Asymmetric Phase-Transfer Catalyzed Glycolate Alkylation, Investigation of the Scope and Application to the Synthesis of (-)-Ragaglitazar

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General Experimental

Air and water sensitive reactions were performed in flame-dried glassware under a nitrogen atmosphere. Air and moisture sensitive reagents were introduced via dry syringe or cannula. Methylene chloride, toluene, THF, diethyl ether, DMSO, DMF, methanol, triethylamine and acetonitrile were dried by passing through columns of activated alumina. Chloroform, benzene and pyridine were stored over molecular sieves. Reagents were purchased from commercial sources. **WARNING!** Peroxide based reagents, (TMSO)₂, present significant detonation hazards. Care should be taken especially on large scale. Use of non-metal tubing and spatulas is strongly recommended. Flash chromatography was carried out using 60-230 mesh silica gel. Radial chromatography was performed using 1, 2, and 4 mm plates loaded with 230-400 mesh PF-254 gypsum bound silica. Analytical thin-layer chromatography (TLC) was performed with silica gel 60 F₂₅₄, 0.25 mm pre-coated TLC plates. TLC plates were visualized using UV₂₅₄ and cerium molybdate with charring. All ¹H NMR spectra were obtained with either 200, 300 or 500 MHz spectrometers using TMS (0.0 ppm) or chloroform (7.27 ppm) as an internal reference. Signals are reported as m (multiplet), s (singlet), d (doublet), t (triplet), q (quartet), bs (broad singlet), ABq (AB quartet) obs (obscured); and coupling constants are reported in hertz (Hz). ¹³C NMR spectra were obtained with either 75 or 125 MHz spectrometers using chloroform (77.2 ppm) as the internal standard. Infrared spectra were obtained on an FTIR instrument. Mass spectral data (HRMS, CI, EI, FAB) were obtained. Optical rotations were obtained with a polarimeter using the sodium D line at ambient temperature. Low temperatures were maintained using an immersion cooler with a cooling probe placed in an acetone bath.

***O*(9)-allyl-*N*-2',3',4'-trifluorobenzylhydrocinchonidinium bromide (9).**³ The catalyst was prepared according to the published procedure with the exceptions that in the workup of *N*-(2',3',4'-Trifluoro)benzylhydrocinchonidinium bromide the reaction mixture was diluted with a 1:40 ratio of MeOH : diethyl ether to precipitate the catalyst. Also the purification of *O*(9)-allyl-*N*-2',3',4'-trifluorobenzylhydrocinchonidinium bromide **9** was accomplished via column chromatography (5% MeOH/CH₂Cl₂) rather than by recrystallization.

Physical Data for Additional Alkylation Products 2 (Table 4)

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-hept-4-en-1-one (entry 4). Following purification via chromatography the product was obtained in 85% yield as a colorless oil. TLC R_f = 0.35 (20% EtOAc/hexanes); [α]_D²³ +1.0° (c 1.8, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 7.41-7.18 (m, 10H), 7.10 (d, J = 3.3 Hz, 1H), 6.97 (dd, J = 3.3, 9.0 Hz, 1H), 6.79 (d, J = 9.0 Hz, 1H), 5.53 (s, 1H), 5.46-5.43 (m, 2H), 4.96 (dd, J = 4.2, 7.5 Hz, 1H), 3.75 (s, 3H), 3.55 (s, 3H), 2.48-2.30 (m, 2H), 2.02-1.94 (m, 2H), 0.94 (t, J = 7.2 Hz, 3H); ¹³C NMR (CDCl₃, 75 MHz) δ 202.6, 153.8, 152.5, 142.7, 141.8, 135.0, 134.1, 128.4, 128.2, 128.1, 127.7, 127.4, 127.3, 124.8, 119.9, 114.2, 113.2, 82.3, 82.0, 56.0, 55.9, 36.1, 25.7, 13.8; HRMS (FAB⁺) found 453.2040 [M+Na]⁺, calcd 453.2036 for C₂₈H₃₀O₄Na. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 0.5 mL/min, 23°C, λ = 254 nm, retention times: *S* (major) 12.2 min, *R* (minor) 12.9 min, 82% ee).

