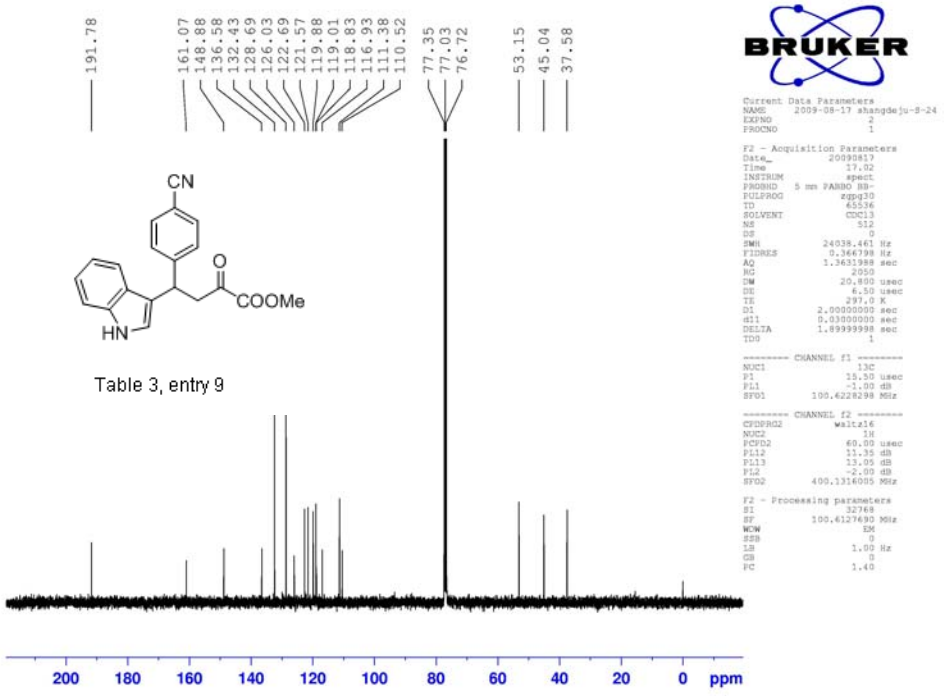

8.056
7.374
7.354
7.322
7.301
7.260
7.255
7.250
7.239
7.224
7.208
7.202
7.174
7.156
7.136
7.043
7.025
7.005
6.999
4.902
4.883
4.864
3.806
3.776
3.739
3.691
3.673
3.648
3.630
3.604
3.598
3.578
3.555
3.535
0.074
0.000
Cl
O
COOMe
HN
Table 3, entry 5
9
8
7
6
5
4
3
2
1
0
ppm
1.15
2.41
6.09
2.26
1.00
3.34
1.02
1.19
BRUKER
Current Data Parameters
NAME 2009-07-06 shangdeju-I27
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090706
Time 23.05
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 296.1 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300164 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

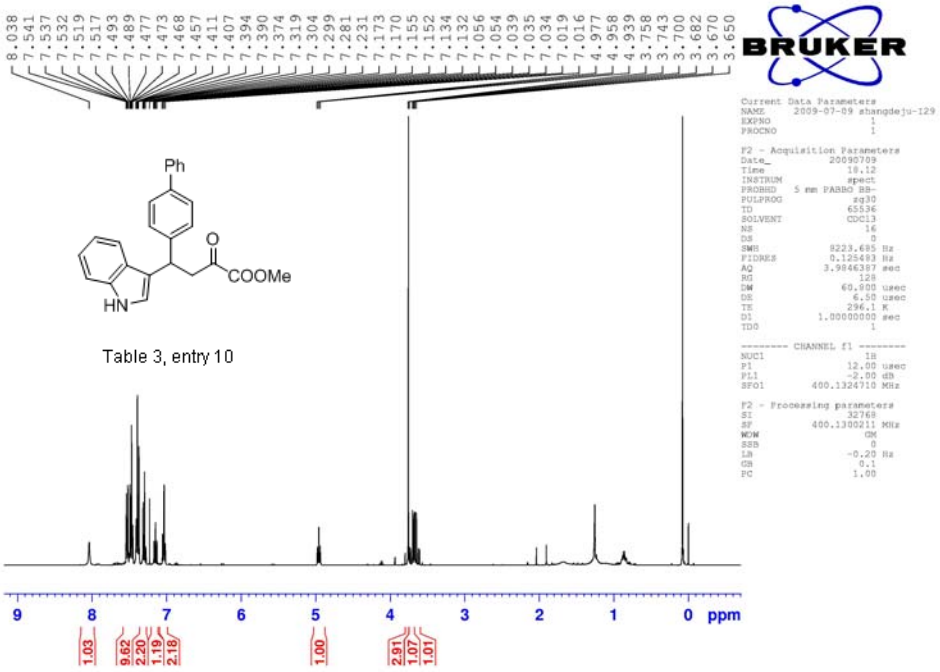

192.33
161.22
141.78
136.60
132.32
129.20
128.68
126.21
122.48
121.48
119.67
119.27
117.84
111.27
77.37
77.05
76.73
53.04
45.47
37.09
1.05
Cl
O
COOMe
HN
Table 3, entry 5
200
180
160
140
120
100
80
60
40
20
0
ppm
BRUKER
Current Data Parameters
NAME 2009-07-06 shangdeju-I27
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090706
Time 23.35
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631989 sec
RG 2050
DW 20.800 usec
DE 6.50 usec
TE 297.0 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

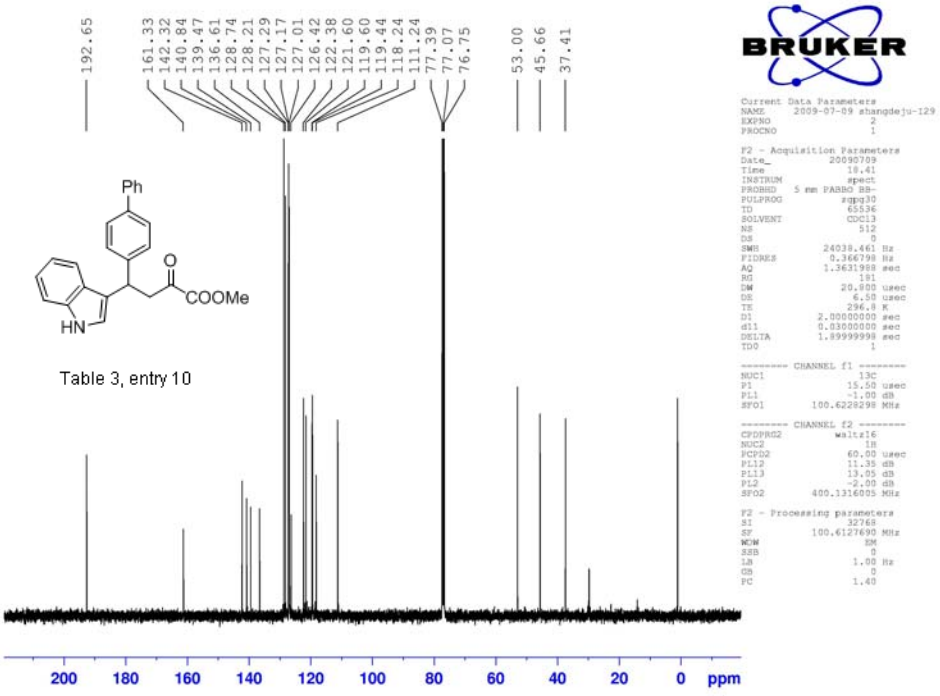

8.248
8.124
8.107
8.100
8.095
8.083
8.078
7.497
7.491
7.486
7.474
7.469
7.343
7.333
7.332
7.322
7.313
7.247
7.184
7.183
7.167
7.164
7.147
7.144
7.074
7.068
7.045
7.043
7.025
7.023
7.007
7.005
5.025
5.006
4.988
3.804
3.769
3.752
3.724
3.707
3.664
3.644
3.619
3.599
NO2
O
COOMe
HN
Table 3, entry 8
9
8
7
6
5
4
3
2
1
0
ppm
0.87
1.84
2.00
1.82
0.98
0.89
1.09
0.89
2.62
0.92
0.92

