Supporting Information For

Generation of Aza-*ortho*-xylylenes via Ring Opening of 2-(2-Acylaminophenyl)aziridines: Application in the Construction of the Communesin Ring System

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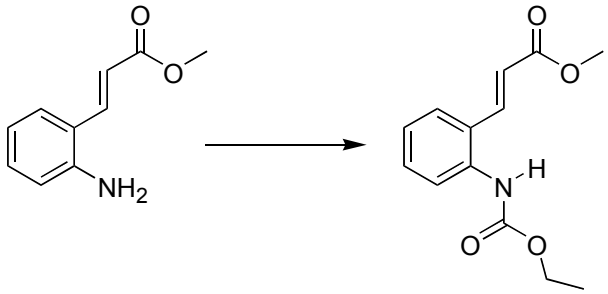
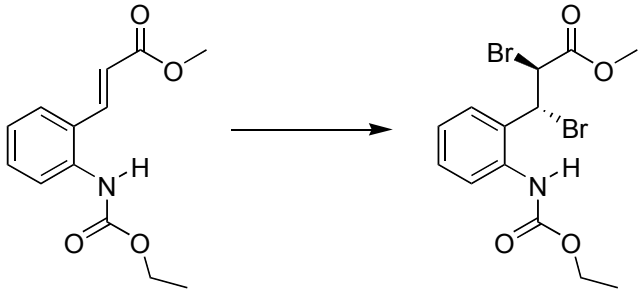
General Methods. Unless otherwise noted, all reactions were carried out under a nitrogen atmosphere using flame-dried glassware. All moisture sensitive reagents were added via a dry syringe or cannula where possible. Anhydrous acetonitrile (CH_3CN), benzene, tetrahydrofuran (THF), dichloromethane (CH_2Cl_2), diethyl ether (Et_2O), toluene, triethylamine (Et_3N), and dimethylformamide (DMF) were obtained from a solvent dispensing system. All other solvents and reagents were used as obtained from commercial sources without further purification. ^1H and ^{13}C NMR spectra were obtained on Bruker 200, 300, or 400 MHz spectrometers. Infrared spectra were obtained using a Perkin-Elmer 1600 FTIR. Chromatographic purification was performed using Sorbent Technologies silica gel 60 (230-400 mesh).

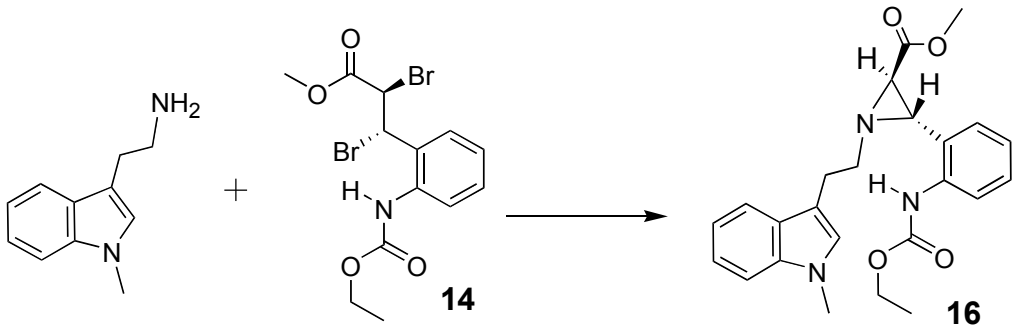


Methyl 2-*N*-(ethoxycarbonyl)cinnamate. To a solution of the methyl 2-aminocinnamate (3.80 g, 21.4 mmol) in CH_2Cl_2 (71.4 mL) at –40 °C was added pyridine (5.20 mL, 64.3 mmol) and ethyl chloroformate (2.25 mL, 23.5 mmol). The solution was warmed to room temperature overnight, quenched with 10% HCl, and extracted with CH_2Cl_2. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. The crude product thus obtained (4.26 g, 80%) was used in the next reaction without purification; ^1H NMR (300 MHz, $CDCl_3$) d 1.33 (t, J = 7.1 Hz, 1 H), 3.82 (s, 3 H), 4.23

(q, J = 7.1, 14.2 Hz, 2 H), 6.39 (d, J = 15.8 Hz, 1 H), 6.61 (br s, 1 H), 7.14 (dt, J = 0.5, 7.3 Hz, 1 H), 7.38 (dt, J = 1.5, 7.5 Hz, 1 H), 7.51 (dd, J = 1.5, 7.5 Hz, 1 H), 7.77 (br d, J = 7.8 Hz, 1 H), 7.83 (d, J = 15.8 Hz, 1 H); ^{13}C (50 MHz, $CDCl_3$) d 14.2, 51.6, 61.4, 120.0, 123.0, 124.6, 126.2, 126.9, 130.6, 136.0, 139.2, 153.7, 165.9; IR (neat) 3291, 2982, 1715, 1632, 1529 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{13}H_{15}NO_4Na$ 272.0889, found 272.09899.