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-5,9-dimethyl-deca-4,8-dien-1-one (entry 5). Following purification via chromatography the product was obtained in 80% yield as a colorless oil. TLC R_f = 0.39 (20% EtOAc/hexanes); [α]_D²³ +9.5° (c 1.0, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 7.41-7.18 (m, 10H), 7.10 (d, J = 3.0 Hz, 1H), 6.96 (dd, J = 3.0, 9.0 Hz, 1H), 6.78 (d, J = 9.0 Hz, 1H), 5.52 (s, 1H), 5.22-5.17 (m, 1H), 5.11-5.07 (m, 1H), 4.97 (t, J = 6.0 Hz, 1H), 3.74 (s, 3H), 3.54 (s, 3H), 2.42 (t, J = 6.3 Hz, 2H), 2.06-1.92 (m, 4H), 1.67 (d, J = 0.9 Hz, 3H), 1.59 (d, J = 0.9 Hz, 3H), 1.49 (d,

$J = 1.2$ Hz, 3H); ^{13}C NMR (CDCl_3 , 75 MHz) δ 202.9, 153.8, 152.5, 142.8, 141.9, 137.6, 131.5, 128.4, 128.2, 128.0, 127.7, 127.4, 127.3, 124.5, 119.9, 119.8, 114.2, 113.2, 82.3, 81.9, 56.0, 55.9, 39.9, 31.7, 26.8, 25.8, 17.9, 16.4; HRMS (FAB^+) found 521.2676 $[\text{M}+\text{Na}]^+$, calcd 521.2662 for $\text{C}_{33}\text{H}_{38}\text{O}_4\text{Na}$. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 0.5 mL/min, 23°C, $\lambda = 254$ nm, retention times: *S* (major) 10.1 min, *R* (minor) 9.1 min, 84% ee).

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-5-methyl-pent-4-yn-1-one (entry 6).

Following purification via chromatography the product was obtained in 89% yield as a colorless oil. TLC $R_f = 0.23$ (20% EtOAc/hexanes); $[\alpha]_D^{23} +10.3^\circ$ (c 0.93, CHCl_3); ^1H NMR (CDCl_3 , 300 MHz) δ 7.45-7.19 (m, 10H), 7.12 (d, $J = 3.3$ Hz, 1H), 6.97 (dd, $J = 3.0, 9.0$ Hz, 1H), 6.78 (d, $J = 9.0$ Hz, 1H), 5.58 (s, 1H), 5.06 (dd, $J = 5.1, 6.9$ Hz, 1H), 3.75 (s, 3H), 3.57 (s, 3H), 2.59-2.56 (m, 2H), 1.72 (t, $J = 2.7$ Hz, 3H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 201.7, 153.9, 152.7, 142.4, 141.7, 128.5, 128.4, 128.2, 128.0, 127.9, 127.8, 127.7, 127.6, 120.2, 114.3, 113.2, 82.8, 80.8, 75.5, 56.2, 56.0, 23.5, 3.8; HRMS (FAB^+) found 437.1725 $[\text{M}+\text{Na}]^+$, calcd 437.1723 for $\text{C}_{27}\text{H}_{26}\text{O}_4\text{Na}$. Anal. calcd for $\text{C}_{27}\text{H}_{26}\text{O}_4$: C, 78.24; H, 6.32. Found: C, 78.24; H, 6.17. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 0.5 mL/min, 23°C, $\lambda = 254$ nm, retention times: *S* (major) 16.8 min, *R* (minor) 15.7 min, 81% ee).

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-5-(trimethyl-silanyl)-pent-4-yn-1-one (entry 7).

Following purification via chromatography the product was obtained in 88% yield as a colorless oil. TLC $R_f = 0.34$ (20% EtOAc/hexanes); $[\alpha]_D^{23} +26.3^\circ$ (c 1.95, CHCl_3); ^1H NMR (CDCl_3 , 500 MHz) δ 7.46-7.28 (m, 10H), 7.15 (d, $J = 3.0$ Hz, 1H), 7.01 (dd, $J = 3.0, 9.0$ Hz, 1H), 6.81 (d, $J = 9.0$ Hz, 1H), 5.65 (s, 1H), 5.16 (dd, $J = 5.5, 7.0$ Hz, 1H), 3.78 (s, 3H), 3.58 (s, 3H), 2.71-2.69 (m, 2H), 0.16 (s, 9H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 201.1, 153.8, 152.8, 142.3, 141.5, 128.5, 128.3, 127.8, 127.7, 127.6, 127.5, 127.4, 120.5, 114.1, 113.2, 103.4, 86.5, 82.6, 80.0, 56.0, 55.9, 24.6, 0.19; HRMS (EI^+) found 472.2078 M^+ , calcd 472.2070 for $\text{C}_{29}\text{H}_{32}\text{O}_4$. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% IPA/hexane, 1.0 mL/min, 23°C, $\lambda = 254$ nm, retention times: *S* (major) 4.7 min, *R* (minor) 6.0 min, 81% ee).