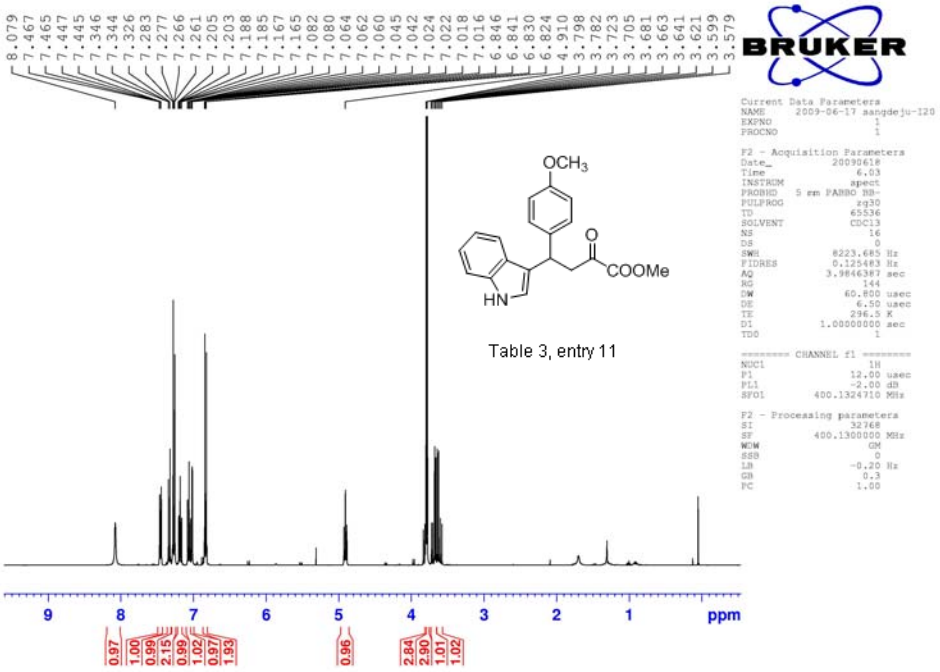

191.79
161.06
151.07
146.67
136.62
128.87
128.78
126.00
123.85
123.78
122.69
121.65
119.87
118.94
116.75
111.48
77.40
77.09
76.77
53.20
45.07
37.37
NO2
O
COOMe
HN
Table 3, entry 8
200
180
160
140
120
100
80
60
40
20
0
ppm


8.133
7.562
7.542
7.453
7.433
7.360
7.340
7.314
7.257
7.198
7.179
7.161
7.078
7.072
7.055
7.037
7.018
4.984
4.965
4.947
3.807
3.746
3.728
3.702
3.684
3.641
3.621
3.597
3.577
CN
O
COOMe
HN
Table 3, entry 9
9
8
7
6
5
4
3
2
1
ppm
1.05
2.05
2.16
2.19
1.15
2.12
1.00
2.74
1.03
1.12

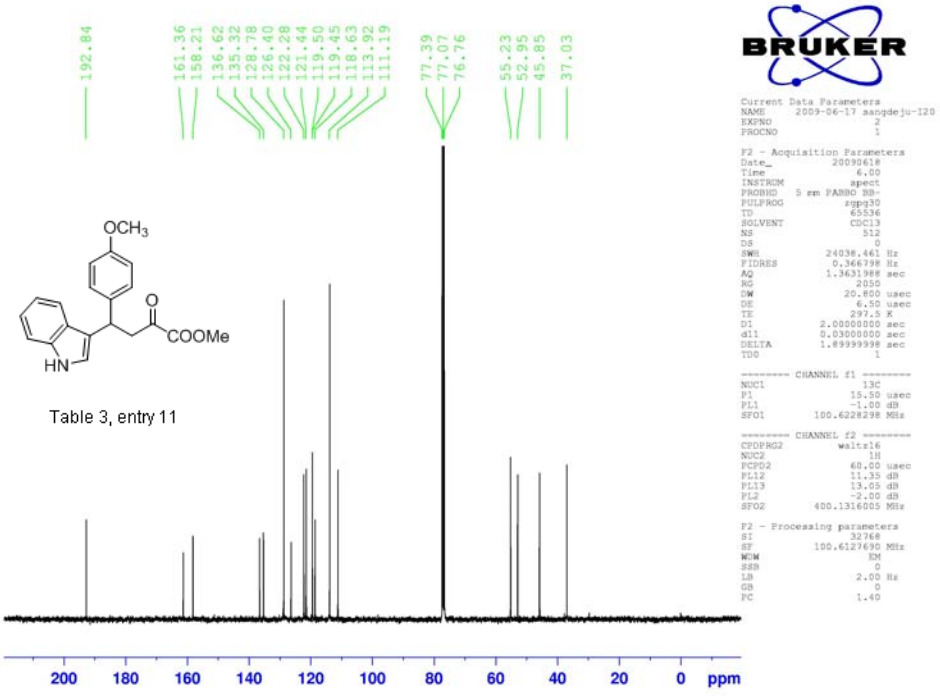

191.78
161.07
148.88
136.58
132.43
128.69
126.03
122.69
121.57
119.88
119.01
118.83
116.93
111.38
110.52
77.35
77.03
76.72
53.15
45.04
37.58
CN
O
COOMe
HN
Table 3, entry 9
200
180
160
140
120
100
80
60
40
20
0
ppm


8.038
7.541
7.537
7.532
7.519
7.517
7.493
7.489
7.477
7.473
7.468
7.457
7.411
7.407
7.394
7.390
7.374
7.319
7.304
7.299
7.281
7.231
7.173
7.170
7.155
7.152
7.134
7.132
7.056
7.054
7.039
7.035
7.034
7.019
7.016
4.977
4.958
4.939
3.758
3.743
3.700
3.682
3.670
3.650
Ph
O
COOMe
HN
Table 3, entry 10
9
8
7
6
5
4
3
2
1
0
ppm
1.03
9.62
2.20
1.19
2.18
1.00
2.91
1.07
1.01
BRUKER
Current Data Parameters
NAME 2009-07-09 shangdeju-129
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090709
Time 18.12
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 296.1 K
D1 1.00000000 sec
TD0 1
-------- CHANNEL f1 --------
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300211 MHz
WDW EM
SSB 0
LB -0.20 Hz
GB 0.1
PC 1.00

