Supporting Information for

Highly Efficient and Stereocontrolled Oxidative Coupling of Tetrahydropyrroloindoles: Synthesis of Chimonanthines, (+)-WIN 64821 and (+)-WIN 64745

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1-((2-Nitrophenyl)sulfonyl)-1,2,3,8-tetrahydropyrrolo[2,3-b]indole (5). To a solution of \(N\)-nosyl tryptamine (2.875 g, 8.3 mmol) and Et\(_3\)N (5 mL, 35.9 mmol) in CH\(_2\)Cl\(_2\) (83 mL) at 0 °C under nitrogen was slowly added \(t\)-BuOCl (1.0 mL, 9.1 mmol). The reaction mixture was stirred at 0 °C for 3 h, and warmed to room temperature for 18 h. Et\(_2\)O (200 mL) and H\(_2\)O (200 mL) were added into the mixture. The two layers were separated, and the organic layer was washed with brine, dried over Na\(_2\)SO\(_4\), and evaporated. The residue was purified by column chromatography on silica gel with CH\(_2\)Cl\(_2\)-hexane (4:5, v:v) as the eluent to give the product 5 (2.230 g, 78% yield) as a red solid. Mp 127-128 °C. IR (KBr): \(\nu\) (cm\(^{-1}\)) 3420, 1557, 1480, 1450, 1374, 1358, 1167, 1007, 771, 743, 660, 609. \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 8.53 (br, 1H), 7.75 (d, \(J = 8.0\) Hz, 1H), 7.70 (t, \(J = 8.0\) Hz, 1H), 7.62-7.54 (m, 2H), 7.36-7.31 (m, 2H), 7.16-7.11 (m, 2H), 4.38 (t, \(J = 7.6\) Hz, 2H), 3.00 (t, \(J = 7.6\) Hz, 2H). \(^13\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 149.0, 140.5, 138.1, 134.5, 131.9, 130.0, 129.2, 124.3, 124.0, 121.0, 120.9, 117.9, 112.2, 103.8, 56.0, 23.3. ESI-MS (m/z): (M+H\(^+\)) \(^+\) 344. Anal. calcd for C\(_{16}\)H\(_{13}\)N\(_3\)O\(_4\)S: C, 55.97; H, 3.82; N, 12.24. Found: C, 55.89; H, 3.98; N, 12.03.

Lithium bis(trimethylsilyl)amide (1.0 M solution in THF, 0.55 mL, 0.55 mmol) was added into the solution of compound 5 (172 mg, 0.5 mmol) in dry THF (5 mL) at 0 °C under nitrogen atmosphere. After 30 min, I\(_2\) (95 mg, 0.375 mmol) was added and the mixture was stirred for 10 min. The resulting mixture was quenched with saturated aqueous Na\(_2\)S\(_2\)O\(_3\) (2 mL) and extracted with CH\(_2\)Cl\(_2\) (3 × 5 mL). The organic phases were combined and dried
over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude products were purified by column chromatography on silica gel with hexane-ethyl acetate (4:3, v:v) as the eluent to give the mixture of 6 and 7. Further separation by HPLC produced 6 (68 mg, 40%) and 7 (23 mg, 13%).

**Compound 6.** White solid. Mp 152-154 °C (dec.). IR (KBr): ν (cm⁻¹) 1623, 1586, 1545, 1447, 1368, 1251, 1082, 990, 765, 741, 656, 604, 579. ¹H NMR (400 MHz, DMSO-d₆) δ 8.27 (d, J = 8.0 Hz, 2H), 8.04 (d, J = 7.6 Hz, 2H), 7.94 (t, J = 7.6 Hz, 2H), 7.87 (t, J = 7.6 Hz, 2H), 7.28 (t, J = 8.0 Hz, 2H), 7.14 (d, J = 7.6 Hz, 2H), 6.92 (t, J = 7.6 Hz, 2H), 6.68 (d, J = 7.2 Hz, 2H), 4.39-4.34 (m, 4H), 3.02 (dd, J = 14.0, 3.6 Hz, 2H), 2.17-2.08 (m, 2H); ¹³C NMR (100 MHz, DMSO-d₆) δ 177.2, 158.5, 148.2, 137.5, 136.4, 133.1, 131.9, 130.1, 129.6, 124.9, 123.8, 123.6, 119.8, 64.9, 57.1, 26.5. ESI-MS (m/z): (M⁺+Na) 707; HRMS calcd for C₃₂H₂₅N₆O₈S₂ (M+H) 685.1170, found: 685.1166. The structure was further confirmed by its X-ray diffractional experiments.