(2*S*)-2-Benzhydryloxy-3-(4-*tert*-butyl-phenyl)-1-(2,5-dimethoxy-phenyl)-propan-1-one (entry 9).

Following purification via chromatography the product was obtained in 96% yield as a colorless oil. TLC $R_f = 0.34$ (20% EtOAc/hexanes); $[\alpha]_D^{23} +18.7^\circ$ (c 1.26, CHCl_3); ^1H NMR (CDCl_3 , 300 MHz) δ 7.33-6.97 (m, 14H), 6.87-6.79 (m, 3H), 5.41 (s, 1H), 5.12 (dd, $J = 3.3, 9.6$ Hz, 1H), 3.75 (s, 3H), 3.58 (s, 3H), 3.02 (dd, $J = 3.3, 13.8$ Hz, 1H), 2.86 (dd, $J = 9.6, 13.8$ Hz, 1H), 1.35 (s, 9H); ^{13}C NMR (CDCl_3 , 75 MHz) δ 202.4, 153.9, 152.7, 149.3, 142.8, 141.5, 135.3, 129.6, 128.3, 128.2, 127.8, 127.4, 127.3, 125.1, 120.4, 114.3, 113.4, 83.0, 82.6, 56.0, 55.9, 38.6, 34.6, 31.7; HRMS (FAB^+) found 531.2530 $[\text{M}+\text{Na}]^+$, calcd 531.2506 for $\text{C}_{34}\text{H}_{36}\text{O}_4\text{Na}$. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 0.5 mL/min, 23°C, $\lambda = 254$ nm, retention times: *S* (major) 11.2 min, *R* (minor) 10.5 min, 84% ee).

(2*S*)-2-Benzhydryloxy-3-biphenyl-2-yl-1-(2,5-dimethoxy-phenyl)-propan-1-one (entry 10).

Following purification via chromatography the product was obtained in 99% yield as a colorless oil. TLC $R_f = 0.27$ (20% EtOAc/hexanes); $[\alpha]_D^{23} -58.9^\circ$ (c 1.35, CHCl_3); ^1H NMR (CDCl_3 , 500 MHz) δ 7.35-7.11 (m, 15H), 7.00-6.98 (m, 2H), 6.88-6.76 (m, 4H), 6.62 (d, $J = 9.0$ Hz, 1H), 5.33 (s, 1H), 4.87-4.85 (m, 1H), 3.68 (s, 3H), 3.36 (s, 3H), 3.12 (dd, $J = 3.0, 14.0$ Hz, 1H), 2.94 (dd, $J = 10.0, 14.0$ Hz, 1H); ^{13}C NMR (CDCl_3 , 125 MHz) δ 203.9, 153.5, 151.9, 142.7, 142.5, 141.5, 141.4, 135.3, 131.3, 130.3, 129.4, 128.3, 128.1, 128.0, 127.7, 127.4, 127.3, 126.7, 126.5, 119.1, 113.8, 112.8, 82.3, 81.8, 55.9, 55.7, 36.1; HRMS (FAB^+) found 551.2198 $[\text{M}+\text{Na}]^+$, calcd 551.2193 for $\text{C}_{36}\text{H}_{32}\text{O}_4\text{Na}$. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10%

EtOH/hexane, 1.0 mL/min, 23°C, λ = 254 nm, retention times: *S* (major) 7.5 min, *R* (minor) 6.8 min, 90% ee).