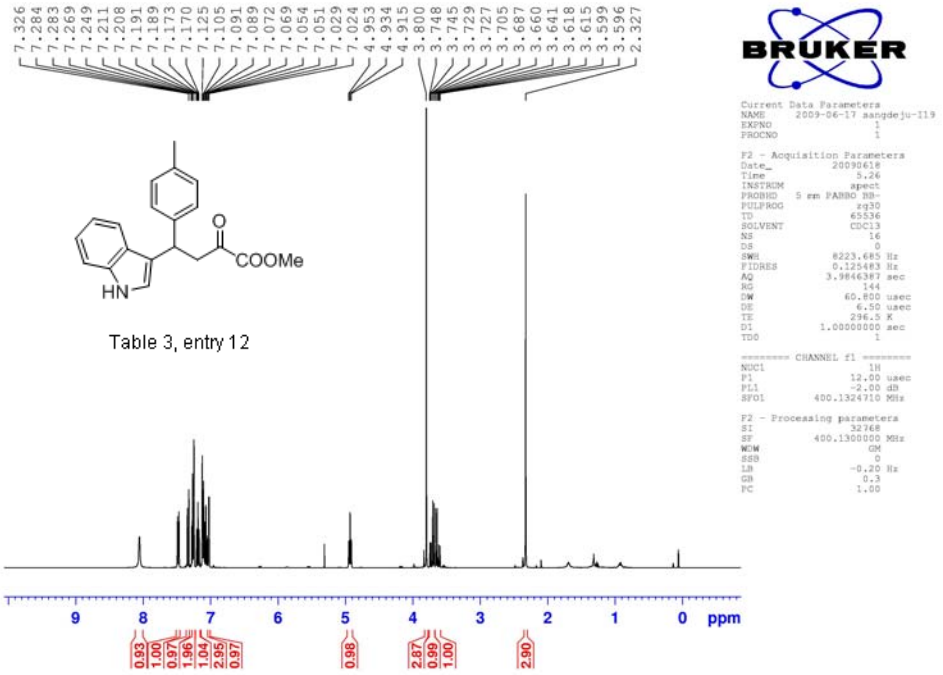

192.65
161.33
142.32
140.84
139.47
136.61
128.74
128.21
127.29
127.17
127.01
126.42
122.38
121.60
119.60
119.44
118.24
111.24
77.39
77.07
76.75
53.00
45.66
37.41
Ph
O
COOMe
HN
Table 3, entry 10
200
180
160
140
120
100
80
60
40
20
0
ppm
BRUKER
Current Data Parameters
NAME 2009-07-09 shangdeju-129
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090709
Time 19.41
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 181
DW 20.800 usec
DE 6.50 usec
TE 296.0 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
-------- CHANNEL f1 --------
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
-------- CHANNEL f2 --------
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40


8.079
7.467
7.465
7.447
7.445
7.346
7.344
7.326
7.283
7.277
7.266
7.261
7.205
7.203
7.188
7.185
7.167
7.165
7.082
7.080
7.064
7.062
7.060
7.045
7.042
7.024
7.022
7.018
7.016
6.846
6.841
6.830
6.824
4.910
3.798
3.782
3.723
3.705
3.681
3.663
3.641
3.621
3.599
3.579
OCH3
O
COOMe
HN
Table 3, entry 11
9
8
7
6
5
4
3
2
1
ppm
0.97
1.00
0.99
2.15
0.99
1.02
0.97
1.93
0.96
2.84
2.90
1.01
1.02

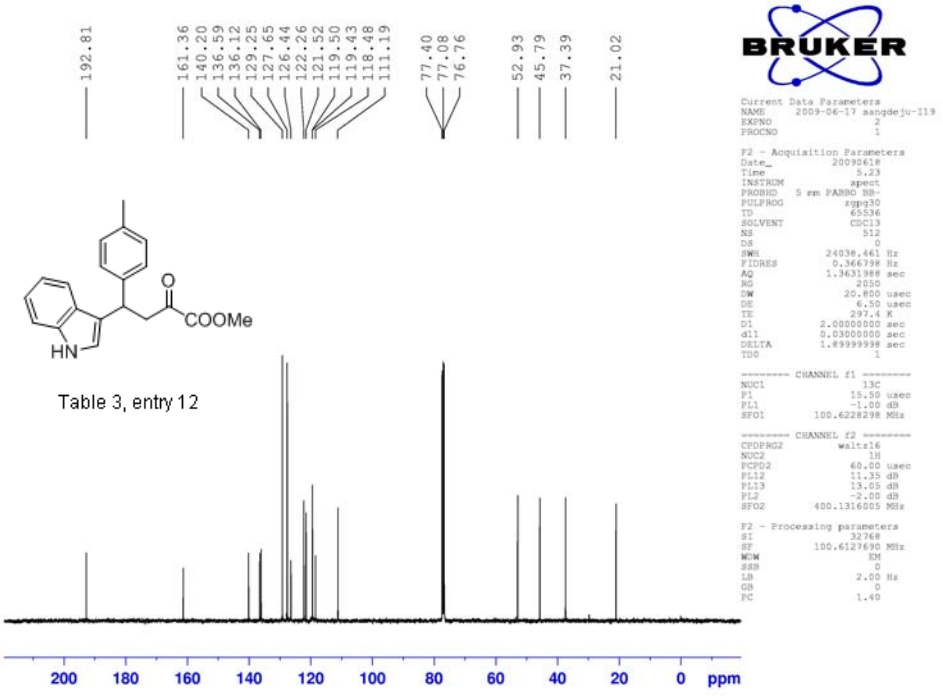
Current Data Parameters
NAME 2009-06-17 sangdeju-I20
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090618
Time 6.03
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 296.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300000 MHz
WDW EM
SSB 0
LB -0.20 Hz
GB 0.3
PC 1.00


192.84
161.36
158.21
136.62
135.32
128.78
126.40
122.28
121.44
119.50
119.45
118.63
113.92
111.19
77.39
77.07
76.76
55.23
52.95
45.85
37.03
OCH3
O
COOMe
HN
Table 3, entry 11
200
180
160
140
120
100
80
60
40
20
0
ppm

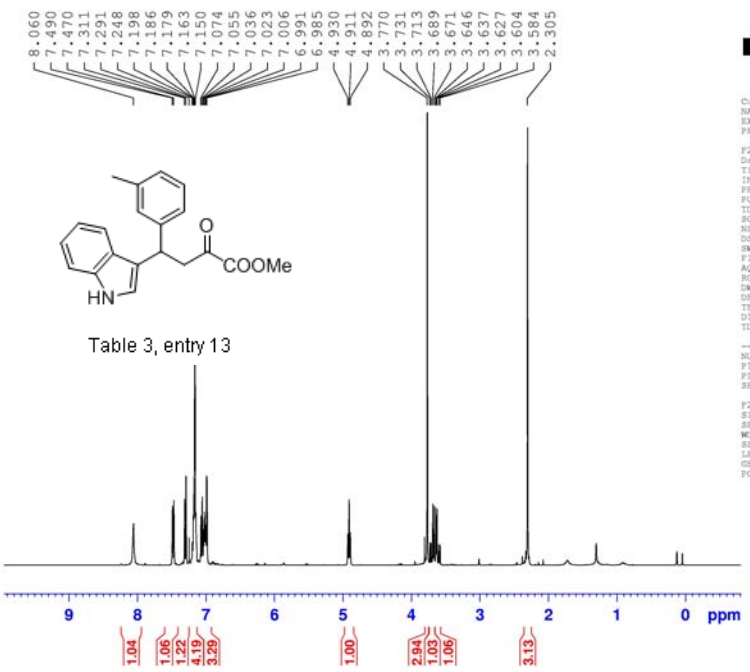
Current Data Parameters
NAME 2009-06-17 sangdeju-I20
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090618
Time 6.00
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 2050
DW 20.800 usec
DE 6.50 usec
TE 297.5 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40