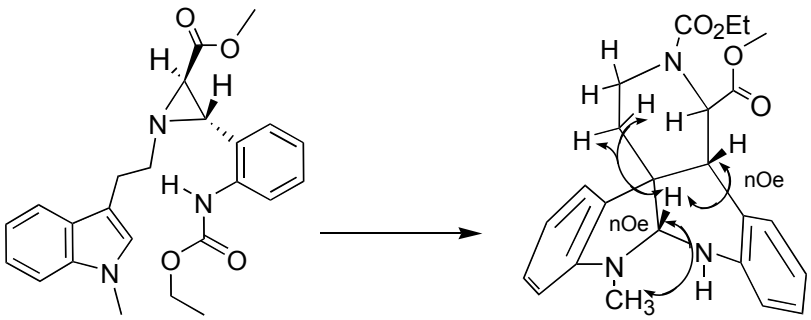


Vicinal dibromide 14. A solution of methyl 2-*N*-(ethoxycarbonyl)cinnamate (272 mg, 1.09 mmol) in cyclohexane (10.9 mL) was heated to reflux with a heatgun. Bromine (56 mL, 1.09 mmol) was added dropwise and the solution was stirred at room temperature for 10 minutes. The solution was quenched with 10% aqueous sodium thiosulfate and extracted with Et_2O. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. The crude product thus obtained (440 mg, 99%) was used in the next reaction without purification; ^{1}H NMR (300 MHz, $CDCl_3$) d 1.30 (t, J = 7.1 Hz, 3 H), 3.85 (s, 3 H), 4.23 (q, J = 7.1, 14.2 Hz, 2 H), 4.93 (d, J = 11.7 Hz, 1 H), 5.62 (d, J = 11.7 Hz, 1 H), 6.82 (br s, 1 H), 7.18 (t, J = 7.4 Hz, 1 H), 7.32 (t, J = 7.6 Hz, 1 H), 7.38 (d, J = 7.7 Hz, 1 H), 7.61 (br d, J = 6.9 Hz, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 15.0, 45.8, 50.5, 53.8, 53.9, 62.1, 126.2, 128.5, 128.9, 130.5, 136.1, 154.6, 168.6; IR (neat) 3320, 2982, 1731, 1528, 1537 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{13}H_{15}NO_4NaBr_2$ 429.9267, found 429.9266.



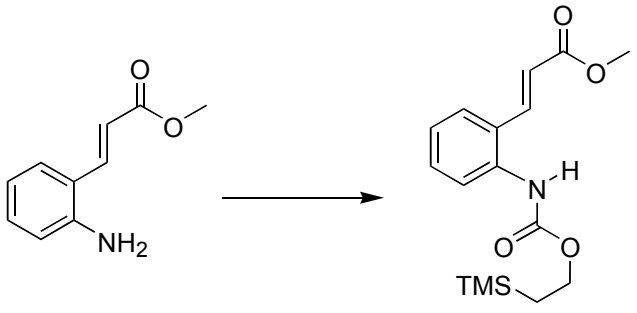
Aziridine 16. To a solution of the dibromide **13** (202 mg, 0.494 mmol) in CH_3CN (4.90 mL) at 0 °C was added the tryptamine **15** (86 mg, 0.494 mmol) in CH_3CN (1.6 mL) followed immediately by Cs_2CO_3 (563 mg, 1.73 mmol). The solution was warmed to room temperature overnight, quenched with saturated aqueous ammonium chloride, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 7 ethyl acetate :

hexanes) afforded a white foam (135 mg, 65%); ^{1}H NMR (300 MHz, $CDCl_3$) d 1.32 (t, *J* = 7.1 Hz, 3 H), 2.91 (d, *J* = 2.8 Hz, 1 H), 2.98 (d, *J* = 2.8 Hz, 1 H), 3.09 (t, *J* = 6.6 Hz, 2 H), 3.27-3.33 (m, 2 H), 3.55 (s, 3 H), 3.57 (s, 3 H), 4.20 (q, *J* = 7.0, 12.7 Hz, 2 H), 6.77 (s, 1 H), 6.89-6.93 (m, 2 H), 7.10-7.12 (m, 1 H), 7.20-7.24 (m, 3 H), 7.59 (d, *J* = 7.6 Hz, 1 H), 8.07 (d, *J* = 8.3 Hz, 1 H), 10.12 (br s, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 14.6, 25.7, 32.2, 40.1, 49.0, 51.2, 52.2, 60.7, 72.2, 109.0, 111.4, 118.6, 118.8, 119.3, 121.4, 122.1, 127.2, 127.5, 128.1, 129.3, 137.0, 137.5, 153.9, 168.8; IR (neat) 2950, 1729, 1592, 1530, 1224 cm^{-1}; HRMS (M + H$^+$) calc for $C_{24}H_{28}N_3O_4$ 422.2100, found 422.2080.