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-3-naphthalen-2-yl-propan-1-one (entry 11). Following purification via chromatography the product was obtained in 91% yield as a colorless oil. TLC R_f = 0.3 (2:1:7, CH₂Cl₂:Et₂O:hexanes); $[\alpha]_D^{23}$ +40.6° (c 1.1, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 7.83-7.69 (m, 3H), 7.58 (s, 1H), 7.45-7.41 (m, 2H), 7.33-6.79 (m, 14H), 5.43 (s, 1H), 5.25 (dd, *J* = 3.3, 9.3 Hz, 1H), 3.72 (s, 3H), 3.59 (s, 3H), 3.22 (dd, *J* = 3.0, 14.1 Hz, 1H), 3.05 (dd, *J* = 9.3, 13.8 Hz, 1H); ¹³C NMR (CDCl₃, 75 MHz) δ 202.1, 153.9, 152.7, 142.6, 141.2, 135.9, 133.6, 132.4, 128.5, 128.3, 128.2, 128.1, 127.8, 127.7, 127.6, 127.4, 127.3, 127.2, 126.0, 125.5, 120.5, 114.3, 113.4, 82.7, 82.6, 56.1, 55.9, 39.2; HRMS (FAB⁺) found 525.2048 [M+Na]⁺, calcd 525.2036 for C₃₄H₃₀O₄Na. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 1.0 mL/min, 23°C, λ = 254 nm, retention times: *S* (major) 9.9 min, *R* (minor) 8.9 min, 85% ee).

(2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-3-(2-methoxy-5-nitro-phenyl)-propan-1-one (entry 12). Following purification via chromatography the product was obtained in 91% yield as a white solid. TLC R_f = 0.2 (30% EtOAc/hexanes); $[\alpha]_D^{23}$ -35.6° (c 1.2, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 8.09 (dd, *J* = 2.7, 9.0 Hz, 1H), 8.01 (d, *J* = 3.0 Hz, 1H), 7.31-7.10 (m, 9H), 6.99-6.93 (m, 3H), 6.79-6.75 (m, 2H), 5.42 (s, 1H), 5.25 (dd, *J* = 5.4, 8.4 Hz, 1H), 3.75 (s, 3H), 3.69 (s, 3H), 3.58 (s, 3H), 3.13-2.99 (m, 2H); ¹³C NMR (CDCl₃, 75 MHz) δ 202.2, 162.8, 153.8, 152.5, 142.3, 141.4, 141.1, 128.3, 128.2, 127.9, 127.3, 127.1, 127.0, 124.2, 120.0, 114.4, 113.0, 109.7, 82.4, 80.3, 56.0, 55.9, 33.1; HRMS (FAB⁺) found 550.1844 [M+Na]⁺, calcd 550.1836 for C₃₁H₂₉NO₇Na. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 2.0 mL/min, 23°C, λ = 254 nm, retention times: *S* (major) 12.2 min, *R* (minor) 15.8 min, 88% ee).

(*S*)-tert-butyl 3-(benzhydryloxy)-4-(2,5-dimethoxyphenyl)-4-oxobutanoate (entry 14). Following purification via chromatography the product was obtained in 70% yield as a colorless oil. $[\alpha]_D^{23}$ -7.4° (c 2.0, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 7.34-7.16 (m, 10H), 7.10 (d, *J* = 3.0 Hz, 1H), 6.98 (dd, *J* = 3.0, 9.0 Hz, 1H), 6.78 (d, *J* = 9.0 Hz, 1H), 5.60 (s, 1H), 5.33 (dd, *J* = 5.1, 7.5 Hz, 2H), 3.75 (s, 3H), 3.59 (s, 3H), 2.71-2.57 (m, 2H), 1.42 (s, 9H); ¹³C NMR (CDCl₃, 75 MHz) δ 200.9, 169.9, 153.8, 152.6, 142.4, 141.7, 128.4, 128.2, 127.9, 127.7, 127.4, 127.3, 120.4, 114.2, 113.2, 83.0, 80.9, 79.0, 56.0, 55.9, 39.1, 28.2; HRMS (FAB⁺) found 499.2100 [M+Na]⁺, calcd 499.2097 for C₂₉H₃₂O₆Na. The enantioselectivity was determined by chiral HPLC (DAICEL Chiralpack AD column, 10% EtOH/hexane, 0.5 mL/min, 23°C, λ = 254 nm, retention times: *S* (major) 13.7 min, *R* (minor) 14.6 min, 89% ee).