7.326
7.284
7.283
7.269
7.249
7.211
7.208
7.191
7.189
7.173
7.170
7.125
7.105
7.091
7.089
7.072
7.069
7.054
7.051
7.029
7.024
4.953
4.934
4.915
3.800
3.748
3.745
3.729
3.727
3.705
3.687
3.660
3.641
3.618
3.615
3.599
3.596
2.327
O
COOMe
HN
Table 3, entry 12
9
8
7
6
5
4
3
2
1
0
ppm
0.93
1.00
0.97
1.96
1.04
2.95
0.97
0.98
2.87
0.99
1.00
2.90

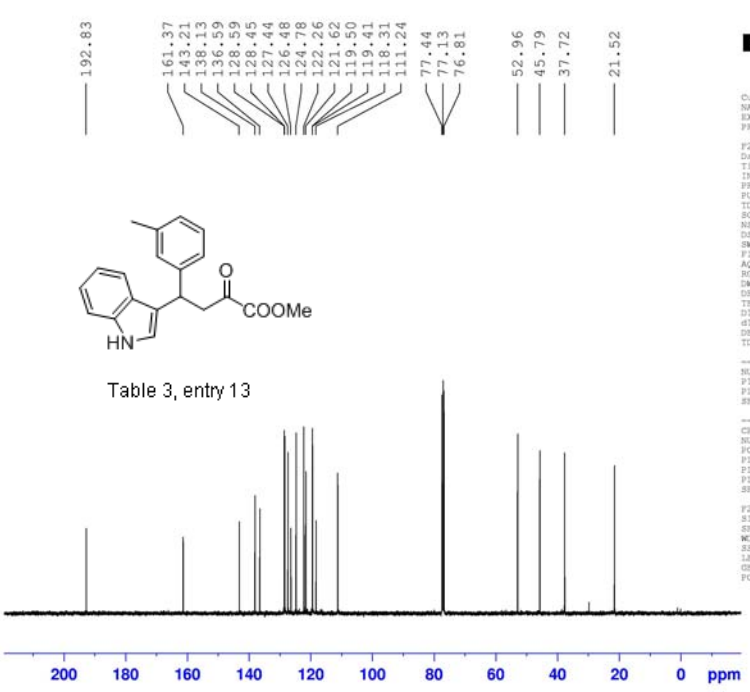
BRUKER
Current Data Parameters
NAME 2009-06-17 sangdeju-I19
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090618
Time 5.26
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 296.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300000 MHz
WDW EM
SSB 0
LB -0.20 Hz
GB 0.3
PC 1.00


192.81
161.36
140.20
136.59
136.12
129.25
127.65
126.44
122.26
121.52
119.50
119.43
118.48
111.19
77.40
77.08
76.76
52.93
45.79
37.39
21.02
O
COOMe
HN
Table 3, entry 12
200
180
160
140
120
100
80
60
40
20
0
ppm

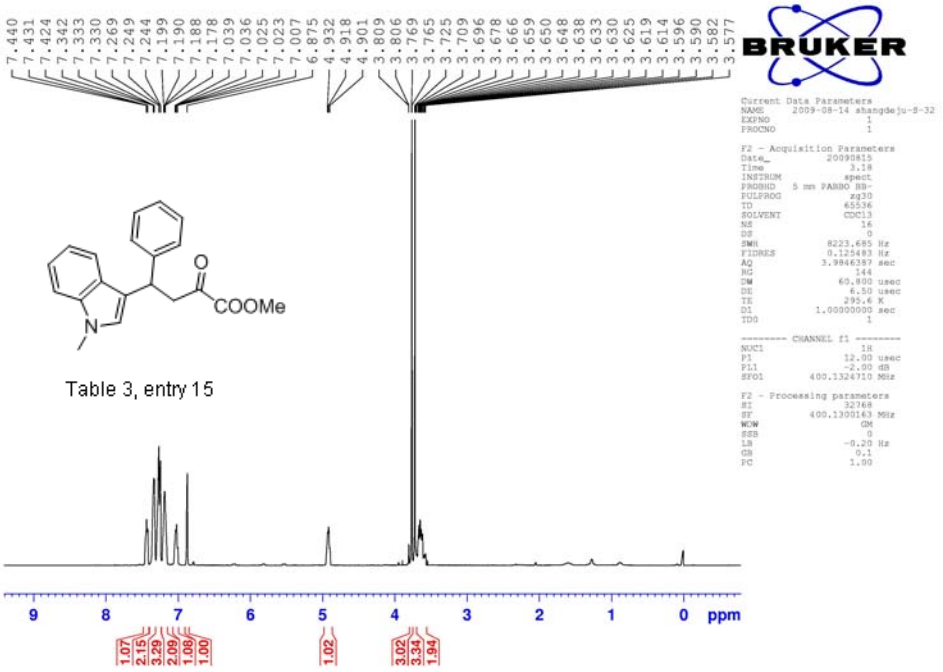
BRUKER
Current Data Parameters
NAME 2009-06-17 sangdeju-I19
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090618
Time 5.23
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 2050
DW 20.800 usec
DE 6.50 usec
TE 297.4 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40

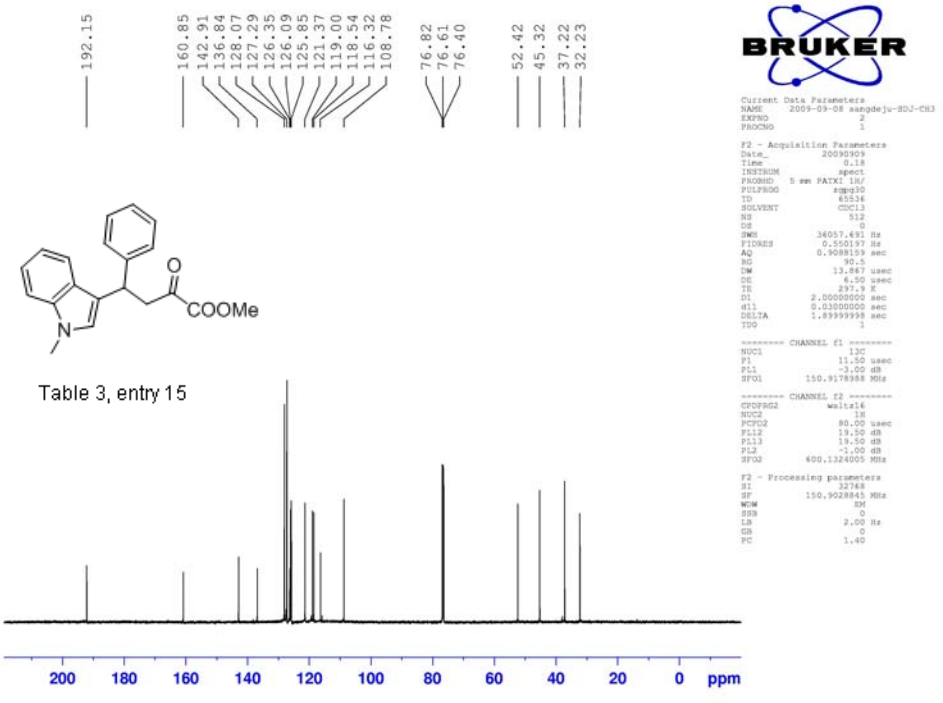

8.060
7.490
7.470
7.311
7.291
7.248
7.198
7.186
7.179
7.163
7.150
7.074
7.055
7.036
7.023
7.006
6.991
6.985
4.930
4.911
4.892
3.770
3.731
3.713
3.689
3.671
3.646
3.637
3.627
3.604
3.584
2.305
O
COOMe
HN
Table 3, entry 13
9
8
7
6
5
4
3
2
1
0
ppm
1.04
1.06
1.22
4.19
3.29
1.00
2.94
1.03
1.06
3.13