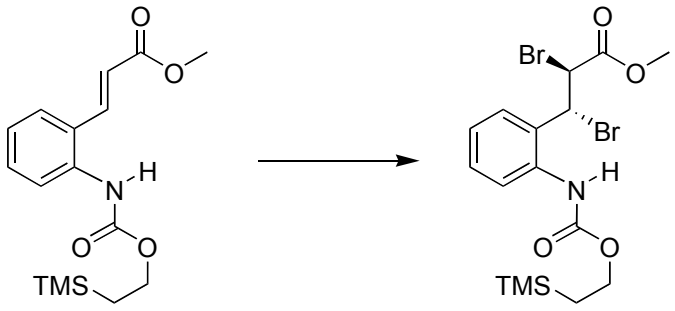


16 **17**

Cycloadduct 17. To a solution of the aziridine **16** (93 mg, 0.228 mmol) in CH_3CN (23 mL) was added bis(trifluoromethanesulfonimide (6.4 mg, 0.023 mmol). The solution was stirred 24 hours at room temperature, quenched with saturated aqueous sodium bicarbonate, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 1 ethyl acetate : hexanes) afforded a yellow foam (64 mg, 70%); ^{1}H NMR (300 MHz, $CDCl_3$) d 1.32 (dt, *J* = 0.5, 7.0 Hz, 2 H), 2.22 (t, *J* = 6.6 Hz, 2 H), 2.81 (s, 3 H), 3.43, (d, *J* = 10.4 Hz, 1 H), 3.72 (s, 3 H), 3.85-3.96 (m, 2 H), 4.19-4.35 (m, 2 H), 4.67 (s, 1 H), 5.23 (d, *J* = 10.6 Hz, 1 H), 6.12 (d, *J* = 7.8 Hz, 1 H), 6.43 (t, *J* = 7.4 Hz, 1 H), 6.53 (d, *J* = 8.1 Hz, 1 H), 6.67 (t, *J* = 7.5 Hz, 1 H), 6.76 (d, *J* = 7.4 Hz, 1 H), 6.91 (q, *J* = 7.9, 15.7 Hz, 2 H), 7.31 (d, *J* = 7.7 Hz, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 14.6, 30.0, 35.3, 38.8, 41.2, 50.5, 52.3, 55.1, 62.0, 85.9, 105.1, 115.4, 117.0, 119.8, 124.4, 124.5, 126.3, 126.8, 128.1, 129.8, 144.1, 150.8, 156.4, 173.3; IR (neat) 3358, 2950, 1741, 1692, 1607, 1496, 1253 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{24}H_{27}N_3O_4Na$ 444.1917, found 444.1899.

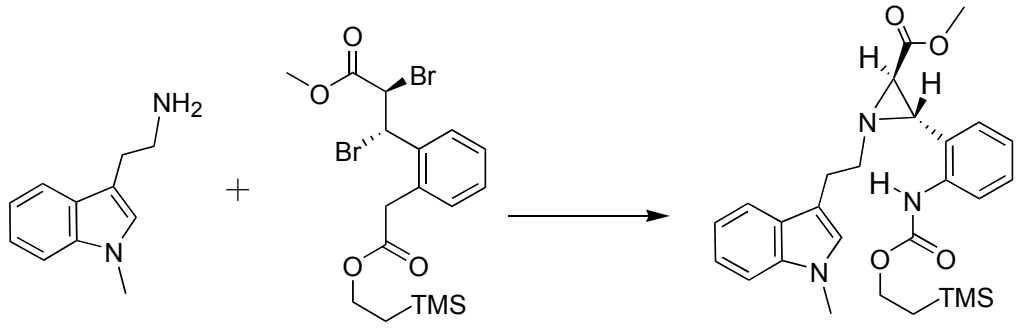


Methyl *N*-[(2-trimethylsilyl)ethoxycarbonyl]cinnamate. To a solution of phosgene (29.4 mL, 297 mmol) at –40 °C was added a solution of 2-trimethylsilyl ethanol (2.98 mL, 20.8 mmol) in toluene (5.9 mL) over 30 minutes via syringe pump. The solution was warmed to 0 °C over 30 minutes, concentrated *in vacuo* to half volume, and added to a solution of methyl 2-amino-cinnamate (3.51 g, 19.8 mmol) and pyridine (4.80 mL, 59.4 mmol) in CH_2Cl_2 (66.0 mL) at –78 °C. The solution was warmed to room temperature over 12 hours, quenched with 10% HCl, and extracted with CH_2Cl_2. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. The crude material thus obtained (5.7 g, 90%) was used without further purification in the next reaction; ^{1}H NMR (200 MHz, $CDCl_3$) d 0.2 (s, 9 H), 0.97-1.04 (m, 2 H), 3.75 (s, 3 H), 4.19-4.25 (m, 2 H), 6.34 (d, *J* = 15.8 Hz, 1 H), 6.96 (br s, 1 H), 7.10 (t, *J* = 7.3 Hz, 1 H), 7.32 (t, *J* = 7.6 Hz, 1 H), 7.47 (d, *J* = 7.8 Hz, 1 H), 7.68 (br d, *J* = 7.6 Hz, 1 H), 7.84 (d, *J* = 15.8 Hz, 1 H); ^{13}C (50 MHz, $CDCl_3$) d –1.7, 17.6, 51.6, 63.7, 119.8, 123.6, 124.7, 126.1, 126.7, 130.6, 136.2, 139.5, 154.1 166.9; IR (neat) 3313, 2952, 2252, 1731, 1633, 1582 cm^{-1}; HRMS (M + Na^+) calc for $C_{16}H_{23}NO_4SiNa$ 344.1287, found 344.1294.