**Compound 7.** Yellow solid. Mp 146-148 °C (dec.). IR (KBr): ν (cm⁻¹) 2924, 1626, 1592, 1541, 1447, 1377, 1250, 1180, 1061, 768, 741, 654, 584. ¹H NMR (400 MHz, CDCl₃) δ 8.74 (dd, J = 8.0, 1.6 Hz, 2H), 7.80-7.72 (m, 4H), 7.60 (d, J = 7.6 Hz, 2H), 7.31-7.23 (m, 4H), 7.18 (d, J = 7.2 Hz, 2H), 7.01 (t, J = 7.2 Hz, 2H), 4.78-4.71 (m, 2H), 4.64-4.59 (m, 2H), 2.02 (dd, J = 13.6, 6.0 Hz, 2H), 1.91-1.82 (m, 2H). ¹³C NMR (100 MHz, acetone-d₆) δ 179.2, 159.9, 148.6, 137.1, 135.6, 133.7, 131.8, 130.6, 129.8, 124.6, 124.0, 122.8, 118.9, 64.4, 57.6, 26.8. ESI-MS (m/z): (M⁺+Na) 707. HRMS calcd for C₃₂H₂₅N₆O₈S₂ (M+H) 685.1170, found: 685.1186. The structure was further confirmed by its X-ray diffractional experiments.

2. Synthesis of *meso*-Chimonanthine 1.

![Reaction Scheme](image)

Benzyl 2,3-dihydropyrrolo[2,3-b]indole-1(8H)-carboxylate (8). To a solution of
N-(benzoxycarbonyl)tryptamine (0.294 g, 1.0 mmol) and Et₃N (1.4 mL, 10 mmol) in CH₂Cl₂ (10 mL) at 0 °C under nitrogen was slowly added t-BuOCl (0.122 mL, 1.1 mmol). The reaction mixture was stirred at 0 °C for 3 h, and warmed to room temperature for 18 h. The solvent was removed under reduced pressure, the residue was purified by column chromatography on silica gel with CH₂Cl₂-hexane-Et₃N (40:50:1, v:v:v) as the eluent to give the product 8 (0.219 g, 75% yield) as a white solid. Mp 152-154 °C. IR (KBr): v (cm⁻¹) 3368, 1697, 1585, 1537, 1421, 1350, 1208, 1164, 734, 689. ¹H NMR (400 MHz, CDCl₃) (mixture of rotamers) δ 8.76/8.13 (2br, 1H), 7.46-7.19 (m, 7H), 7.10-7.02 (m, 2H), 5.33/5.26 (2s, 2H), 4.46-4.37 (m, 2H), 3.15-3.09 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) (mixture of rotamers) δ 152.5/151.2, 142.5/140.9, 137.2/136.0, 128.9, 128.6, 128.4, 128.2/128.0, 124.6/124.4, 120.6/120.4, 119.7/119.4, 117.2/117.0, 111.7/111.5, 101.2/100.1, 67.9/67.4, 53.4/53.1, 23.2/22.5. ESI-MS (m/z): (M+H)⁺ 293; HRMS calcd for C₁₈H₁₇N₂O₂ (M+H) 293.1285, found 293.1292.

**Compound 9.** The solution of 8 (58 mg, 0.2 mmol) in dry THF (2 mL) was cooled to -40 °C under nitrogen atmosphere, A LiHMDS solution (1.0 M solution in THF, 0.22 mL, 0.22 mmol) was added slowly. After 30 min, I₂ (38 mg, 0.15 mmol) was added and the mixture was stirred for 10 min. The reaction was quenched with saturated aqueous Na₂S₂O₃ (2 mL) and extracted with CH₂Cl₂ (3 × 5 mL). The organic phases were combined and then dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with CH₂Cl₂-ethyl acetate (5:1, v:v) as the eluent to give the product (55 mg, 95% yield) as a white solid. Mp 218-220 °C (decomposed). IR (KBr): v (cm⁻¹) 3054, 2964, 1735, 1574, 1449, 1406, 1309, 1211, 1137, 1033, 919, 747, 702. ¹H NMR (400 MHz, CDCl₃) δ 7.47-7.29 (m, 14H), 6.94 (d, J = 7.2 Hz, 2H), 6.75 (t, J = 7.6 Hz, 2H), 5.34 (s, 4H), 3.73 (t, J = 10.4 Hz, 2H), 2.66 (dd, J = 17.2, 10.0 Hz, 2H), 2.12 (dd, J = 14.0, 6.8 Hz, 2H), 1.78-1.69 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) δ
179.9, 160.0, 150.6, 136.6, 135.6, 130.0, 128.6, 128.5, 123.5, 123.2, 120.0, 68.4, 65.4, 54.1, 23.4. MALDI-MS (m/z): (M⁺) 582; HRMS calcd for C₃₆H₃₁N₄O₄ (M+H) 583.2340, found 583.2334.