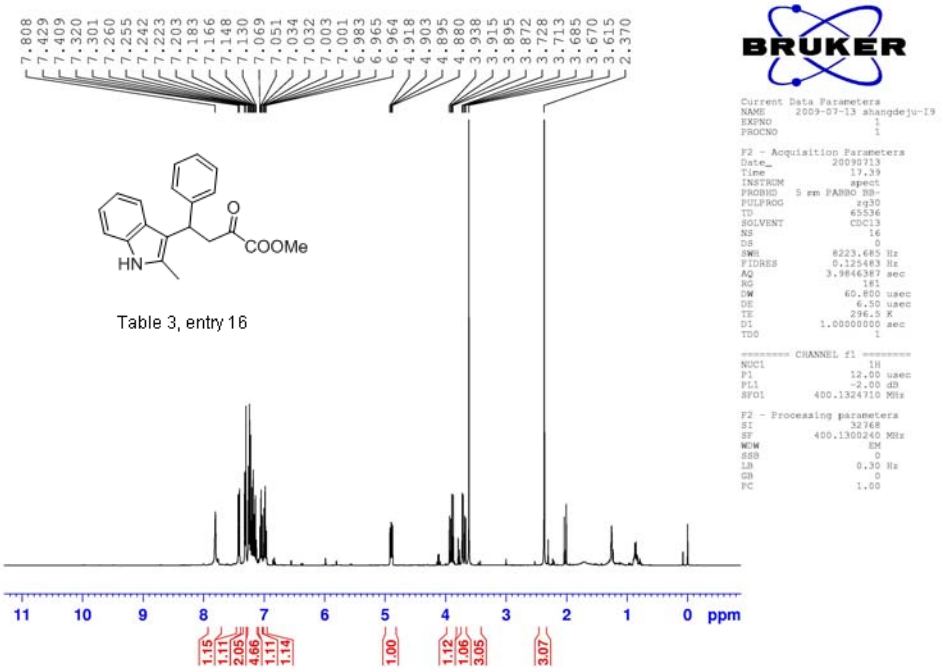

BRUKER
Current Data Parameters
NAME 2009-07-06 shangdeju-126
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090706
Time 23.44
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125493 Hz
AQ 3.9846387 sec
RG 128
DW 60.800 usec
DE 6.50 usec
TE 296.0 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300139 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


192.83
161.37
143.21
138.13
136.59
128.59
128.45
127.44
126.48
124.78
122.26
121.62
119.50
119.41
118.31
111.24
77.44
77.13
76.81
52.96
45.79
37.72
21.52
O
COOMe
HN
Table 3, entry 13
200
180
160
140
120
100
80
60
40
20
0
ppm

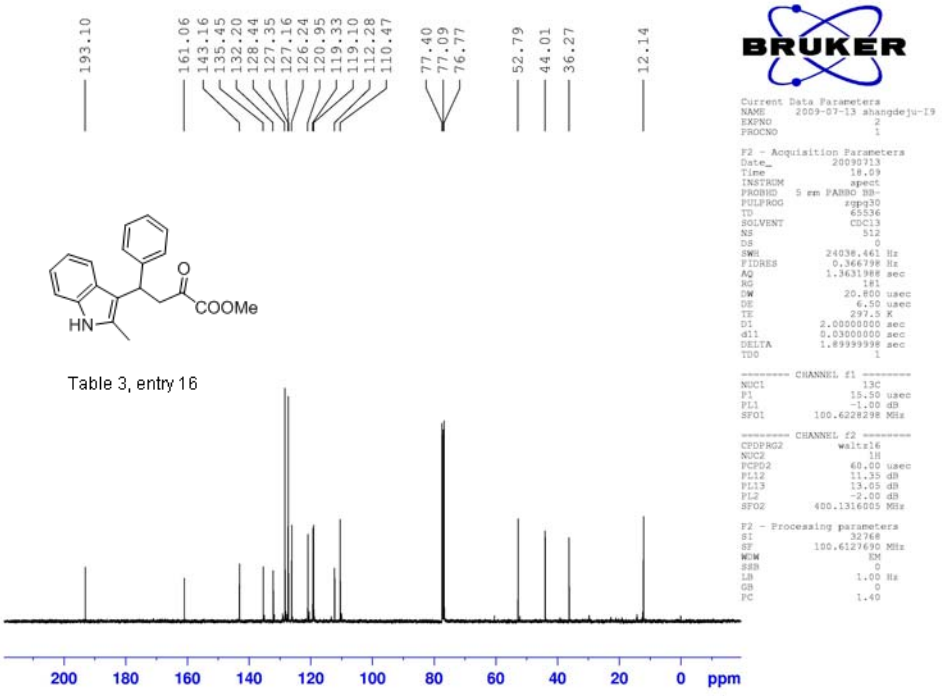

BRUKER
Current Data Parameters
NAME 2009-07-06 shangdeju-126
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090707
Time 0.13
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631989 sec
RG 2050
DW 20.800 usec
DE 6.50 usec
TE 297.2 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40


7.440
7.431
7.424
7.342
7.333
7.330
7.269
7.249
7.244
7.199
7.190
7.188
7.178
7.039
7.036
7.025
7.023
7.007
6.875
4.932
4.918
4.901
3.809
3.806
3.769
3.765
3.725
3.709
3.696
3.678
3.666
3.659
3.650
3.648
3.638
3.633
3.630
3.625
3.619
3.614
3.596
3.590
3.582
3.577
BRUKER
Current Data Parameters
NAME 2009-08-14 shangdeju-S-32
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090815
Time 3.18
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 144
DW 60.800 usec
DE 6.50 usec
TE 295.6 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300163 MHz
WDW EM
SSB 0
LB -0.20 Hz
GB 0.1
PC 1.00
O
COOMe
N
Table 3, entry 15
9
8
7
6
5
4
3
2
1
0
ppm
1.07
2.15
3.29
2.09
1.08
1.00
1.02
3.02
3.34
1.94


192.15
160.85
142.91
136.84
128.07
127.29
126.35
126.09
125.85
121.37
119.00
118.54
116.32
108.78
76.82
76.61
76.40
52.42
45.32
37.22
32.23
BRUKER
Current Data Parameters
NAME 2009-09-08 sangdeju-SDJ-CH3
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090909
Time 0.18
INSTRUM spect
PROBHD 5 mm PATX2 1H/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 36057.691 Hz
FIDRES 0.550197 Hz
AQ 0.9088159 sec
RG 90.5
DW 13.867 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 11.50 usec
PL1 -3.00 dB
SFO1 150.9178988 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 19.50 dB
PL13 19.50 dB
PL2 -1.00 dB
SFO2 400.1324005 MHz
F2 - Processing parameters
SI 32768
SF 150.9028845 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40
O
COOMe
N
Table 3, entry 15
200
180
160
140
120
100
80
60
40
20
0
ppm