(2*S*)-1-(2,5-Dimethoxy-phenyl)-2-hydroxy-hept-4-en-1-one (precursor to 19). To a round bottom flask containing (2*S*)-2-Benzhydryloxy-1-(2,5-dimethoxy-phenyl)-hept-4-en-1-one (0.189 g, 0.439 mmol) was added CH₂Cl₂ (8.8 mL). The solution was then cooled to -78°C and TiCl₄ (0.44 mL, 1.0 M CH₂Cl₂) was added dropwise. The resulting dark red/orange solution was stirred at -78°C for 30 min. The reaction was then quenched by the addition of a saturated aqueous NaHCO₃ solution (10 mL). The layers were separated and the aqueous layer was extracted with CH₂Cl₂ (2 x 15 mL). The combined organic layers were washed with H₂O followed by a saturated aqueous NaCl solution, then dried over MgSO₄, filtered and concentrated *in vacuo*. Chromatography (radial, 1mm plate, 20% EtOAc/hexanes) afforded the title compound, 0.103g (89%), as a colorless oil. Data are: TLC R_f = 0.23 (20% EtOAc/hexanes); $[\alpha]_D^{23}$ -64.5° (c 1.0, CHCl₃); ¹H NMR (CDCl₃, 300 MHz) δ 7.31 (d, *J* = 3.3 Hz, 1H), 7.09 (dd, *J* = 3.0, 9.0 Hz, 1H), 6.93 (d, *J* = 9.3 Hz, 1H), 5.42-5.39 (m, 2H), 5.21-5.16 (m, 1H), 3.88 (s, 3H), 3.82 (obs d, *J* = 6.3 Hz, 1H), 3.80 (s, 3H), 2.57-2.49 (m, 1H), 2.23-2.14 (m, 1H), 2.02-

1.93 (m, 2H), 0.93 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (CDCl_3 , 75 MHz) δ 202.7, 153.8, 153.3, 135.7, 124.8, 123.7, 121.5, 114.6, 113.2, 76.8, 56.1, 55.9, 37.8, 25.8, 13.9; HRMS (EI^+) found 287.1250 M^+ , calcd 287.1254 for $\text{C}_{15}\text{H}_{20}\text{O}_4\text{Na}$.

(1S)-Benzoic acid 1-(2,5-dimethoxy-benzoyl)-hex-3-enyl ester (precursor to 19). To a round bottom flask containing (2S)-1-(2,5-Dimethoxy-phenyl)-2-hydroxy-hept-4-en-1-one (0.073 g, 0.276 mmol) was added 1.4 mL of CHCl_3 and pyridine (0.112 mL, 1.38 mmol). The solution was cooled to 0°C , then benzoyl chloride (0.048 mL, 0.414 mmol) was added slowly. The reaction was stirred at 0°C for 2.5 h, then quenched by the addition of H_2O (10 mL). The layers were separated and the aqueous layer was extracted with CHCl_3 (2 x 10 mL). The combined organic layers were washed with a saturated aqueous NH_4Cl solution, then dried over MgSO_4 , filtered and concentrated. The title compound was obtained after radial chromatography (1mm plate, 20% EtOAc/hexanes) as a white solid, 0.094 g (92%). Data are: mp = $68\text{--}72^\circ\text{C}$; $[\alpha]_{\text{D}}^{23} +25.2^\circ$ (c 1.0, CHCl_3); ^1H NMR (CDCl_3 , 300 MHz) δ 8.11–8.08 (m, 2H), 7.59–7.54 (m, 1H), 7.47–7.42 (m, 2H), 7.38 (d, $J = 3.3$ Hz, 1H), 7.08 (dd, $J = 3.0, 9.0$ Hz, 1H), 6.92 (d, $J = 9.3$ Hz, 1H), 6.25–6.21 (m, 1H), 5.63–5.47 (m, 2H), 3.89 (s, 3H), 3.79 (s, 3H), 2.76–2.70 (m, 1H), 2.62–2.53 (m, 1H), 2.06–1.97 (m, 2H), 0.94 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (CDCl_3 , 75 MHz) δ 196.5, 166.3, 153.8, 153.2, 136.0, 133.2, 130.2, 129.9, 128.5, 125.7, 123.7, 121.4, 114.5, 113.2, 79.3, 56.3, 55.9, 34.2, 25.8, 13.9.