**CatBH**

**Compound 12.** To a solution of compound 9 (29 mg, 0.05 mmol) in dry THF (0.5 mL) was added catecholborane (1.0 M solution in THF, 0.2 mL, 0.2 mmol) at 0 °C under nitrogen atmosphere. After 2 hours, the reaction mixture was warmed to room temperature and stirred for another 12 h. Water (1 mL) was added to the reaction mixture. The resulting mixture was then extracted with CH₂Cl₂ (4 × 3 ml). The organic phases were combined and then washed with brine, dried over Na₂SO₄, and evaporated. The residue was purified by column chromatography on silica gel with CH₂Cl₂-ethyl acetate (2:1, v:v) as the eluent to give the product 12 (22 mg, 75% yield) as a white solid. Mp 208-210 °C. IR (KBr): ν (cm⁻¹) 3332, 1692, 1606, 1468, 1420, 1199, 892, 746, 696. ¹H NMR (400 MHz, CDCl₃) δ 7.38-7.28 (m, 10H), 7.10-7.04 (m, 2H), 6.75-6.61 (m, 4H), 6.55-6.43 (m, 2H), 5.50-5.03 (m, 6H), 4.59 (br, 2H), 3.80-3.63 (m, 2H), 3.04-2.97 (m, 2H), 2.31-2.19 (m, 4H); ¹³C NMR (100 MHz, CDCl₃) δ 154.7/153.8, 150.4/150.3/150.0, 136.7/136.5, 129.1, 128.1/128.7, 128.5, 128.3/128.1, 127.9, 124.1, 118.9/118.7, 109.4/109.2, 77.9, 67.1/66.9, 62.5/62.4/61.3/61.2, 45.6/45.3, 33.2/33.1/33.0. ESI-MS (m/z): (M⁺+Na) 609; HRMS calcd for C₃₆H₃₄N₄O₄Na (M+Na) 609.2472, found 609.2489.
**meso-Chimonanthine (1).** To a solution of compound 12 (59 mg, 0.1 mmol) in toluene (1 mL) was added Red-Al (65% in toluene, 0.28 mL, 1 mmol) dropwise. The reaction mixture was heated to reflux. After 3 h, the mixture was cooled down to room temperature, diluted with CH₂Cl₂, and quenched with saturated aqueous Na-K tartrate (5 mL). The resulting mixture was vigorously stirred for 1 h at room temperature. The layers were separated, and the aqueous layer was extracted with CH₂Cl₂ (3 × 5 mL). The organic phases were combined and then washed with brine, dried over Na₂SO₄, and concentrated under reduced pressure. The residue was purified by flash column chromatography (10% methanol in dichloromethane saturated with ammonia) to afford *meso*-chimonanthine (1) (25 mg, 72%) as a white solid. Mp 190-192 °C (lit.⁴a mp 199-201 °C). IR (KBr): ν (cm⁻¹) 3374, 2965, 2926, 2854, 2809, 1604, 1485, 1247, 1158, 1024, 745. ¹H NMR (400 MHz, CD₃OD) δ 6.84 (br s, 2H), 6.41 (br, 2H), 6.34 (d, J = 8.0 Hz, 4H), 4.47 (br, 2H), 2.63 (br s, 2H), 2.40 (br s, 2H), 2.24 (br, 8H), 1.95 (d, J = 9.2 Hz, 2H); ¹³C NMR (100 MHz, CD₃OD) δ 153.6, 133.9, 129.1, 125.4, 118.6, 109.5, 84.3, 64.9, 53.5, 37.3, 36.3. ESI-MS (m/z): (M⁺+H) 347; HRMS calcd for C₂₂H₂₇N₄ (M+H) 347.2230, found 347.2233.