7.808
7.429
7.409
7.320
7.301
7.260
7.255
7.242
7.223
7.203
7.183
7.166
7.148
7.130
7.069
7.051
7.034
7.032
7.003
7.001
6.983
6.965
6.964
4.918
4.903
4.895
4.880
3.938
3.915
3.895
3.872
3.728
3.713
3.685
3.670
3.615
2.370
O
COOMe
HN
Table 3, entry 16
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.15
1.11
2.05
4.66
1.11
1.14
1.00
1.12
1.06
3.05
3.07

BRUKER
Current Data Parameters
NAME 2009-07-13 ahangdeju-I9
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090713
Time 17.39
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 181
DW 60.800 usec
DE 6.50 usec
TE 296.5 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 12.00 usec
PL1 -2.00 dB
SFO1 400.1324710 MHz
F2 - Processing parameters
SI 32768
SF 400.1300240 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


193.10
161.06
143.16
135.45
132.20
128.44
127.35
127.16
126.24
120.95
119.33
119.10
112.28
110.47
77.40
77.09
76.77
52.79
44.01
36.27
12.14
O
COOMe
HN
Table 3, entry 16
200
180
160
140
120
100
80
60
40
20
0
ppm

BRUKER
Current Data Parameters
NAME 2009-07-13 ahangdeju-I9
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090713
Time 18.09
INSTRUM apect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 512
DS 0
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 181
DW 20.800 usec
DE 6.50 usec
TE 297.5 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 15.50 usec
PL1 -1.00 dB
SFO1 100.6228298 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 60.00 usec
PL12 11.35 dB
PL13 13.05 dB
PL2 -2.00 dB
SFO2 400.1316005 MHz
F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

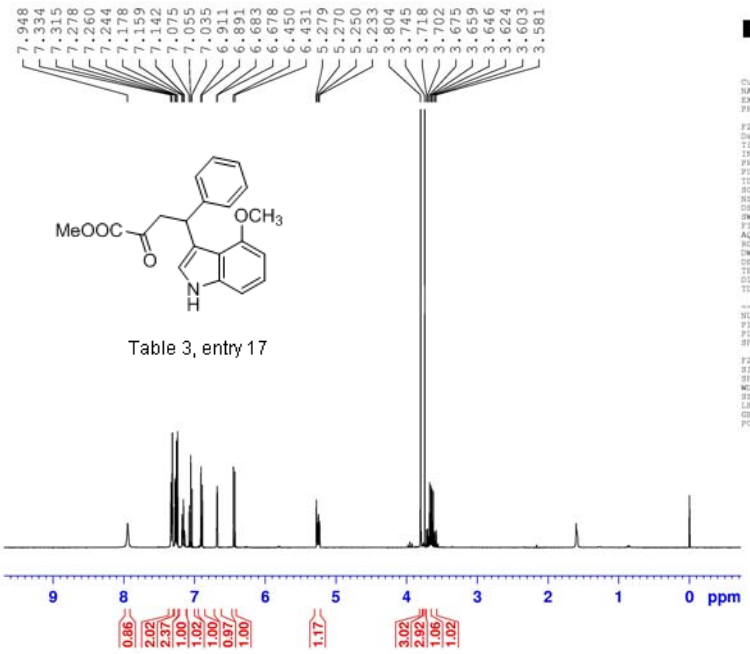


Table 3, entry 17

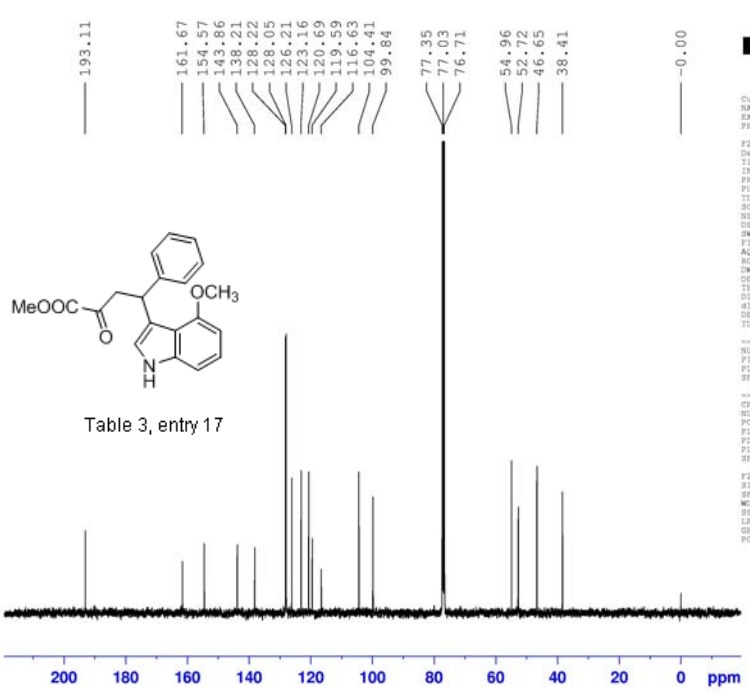


Table 3, entry 17

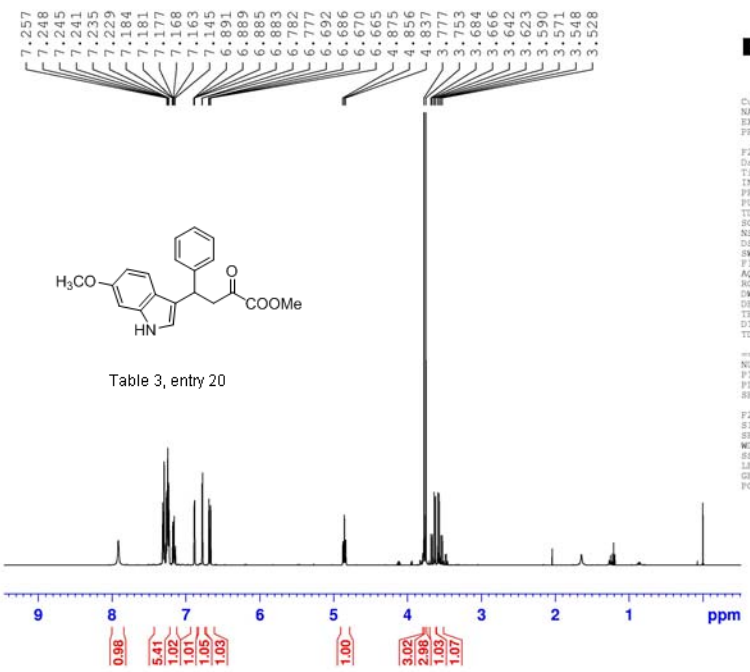


Table 3, entry 20


```
Current Data Parameters
NAME      2009-07-09 ahangdeju-IS
EXPNO                1
PROCNO               1

F2 - Acquisition Parameters
Date_           20090709
Time              18.46
INSTRUM           apect
PROBHD   5 mm PABBO BB-
PULPROG           zg30
TD                65536
SOLVENT           CDCl3
NS                   16
DS                    0
SWH            8223.685 Hz
FIDRES         0.125483 Hz
AQ             3.9846387 sec
RG                  128
DW               60.800 usec
DE                6.50 usec
TE                296.1 K
D1             1.00000000 sec
TD0                  1

======== CHANNEL f1 ========
NUC1                1H
P1                12.00 usec
PL1               -2.00 dB
SFO1         400.1324710 MHz

F2 - Processing parameters
SI                32768
SF           400.1300171 MHz
WDW                  EM
SSB                   0
LB                -0.20 Hz
GB                   0.1
PC                  1.00
```