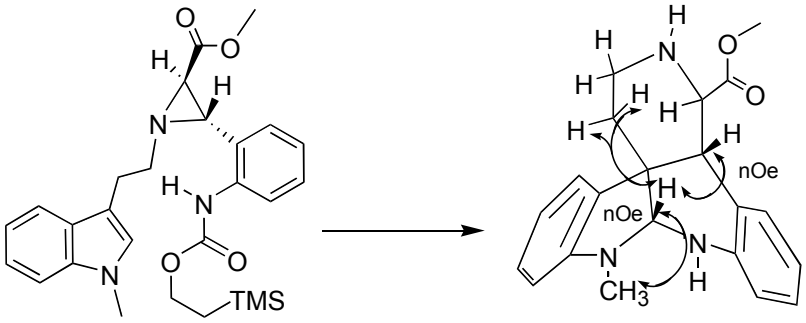
TEOC vicinal dibromide. A solution of methyl *N*-[(2-trimethylsilyl)-ethoxycarbonyl]cinnamate (1.20 g, 3.73 mmol) in cyclohexane (37 mL) was heated to reflux with a heatgun. Bromine (191 mL, 3.73 mmol) was added dropwise and the solution was stirred at room temperature for 10 minutes. The solution was quenched with 10 % aqueous sodium thiosulfate and extracted with Et_2O. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. The crude product thus obtained (1.65 g, 91%) was used in the next reaction without purification; ^{1}H NMR (200 MHz, $CDCl_3$) d 0.06 (s, 9 H), 1.03-1.09 (m, 2 H), 3.90 (s, 3 H), 4.27-4.33 (m, 2 H), 4.95 (d, *J* = 11.7 Hz, 1 H), 5.59 (d, *J* = 11.7 Hz, 1 H), 6.64 (br s, 1 H), 7.25 (t, *J* = 2.7 Hz, 1 H), 7.33-

7.41 (m, 2 H), 7.67 (br d, J = 7.9 Hz, 1 H); ^{13}C (75 MHz, $CDCl_3$) d –1.5, 17.4, 17.6, 45.1, 53.4, 64.0, 65.9, 77.4, 125.8, 128.4, 130.0, 135.6, 154.1, 168.1; IR (neat) 3320, 2953, 1750, 1522 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{16}H_{23}Br_2NO_4SiNa$ 501.9653, found 501.9661.

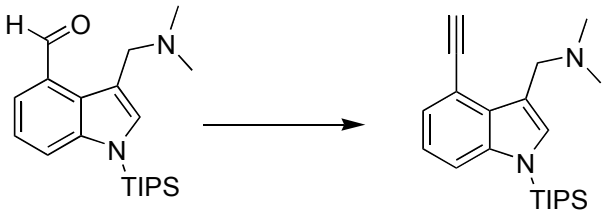


21

Teoc aziridine 21 . To a solution of the TEOC vicinal dibromide (231 mg, 0.479 mmol) in CH_3CN (4.80 mL) at 0 °C was added the tryptamine **15** (83.6 mg, 0.479 mmol) in CH_3CN (1.60 mL) followed immediately by Cs_2CO_3 (470 mg, 1.44 mmol). The solution was warmed to room temperature overnight, quenched with saturated aqueous ammonium chloride, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 3 ethyl acetate : hexanes) afforded a yellow foam (154 mg, 65%); ^{1}H NMR (300 MHz, $CDCl_3$) d 0.99 (s, 9 H), 1.03-1.09 (m, 2 H), 2.92 (d, J = 2.9 Hz, 1 H), 2.96 (d, J = 2.9 Hz, 1 H), 3.09 (t, J = 6.7 Hz, 2 H), 3.21-3.35 (m, 2 H), 3.53 (s, 3 H), 3.60 (s, 3 H), 4.22-4.28 (m, 2 H), 6.76 (s, 1 H), 6.88-6.92 (m, 2 H), 7.07-7.12 (m, 1 H), 7.16-7.28 (m, 3 H), 7.60 (d, J = 7.8 Hz, 1 H), 8.08 (d, J = 8.2 Hz, 1 H), 10.12 (br s, 1 H); ^{13}C (75 MHz, $CDCl_3$) d –1.5, 1.4, 17.6, 25.7, 32.2, 39.9, 49.2, 51.3, 52.1, 62.9, 109.0, 111.4, 118.6, 119.3, 121.4, 122.0, 122.3, 127.2, 128.1, 129.3, 136.9, 137.6, 154.0, 168.8; IR (neat) 2951, 1729, 1593, 1531 cm^{-1} ; HRMS (M + Na$^+$) calc for $C_{27}H_{35}N_3O_4NaSi$ 516.2292, found 516.2295.