3. **Synthesis of rac-Chimonanthine 2.**

![Chemical Structure](image)

**Compound 10.** To the solution of 8 (58 mg, 0.2 mmol) in dry THF (10 mL) at 0 °C under nitrogen atmosphere was added KH (9 mg, 0.23 mmol). After 30 min, I₂ (38 mg, 0.15 mmol) was added and the mixture was stirred for 10 min. The reaction was quenched with saturated aqueous Na₂S₂O₃ (2 mL) and extracted with CH₂Cl₂ (3 × 5 mL). The organic phases were combined and then dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (4:3, v:v) as the eluent to give the product 10 (51 mg, 87% yield) as a
white solid. Mp 194-196 °C (dec.). IR (KBr): ν (cm⁻¹) 1717, 1627, 1589, 1411, 1321, 1246, 1133, 772, 754. ¹H NMR (400 MHz, CDCl₃) δ 7.53 (d, J = 8.0 Hz, 2H), 7.42-7.29 (m, 14H), 7.12 (t, J = 7.6 Hz, 2H), 5.20 (d, J = 12.0 Hz, 2H), 5.12 (d, J = 12.4 Hz, 2H), 4.40-4.33 (m, 2H), 4.08 (t, J = 10.0 Hz, 2H), 1.82 (dd, J = 13.6, 6.0 Hz, 2H), 1.71-1.62 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 180.7, 161.0, 150.5, 136.8, 135.2, 129.9, 128.6, 128.3, 128.2, 124.5, 123.0, 119.9, 68.3, 64.4, 54.8, 25.3. MALDI-MS (m/z): (M++K) 621; HRMS calcd for C₃₆H₃₁N₄O₄ (M+H) 583.2340, found 583.2351.

**Compound 13.** To the solution of compound 10 (15 mg, 0.025 mmol) in dry THF (0.6 mL) at room temperature under nitrogen atmosphere was added HOAc (3 μL, 0.05 mmol). After 1 h, NaBH₃CN (9 mg, 0.15 mmol) was added and then the mixture was stirred at 40 °C for 18 hours, the reaction was quenched with saturated aqueous NH₄Cl (1 mL) and extracted with CH₂Cl₂ (3 × 2 mL). The organic phases were combined and then dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (2:1, v:v) as the eluent to give the product 13 (12 mg, 80% yield) as a white solid. Mp 114-116 °C. IR (KBr): ν (cm⁻¹) 3337, 3034, 2956, 1686, 1425, 1356, 1202, 889, 731, 699. ¹H NMR (400 MHz, CDCl₃) (mixture of rotamers) δ 7.38-7.24 (m, 10H), 7.20-7.09 (m, 4H), 6.80-6.54 (m, 4H), 5.22-4.87 (m, 6H), 4.50 (br s, 2H), 3.70-3.56 (m, 2H), 2.92-2.86 (m, 2H), 2.65-2.55 (m, 2H), 2.16-2.00 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) (mixture of rotamers) δ 154.6/153.7, 150.5/150.2/150.1, 136.6/136.4, 129.3/129.2, 128.7, 128.5/128.4, 128.2/128.1, 127.9, 125.4/125.2/125.1, 119.2/118.9/118.8/118.6, 110.0/109.8, 79.3/79.1/78.4, 67.0/66.9, 61.9/60.9, 45.6/45.4, 31.6/31.5/31.4. ESI-MS (m/z): (M++Na) 609; HRMS calcd for C₃₆H₃₄N₄O₄Na (M+Na) 609.2472, found 609.2491.
**rac-Chimonanthine (2).** rac-Chimonanthine 2 was synthesized from 13 according to the procedure outlined for meso-chimonanthine 1. Compound 2 was obtained in 76% yield as a white solid. Mp 150-152 °C (lit.\textsuperscript{12a} mp 168-172 °C). IR (KBr): ν (cm\textsuperscript{-1}) 3408, 2932, 2790, 1605, 1486, 1466, 1353, 1247, 1154, 1024, 736. \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) δ 7.18 (d, J = 6.8 Hz, 2H), 6.98 (t, J = 6.8 Hz, 2H), 6.67 (d, J = 6.4 Hz, 2H), 6.54 (d, J = 7.2 Hz, 2H), 4.32 (br s, 4H), 2.56-2.51 (m, 6H), 2.31 (s, 6H), 2.09-2.07 (m, 2H); \textsuperscript{13}C NMR (100 MHz, CD\textsubscript{3}Cl) δ 150.7, 133.3, 128.1, 124.5, 118.7, 109.3, 85.3, 63.4, 52.7, 37.3, 35.7. ESI-MS (m/z): (M\textsuperscript{+}+H) 347; HRMS calcd for C\textsubscript{22}H\textsubscript{27}N\textsubscript{4} (M+H) 347.2230, found 347.2229.