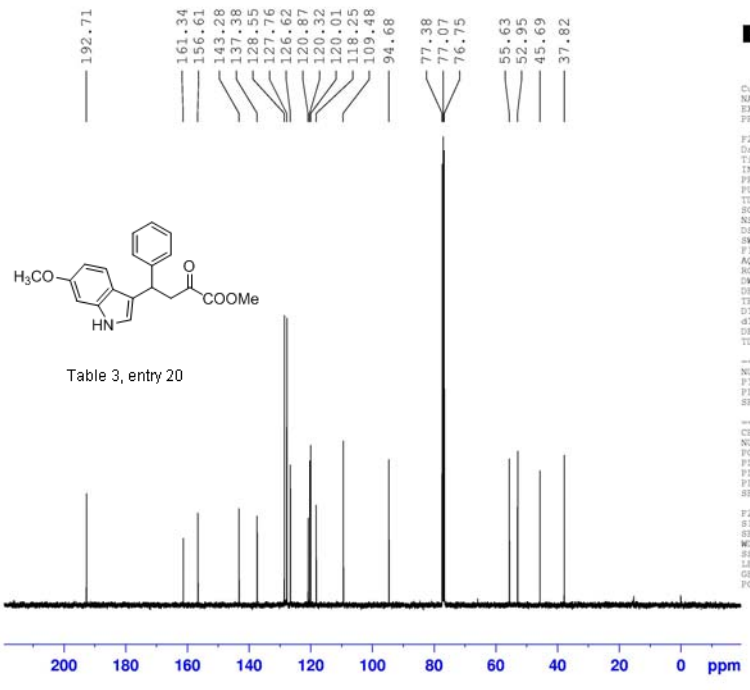
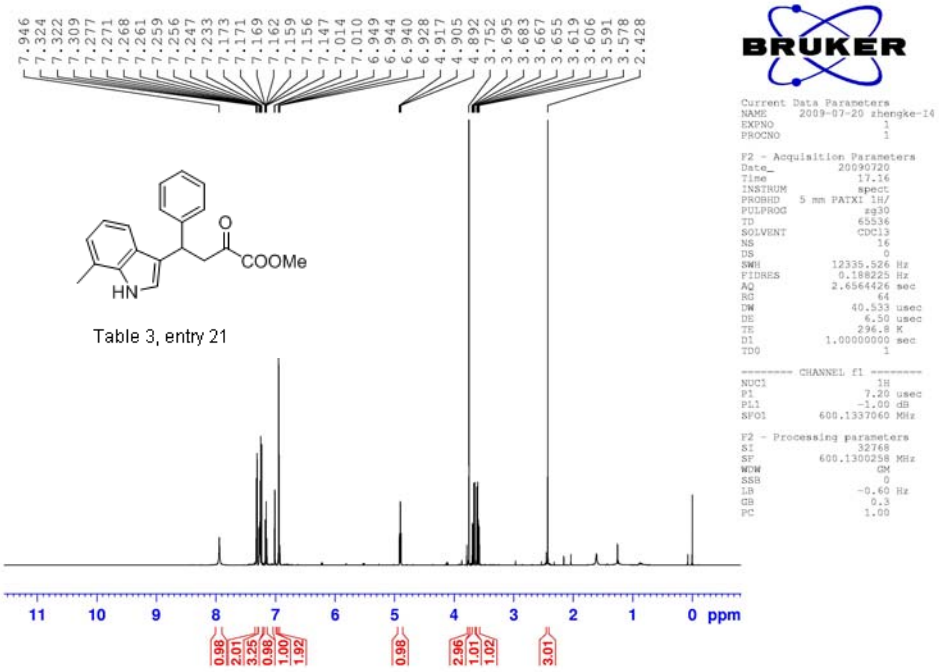
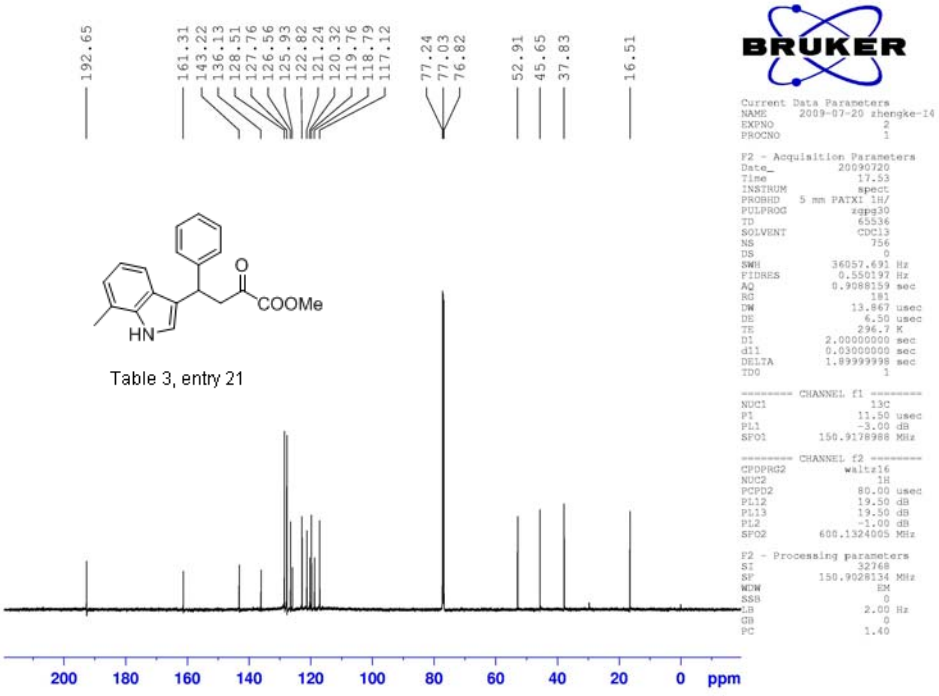