(1S)-Benzoic acid 1-(2,5-dimethoxy-phenoxy-carbonyl)-hex-3-enyl ester (19). To a flame dried round bottom flask was added activated 4 angstrom molecular sieves (0.100 g), trans-N,N-bis(*p*-toluenesulfonyl)-1,2-cyclohexanediamine (0.027 g, 0.065 mmol), K_2CO_3 (0.036 g, 0.260 mmol) and 1.25 mL of CH_2Cl_2 . The mixture was cooled to 0°C and SnCl_4 (0.065 mL, 1.0 M in CH_2Cl_2) was added followed by bis(trimethylsilyl) peroxide (0.070 mL, 0.325 mmol). The mixture was stirred at 0°C for 5 minutes, then (1S)-Benzoic acid 1-(2,5-dimethoxy-benzoyl)-hex-3-enyl ester (0.048 g, 0.130 mmol) was added as a CH_2Cl_2 solution (2.0 mL). The reaction stirred at 0°C for 20 min, at which time the reaction was quenched by the addition of a saturated aqueous NaHCO_3 (5 mL) followed by a saturated aqueous $\text{Na}_2\text{S}_2\text{O}_3$ solution (5 mL). The mixture was stirred at ambient temperature for 30 minutes then diluted with 10 mL of CH_2Cl_2 and the layers separated. The aqueous phase was extracted with CH_2Cl_2 (2 x 20 mL) and the combined organic layers were washed with H_2O followed by a saturated aqueous NaCl solution. The mixture was then dried over Na_2SO_4 , filtered, concentrated and purified via flash column chromatography (30% Et₂O/hexanes) to provide 0.037 g (74%) of the title compound as a colorless oil. Data are: $[\alpha]_{\text{D}}^{23} -11.1^\circ$ (c 1.0, CHCl_3); ^1H NMR (CDCl_3 , 300 MHz) δ 8.14–8.11 (m, 2H), 7.62–7.57 (m, 1H), 7.49–7.44 (m, 2H), 6.90 (d, $J = 9.0$ Hz, 1H), 6.75 (dd, $J = 3.0, 9.0$ Hz, 1H), 6.70 (d, $J = 3.0$ Hz, 1H), 5.82–5.72 (m, 1H), 5.65–5.50 (m, 2H), 3.78 (s, 3H), 3.76 (s, 3H), 2.90–2.86 (m, 2H), 2.08 (m, 2H), 1.00 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (CDCl_3 , 75 MHz) δ 168.1, 166.1, 153.9, 145.4, 140.0, 137.1, 133.5, 130.1, 129.7, 128.6, 122.5, 113.7, 112.1, 109.4, 72.6, 56.8, 56.0, 34.9, 25.9, 13.9.

Precursor to **27**

Precursor to **28**

Precursor to **29**

Compound 2 (table 4, entry 6)

Data:

Data:

Compound 2 (table 4, entry 7)

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	4.735	N	49972	570242	90.769
2	5.981	N	4112	57992	9.230
Total Area				628234	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	4.736	N	25329	285607	50.492
2	5.986	N	19101	280038	49.507
Total Area				565645	99.999

Compound 2 (table 4, entry 8)

Data:

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	6.416	N	4253	61324	6.961
2	7.370	N	44235	819563	93.038
Total Area				880887	99.999

Data:

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	6.256	N1	30376	468403	48.821
2	7.160	N2	27087	491013	51.178
Total Area				959416	99.999

Compound 2 (table 4, entry 9)

Data:

0.0 19.1

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	10.481	N1	4042	81518	8.104
2	11.196	N2	38034	924290	91.895
Total Area				1005808	99.999

Data:

0.0 19.5

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	10.495	*N1	40044	880242	49.303
2	11.230	*N2	36974	905106	50.696
Total Area				1785348	99.999

Precursor to compound **28**

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μV)	Area($\mu\text{V-sec}$)	Area%
1	8.481	*N	1289	26482	2.582
2	10.046	*N	30706	999124	97.417
Total Area				1025606	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μV)	Area($\mu\text{V-sec}$)	Area%
1	8.218	N	20126	445203	50.077
2	10.096	*N	15837	443824	49.922
Total Area				889027	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	13.135	*N1	1026	26037	2.486
2	13.881	*N2	30770	1021299	97.513
Total Area				1047336	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	13.328	*N1	24673	721573	48.854
2	14.221	*N2	21995	755418	51.145
Total Area				1476991	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	10.383	*N1	1739	38970	2.688
2	11.056	*N2	48128	1410466	97.311
Total Area				1449436	99.999

Data:

Analysis: Channel A

Peak No.	Time	Type	Height(μ V)	Area(μ V-sec)	Area%
1	10.196	N1	70780	1838163	48.226
2	10.971	N2	63833	1973382	51.773
Total Area				3811545	99.999