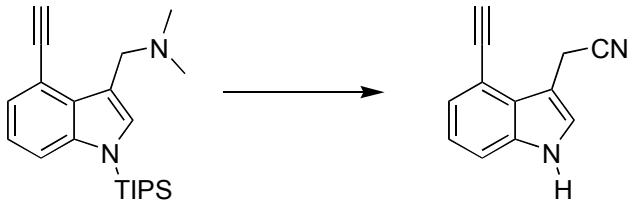


Cycloadduct 22. To a solution of the aziridine **21** (560 mg, 1.13 mmol) in THF (5.7 mL) was added tetrabutylammonium fluoride (4.53 mL, 4.53 mmol). The solution was stirred 4 hours at room temperature, quenched with saturated aqueous ammonium chloride, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 15 methanol : CH_2Cl_2) afforded a yellow oil (315 mg, 80%); ^{1}H NMR (300 MHz, $CDCl_3$) d 1.94-2.09 (m, 2 H), 2.86 (s, 3 H), 3.09-3.36 (m, 1 H), 3.25 (dt, *J* = 2.9, 13.4 Hz, 1 H), 3.33 (d, *J* = 11.4 Hz, 1 H), 3.77 (s, 3 H), 4.54 (d, *J* = 11.4 Hz, 1 H), 4.66 (s, 3 H), 6.21 (d, *J* = 7.7 Hz, 1 H), 6.43-6.59 (m, 2 H), 6.56 (t, *J* = 6.8 Hz, 1 H), 6.82 (d, *J* = 7.7 Hz, 1 H), 6.81-6.93 (m, 1 H), 6.91 (t, *J* = 7.7 Hz, 1 H), 7.10 (d, *J* = 7.3 Hz, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 30.3, 38.1, 41.3, 42.0, 50.7, 53.0, 58.1, 85.4, 106.1, 15.4, 117.8, 119.6, 123.7, 125.6, 126.9, 127.6, 127.9, 128.4, 131.8, 144.8, 151.2, 173.7; IR (neat) 3378, 2947, 1737, 1608, 1495 cm^{-1}; HRMS (M + H$^+$) calc for $C_{21}H_{24}N_3O_2$ 350.1877, found 350.1869.

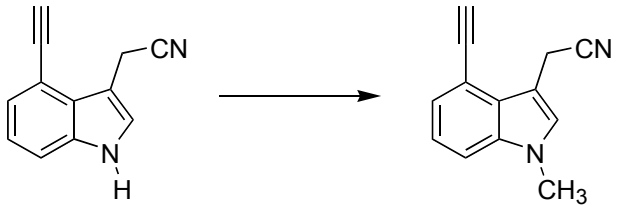


4-Ethynyl-1-(triisopropylsilyl)gramine. Butyllithium (1.97 mL, 4.94 mmol) was added dropwise to a solution of diisopropylamine (690 mL, 4.94 mmol) in THF (16.4 mL) at –78 °C. The solution was stirred 30 minutes at –78 °C, and trimethylsilyldiazomethane (2.47 mL, 4.94 mmol) was added dropwise. The solution was stirred another 30 minutes at –78 °C, and then 4-formyl-1-(triisopropylsilyl)gramine (1.18 g, 3.29 mmol) was added dropwise. The solution was warmed to 0 °C over 3 hours, quenched with saturated aqueous ammonium chloride and extracted with ether. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 9 methanol : CH_2Cl_2) afforded a yellow oil (589 mg, 50%); ^{1}H NMR (400 MHz, $CDCl_3$) d 1.60 (d, *J* = 2.6 Hz, 18 H), 2.23-2.38 (m, 3 H), 2.42 (s, 6 H),

3.35 (s, 1 H), 3.98 (s, 2 H), 7.10 (t, J = 8.2 Hz, 1 H), 7.36 (d, J = 7.2 Hz, 1 H), 7.53 (d, J = 8.3 Hz, 1 H); ^{13}C (100 MHz, $CDCl_3$) d 12.6, 17.8, 44.7, 53.9, 79.5, 83.8, 112.8, 114.7, 115.6, 120.7, 125.8, 130.1, 131.9, 141.3; IR (neat) 3308, 2946, 2813, 2787, 2097, 1892, 1877, 1698, 1632, 1593, 1358 cm^{-1}; HRMS (M + H$^+$) calc for $C_{22}H_{35}N_2Si$ 355.2562, found 355.2570.

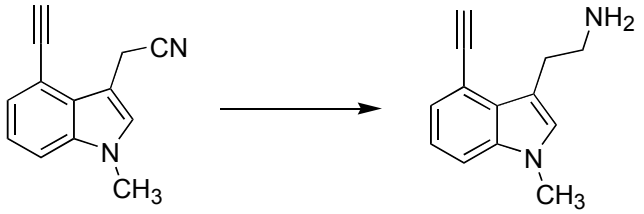


(4-Ethynyl-1*H*-indol-3-yl)-acetonitrile. To a solution of 4-ethynyl-1-(triisopropylsilyl)gramine (1.76 g, 4.96 mmol) in benzene (12.4 mL) at 0 °C was added iodomethane (1.55 mL, 24.8 mmol). The solution was stirred to room temperature overnight and concentrated. The crude ammonium salt was dissolved in DMF (7.1 mL), and a solution of KCN (1.29 g, 19.8 mmol) in H_2O (15.3 mL) was added. The solution was heated to 80 °C for 8 hours, quenched with brine, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 1 ethyl acetate : hexanes) afforded a white foam (615 mg, 70%); ^{1}H NMR (400 MHz, $CDCl_3$) d 3.34 (s, 1 H), 4.23 (s, 2 H), 7.18 (d, J = 7.5 Hz, 1 H), 7.31-7.34 (m, 2 H), 7.41 (dd, J = 0.9, 8.2 Hz, 1 H), 8.27 (br s, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 15.2, 77.4, 80.5, 82.5, 105.9, 112.7, 118.8, 122.5, 124.0, 125.6, 126.0, 136.3; IR (neat) 3334, 3290, 2918, 2254, 2102, 1651, 1609 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{12}H_8N_2Na$ 203.0584, found 203.0585.