Table 3, entry 20

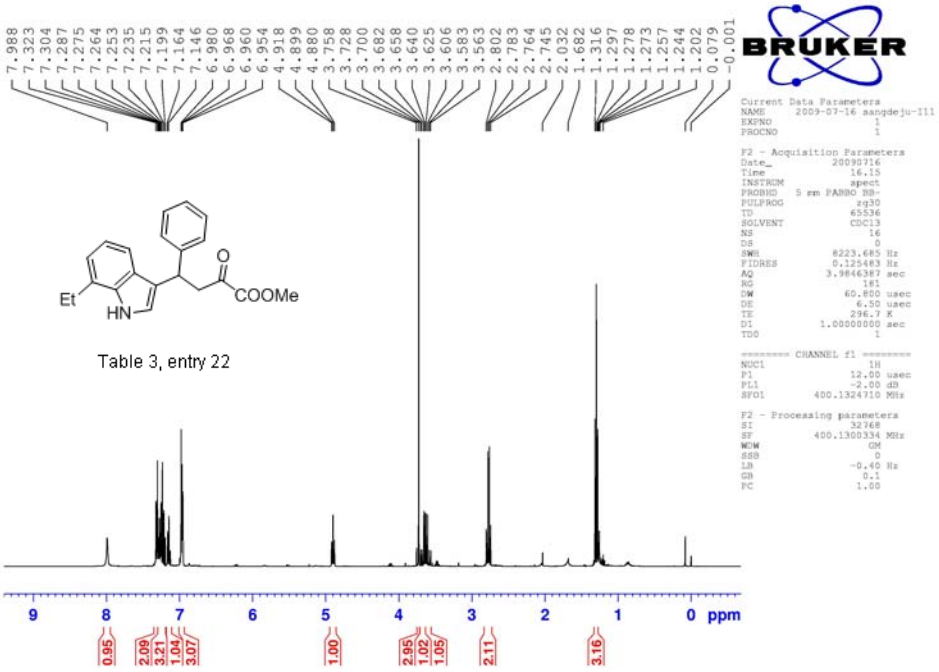

```
Current Data Parameters
NAME      2009-07-09 ahangdeju-IS
EXPNO                2
PROCNO               1

F2 - Acquisition Parameters
Date_           20090709
Time              19.15
INSTRUM           apect
PROBHD   5 mm PABBO BB-
PULPROG         zgpg30
TD                65536
SOLVENT           CDCl3
NS                  512
DS                    0
SWH           24038.461 Hz
FIDRES         0.366798 Hz
AQ             1.3631988 sec
RG                  181
DW               20.800 usec
DE                6.50 usec
TE                297.2 K
D1             2.00000000 sec
d11            0.03000000 sec
DELTA          1.89999998 sec
TD0                  1

======== CHANNEL f1 ========
NUC1                13C
P1                15.50 usec
PL1               -1.00 dB
SFO1         100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG2          waltz16
NUC2                1H
PCPD2             60.00 usec
PL12              11.35 dB
PL13              13.05 dB
PL2               -2.00 dB
SFO2         400.1316005 MHz

F2 - Processing parameters
SI                32768
SF           100.6127690 MHz
WDW                  EM
SSB                   0
LB                1.00 Hz
GB                    0
PC                1.40
```

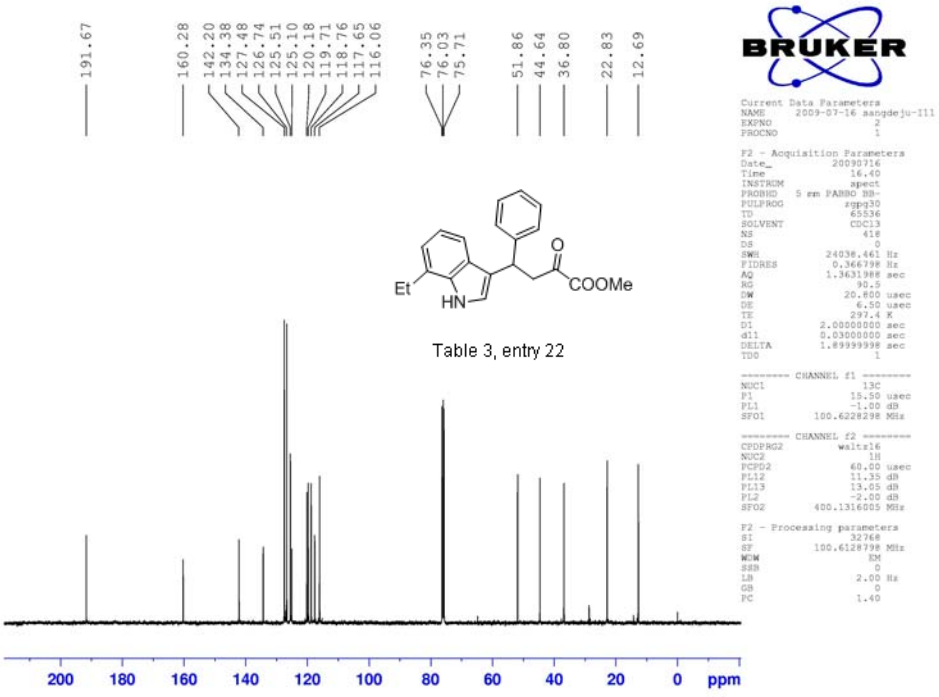

7.946
7.324
7.322
7.309
7.277
7.271
7.268
7.261
7.259
7.256
7.247
7.233
7.173
7.171
7.169
7.162
7.159
7.156
7.147
7.014
7.010
6.949
6.944
6.940
6.928
4.917
4.905
4.892
3.752
3.695
3.683
3.667
3.655
3.619
3.606
3.591
3.578
2.428
O
COOMe
HN
Table 3, entry 21
11 10 9 8 7 6 5 4 3 2 1 0 ppm
0.98 2.01 3.25 0.98 1.00 1.92 0.98 2.96 1.01 1.02 3.01

BRUKER
Current Data Parameters
NAME 2009-07-20 zhengke-I4
EXPNO 1
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090720
Time 17.16
INSTRUM spect
PROBHD 5 mm PATXI 1H/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 0
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 64
DW 40.533 usec
DE 6.50 usec
TE 296.8 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
NUC1 1H
P1 7.20 usec
PL1 -1.00 dB
SFO1 600.1337060 MHz
F2 - Processing parameters
SI 32768
SF 600.1300258 MHz
WDW EM
SSB 0
LB -0.60 Hz
GB 0.3
PC 1.00


192.65
161.31
143.22
136.13
128.51
127.76
126.56
125.93
122.82
121.24
120.32
119.76
118.79
117.12
77.24
77.03
76.82
52.91
45.65
37.83
16.51
O
COOMe
HN
Table 3, entry 21
200 180 160 140 120 100 80 60 40 20 0 ppm

BRUKER
Current Data Parameters
NAME 2009-07-20 zhengke-I4
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20090720
Time 17.53
INSTRUM spect
PROBHD 5 mm PATXI 1H/
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 756
DS 0
SWH 36057.691 Hz
FIDRES 0.550197 Hz
AQ 0.9088159 sec
RG 181
DW 13.867 usec
DE 6.50 usec
TE 296.7 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1
======== CHANNEL f1 ========
NUC1 13C
P1 11.50 usec
PL1 -3.00 dB
SFO1 150.9178988 MHz
======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL12 19.50 dB
PL13 19.50 dB
PL2 -1.00 dB
SFO2 600.1324005 MHz
F2 - Processing parameters
SI 32768
SF 150.9028134 MHz
WDW EM
SSB 0
LB 2.00 Hz
GB 0
PC 1.40


7.988
7.323
7.304
7.287
7.275
7.264
7.253
7.235
7.215
7.199
7.164
7.146
6.980
6.968
6.960
6.954
4.918
4.899
4.880
3.758
3.728
3.700
3.682
3.658
3.640
3.625
3.606
3.583
3.563
2.802
2.783
2.764
2.745
2.032
1.682
1.316
1.297
1.278
1.273
1.257
1.244
1.202
0.079
0.001
Et
HN
O
COOMe
Table 3, entry 22
9
8
7
6
5
4
3
2
1
0 ppm
0.95
2.09
3.21
1.04
3.07
1.00
2.95
1.02
1.05
2.11
3.16


191.67
160.28
142.20
134.38
127.48
126.74
125.51
125.10
120.18
119.71
118.76
117.65
116.06
76.35
76.03
75.71
51.86
44.64
36.80
22.83
12.69
Et
HN
O
COOMe
Table 3, entry 22
200
180
160
140
120
100
80
60
40
20
0 ppm