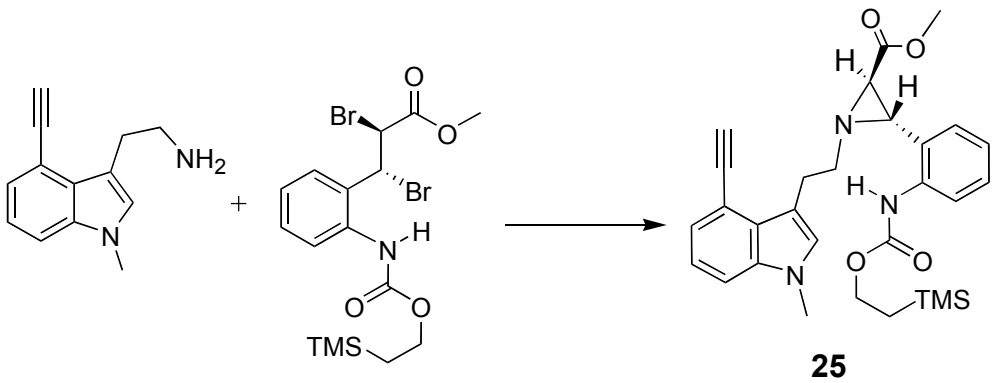


(4-Ethynyl-1-methyl-1*H*-indol-3-yl)-acetonitrile. To a solution of (4-ethynyl-1*H*-indol-3-yl)-acetonitrile (615mg, 3.41 mmol) in THF (11.4 mL) at 0 °C was added NaH (150 mg, 6.25 mmol). The solution was stirred 15 minutes at 0 °C and methyl iodide (276 mL, 4.44 mmol) was added. The solution was stirred 30 min at 0 °C, quenched with saturated aqueous ammonium chloride and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 1 ethyl acetate : hexanes) afforded a yellow foam (654 mg, 99%); ^{1}H NMR (400 MHz, $CDCl_3$) d 3.48 (s, 1 H), 3.69 (s, 3 H), 4.19 (d, J = 1.1 Hz, 2 H), 7.11 (s, 1 H), 7.24 (t, J = 8.3 Hz, 1 H), 7.32 (dd, J = 0.9, 8.3 Hz, 1 H), 7.39 (dd, J = 0.9, 7.1 Hz, 1

H); ^{13}C (100 MHz, $CDCl_3$) d 14.4, 22.3, 80.3, 86.3, 103.9, 110.5, 112.2, 118.6, 121.4, 125.0, 125.5, 128.6, 136.6; IR (neat) 3282, 2942, 2249, 2047, 1552, 1454 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{13}H_{10}N_2Na$ 217.0751, found 217.0742.



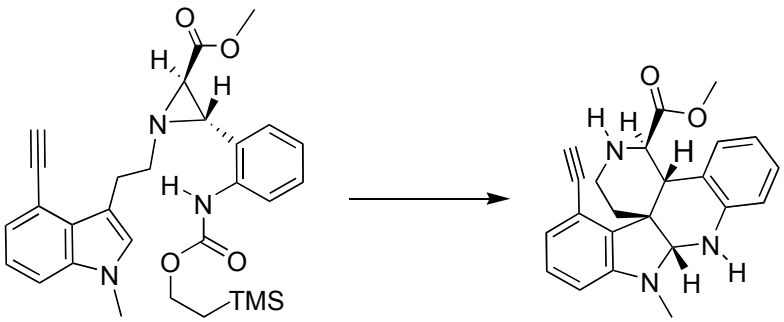
4-Ethynyl-1-methyltryptamine. To a solution of (4-ethynyl-1-methyl-1*H*-indol-3-yl)-acetonitrile (140 mg, 0.721 mmol) in Et_2O (2.40 mL) at 0 °C was added lithium aluminum hydride (109 mg, 2.88 mmol). The solution was stirred 1 h at 0 °C, and quenched with H_2O (109 mL), 10% NaOH (163 mL), and H_2O (327 mL). The solids were filtered off, and the filtrate was concentrated to provide the amine as a yellow foam (121 mg, 85%). The crude product thus obtained was used in the next reaction without purification. ^{1}H NMR (300 MHz, $CDCl_3$) d 1.55 (br s, 2 H), 3.01 (t, *J* = 6.4 Hz, 2 H), 3.12 (t, *J* = 6.4 Hz, 2 H), 3.28 (s, 1 H), 3.67 (s, 3 H), 6.88 (s, 1 H), 7.10 (t, *J* = 7.6 Hz, 1 H), 7.26 (t, *J* = 7.5 Hz, 2 H); ^{13}C (75 MHz, $CDCl_3$) d 29.4, 32.4, 43.5, 79.4, 83.5, 110.2, 112.9, 113.0, 120.8, 125.0, 127.1, 128.2, 137.0; IR (neat) 3280, 2935, 2097, 1453 cm^{-1}; HRMS (M + Na$^+$) calc for $C_{13}H_{14}N_2Na$ 221.1062, found 221.1055.



25

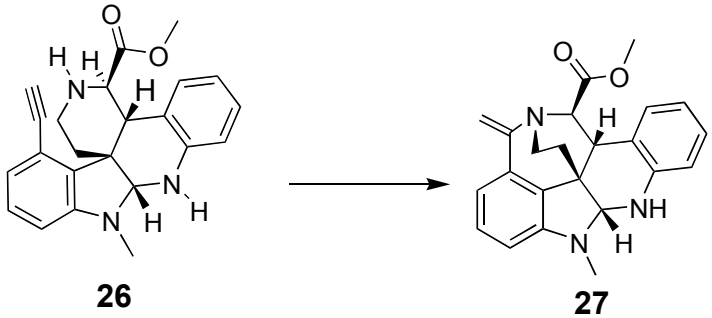
Aziridine 25. To a solution of 4-ethynyl-1-methyltryptamine (58 mg, 0.29 mmol) in CH_3CN (1.00 mL) at 0 °C was added sequentially Cs_2CO_3 (286 mg, 0.88 mmol) and the TEOC vicinal dibromide (141 mg, 0.29 mmol) in CH_3CN (2.90 mL). The solution was warmed to room temperature overnight, quenched with saturated aqueous ammonium chloride, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 7 ethyl acetate : hexanes) afforded a yellow foam (68 mg, 45%); ^{1}H NMR (300 MHz,

$CDCl_3$) d 0.08 (s, 9 H), 1.01-1.05 (m, 2 H), 2.94 (d, *J* = 2.8 Hz, 1 H), 2.98 (d, *J* = 2.8 Hz, 1 H), 3.31 (s, 1 H), 3.24-3.39 (m, 4 H), 3.49 (s, 3 H), 3.59 (s, 3 H), 4.17-4.28 (m, 2 H), 6.78 (s, 1 H), 6.89-6.98 (m, 2 H), 7.09-7.24 (m, 4 H), 8.11 (d, *J* = 8.3 Hz, 1 H), 10.31 (br s, 1 H); ^{13}C (100 MHz, $CDCl_3$) d -0.9, 18.1, 26.4, 32.7, 40.4, 49.7, 52.6, 53.1, 63.4, 80.0, 83.9, 110.7, 112.7, 113.5, 119.6, 121.3, 122.4, 122.7, 125.5, 127.5, 129.5, 129.5, 129.8, 137.6, 138.1, 154.4, 169.2; IR (neat) 3290, 2952, 2360, 1728, 1593 cm^{-1}; HRMS (M + H^+) calc for $C_{29}H_{36}N_3O_4Si$ 518.2488, found 518.24754.



25 **26**

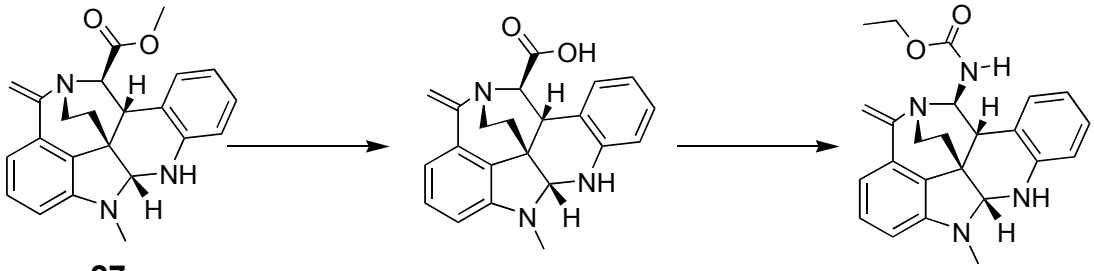
Cycloadduct 26. To a solution of the aziridine **25** (611 mg, 1.18 mmol) in THF (11.8 mL) was added tetrabutylammonium fluoride (4.70 mL, 4.72 mmol). The solution was stirred 4 h at room temperature, quenched with saturated aqueous ammonium chloride, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 15 methanol : CH_2Cl_2) afforded a yellow foam (270 mg, 61%); ^1H NMR (300 MHz, $CDCl_3$) d 1.89-2.08 (m, 2 H), 2.85 (s, 3 H), 3.08 (dq, *J* = 2.5, 3.9, 13.5, 16.2 Hz, 1 H), 3.31 (d, *J* = 11.6 Hz, 1 H), 3.38 (s, 1 H), 3.53 (dt, *J* = 2.7, 13.1 Hz, 1 H), 3.75 (s, 3 H), 4.39 (br s, 1 H), 4.67 (s, 1 H), 5.87 (d, *J* = 11.6 Hz, 1 H), 6.26 (dd, *J* = 0.9, 7.8 Hz, 1 H), 6.35 (dd, *J* = 0.9, 7.7 Hz, 1 H), 6.56 (dt, *J* = 1.0, 7.5 Hz, 1 H), 6.67 (dd, *J* = 1.0, 7.7 Hz, 1 H), 6.82 (t, *J* = 7.5 Hz, 1 H), 6.87 (t, *J* = 7.7 Hz, 1 H), 7.08 (d, *J* = 7.5 Hz, 1 H); IR (neat) 3389, 3291, 2949, 1732, 1576, 1484 cm^{-1};



26 **27**

Enamine 27. To a solution of the alkene **26** (74 mg, 0.198 mmol) in CH_2Cl_2 (1.90 mL), was added Ph_3AuCl (1.00 mg, 0.002 mmol) and AgOTf (0.5 mg, 0.002 mmol). The solution was stirred overnight at 40 °C and concentrated. Purification by silica-gel

chromatography (1 : 1 ethyl acetate : hexanes) afforded a white solid (66 mg, 89%); ^{1}H NMR (300 MHz, $CDCl_3$) d 2.18-3.05 (m, 2 H), 2.70 (s, 3 H), 3.16 (d, *J* = 8.5, 14.5 Hz, 1 H), 3.32 (d, *J* = 10.6 Hz, 1 H), 3.79 (s, 3 H), 3.74-3.85 (m, 1 H), 4.00 (d, *J* = 10.6 Hz, 1 H), 4.62 (s, 1 H), 4.65 (br s, 1 H), 5.16 (s, 1 H), 5.26 (s, 1 H), 6.02 (d, *J* = 7.7 Hz, 1 H), 6.73 (t, *J* = 8.2 Hz, 2 H), 6.76 (d, *J* = 5.3 Hz, 2 H), 6.95 (t, *J* = 7.8 Hz, 1 H), 7.04-7.07 (m, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 30.7, 39.4, 40.9, 47.8, 52.2, 52.3, 62.1, 84.2, 103.6, 108.0, 113.6, 116.5, 120.9, 124.0, 126.9, 128.5, 128.7, 130.0, 134.2, 144.0, 150.6, 156.7, 172.5; IR (neat) 1731, 1587, 1480, 1276, 1168 cm^{-1}; HRMS (M + H$^+$) calcd for $C_{23}H_{24}N_3O_2$ 374.1875, found 374.1869.



27 **28**

***N*-Acylaminal 28.** To a solution of the ester **27** (14 mg, 0.037 mmol) in THF (300 mL) and H_2O (75 mL) at room temperature was added a solution of LiOH (1.4 mg, 0.059 mmol) in H_2O (200 mL) and H_2O_2 (16.2 mL, 0.525 mmol). The solution was stirred 12 h at 50 °C, quenched with 10 % HCl, and extracted with ethyl acetate. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. The crude product thus obtained (12 mg, 92%) was used immediately in the next reaction without purification. ^{1}H NMR (400 MHz, $CDCl_3$) d 2.23-2.28 (m, 2 H), 2.72 (s, 3 H), 3.16 (d, *J* = 10.1 Hz, 1 H), 3.25-3.33 (m, 1 H), 3.46 (dt, *J* = 8.8, 14.4 Hz, 1 H), 4.15 (dd, *J* = 1.5, 10.1 Hz, 1 H), 4.66 (s, 1 H), 5.25 (s, 1 H), 5.45 (s, 1 H), 6.01 (d, *J* = 7.7 Hz, 1 H), 6.70 (t, *J* = 5.2 Hz, 1 H), 6.73 (d, *J* = 13.1 Hz, 1 H), 6.92 (t, *J* = 7.4 Hz, 1 H), 6.95 (t, *J* = 7.8 Hz, 2 H), 7.06 (t, *J* = 7.5 Hz, 1 H); HRMS (M + Na$^+$) calc for $C_{22}H_{21}N_3O_2Na$ 382.1519, found 382.1531. To a solution of the crude acid prepared above (19 mg, 0.053 mmol) in acetone (530 mL) at 0 °C was added *N*,*N*-diisopropylethylamine (13.8 mL, 0.079 mmol) and ethyl chloroformate (5.6 mL, 0.058 mmol). The solution was stirred 3 hours at 0 °C, and then NaN_3 (12 mg, 0.185 mmol) was added. The solution was stirred to room temperature overnight, quenched with saturated aqueous sodium bicarbonate, and extracted with CH_2Cl_2. The combined organic extracts were dried (Na_2SO_4), filtered, and concentrated. Purification by silica-gel chromatography (1 : 1 ethyl acetate : hexanes) afforded a yellow foam (11 mg, 75%); ^{1}H NMR (400 MHz, CD_3CN) d 1.20 (t, *J* = 7.1 Hz, 3 H), 2.66 (s, 3 H), 2.67-2.69 (m, 1 H), 2.99-3.09 (m, 1 H), 3.47-3.67 (m, 2 H), 4.08 (q, *J* = 2.0, 14.3 Hz, 2 H), 4.61 (d, *J* = 2.5 Hz, 1 H), 4.81-4.84 (m, 1 H), 4.99 (br s, 1 H), 5.26 (s, 1 H), 5.43 (s, 1 H), 6.01 (d, *J* = 7.6 Hz, 1 H), 6.23 (br s, 1 H), 6.65-6.73 (m, 2 H), 6.77 (br s, 1 H), 6.81 (d, *J* = 6.8 Hz, 1 H), 6.91 (t, *J* = 7.8 Hz, 1 H), 7.03 (t, *J* = 7.4 Hz, 1 H); ^{13}C (75 MHz, $CDCl_3$) d 14.5, 14.9, 30.1, 31.3, 40.1, 46.1, 46.3, 52.6, 61.4, 67.9, 84.6, 103.9, 109.1,

114.0, 117.0, 121.6, 125.3, 127.5, 127.8, 129.2, 129.8, 135.2, 144.2, 151.0, 155.8; IR (neat) 3333, 2927, 1704, 1587, 1480 cm^{-1}; HRMS (M + H^+) calcd for $C_{24}H_{27}N_4O_2$ 403.2128, found 403.2134.