**4. Synthesis of (+)-WIN 64821 (3) and (+)-WIN 64745 (4).**

(S)-1-Benzyl 2-methyl 2,3-dihydropyrrolo[2,3-b]indole-1,2(8H)-dicarboxylate (15). To a solution of N-(benzoxycarbonyl)tryptophan methyl ester (3.987 g, 0.011 mol) and Et\textsubscript{3}N (15.3 mL, 0.11 mol) in CH\textsubscript{2}Cl\textsubscript{2} (110 mL) at 0 °C under nitrogen was slowly added t-BuOCl (1.4 mL, 0.012 mol). The reaction mixture was stirred at 0 °C for 3 h, and then warmed up to room temperature for 18 h. Et\textsubscript{2}O and H\textsubscript{2}O were added to the mixture. The two layers were separated, and the organic layer was washed with saturated aqueous Na\textsubscript{2}CO\textsubscript{3} for three times, dried over Na\textsubscript{2}SO\textsubscript{4}, and evaporated. The residue was recrystallized from CH\textsubscript{2}Cl\textsubscript{2}/Et\textsubscript{2}O to give the tricyclic compound as white powder (2.293 g). The mother liquor was concentrated and purified by column chromatography on silica gel with hexane-ethyl acetate-Et\textsubscript{3}N (40:10:0.5,
v:v:v) as the eluent to afford the second crop of product 15 (0.895 g, 3.188 g total, 83 % yield). Mp 154-156 °C. \([\alpha]_{D}^{26} = -38.2 \text{ (c 1.00, CHCl}_3\text{)}\). IR (KBr): v (cm\(^{-1}\)) 3200, 2955, 1756, 1687, 1589, 1536, 1452, 1425, 1347, 1164, 737, 696. \(^1\)H NMR (400 MHz, CDCl\(_3\)) (mixture of rotamers) \(\delta\) 8.88/8.22 (2 br s, 1H), 7.44-7.18 (m, 7H), 7.09-7.01 (m, 2H), 5.38-5.15 (m, 3H), 3.78/3.62 (2s, 3H), 3.57-3.50 (m, 1H), 3.17-3.12 (m, 1H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) (mixture of rotamers) \(\delta\) 171.4/171.2, 152.0/151.2, 142.1/140.5, 137.4/137.3/135.7, 128.9/128.7, 128.6/128.5, 128.2/128.1, 127.8, 124.2/124.0, 120.8/120.6, 120.0/119.8, 117.2/117.0, 111.9/111.7, 98.6/97.5, 68.3/67.9, 65.6/65.5, 52.7/52.5, 29.5/28.5. ESI-MS (m/z): (M\(^{+}\)+Na) 373; HRMS calcd for C\(_{20}\)H\(_{18}\)N\(_2\)O\(_4\)Na (M+Na) 373.1159, found 373.1144.

**Compound 16.** To the solution of compound 15 (70 mg, 0.2 mmol) in dry THF (10 mL) at -40 °C under nitrogen atmosphere was added sodium hydride (60%, 9 mg, 0.22 mmol). After 30 min, the reaction mixture was warmed to 0 °C, then I\(_2\) (38 mg, 0.15 mmol) was added and the mixture was stirred for 15 min. The reaction was quenched with saturated aqueous Na\(_2\)S\(_2\)O\(_3\) (2 mL) and extracted with CH\(_2\)Cl\(_2\) (3 × 5 mL). The organic phases were combined and then dried over anhydrous Na\(_2\)SO\(_4\). After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (4:3, v:v) as the eluent to give the product 16 (56 mg, 80% yield) as a white solid. Mp 182-184 °C. \([\alpha]_{D}^{24} = 113.6 \text{ (c 0.20, CHCl}_3\text{)}\); IR (KBr): v (cm\(^{-1}\)) 1752, 1717, 1627, 1591, 1407, 1298, 1218, 768, 689; \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.60 (d, \(J = 7.6\) Hz, 2H), 7.45-7.31 (m, 14H), 7.15 (t, \(J = 7.6\) Hz, 2H), 5.33 (d, \(J = 12.0\) Hz, 2H), 5.13-5.09 (m, 4H), 3.38 (br s, 6H), 2.11 (dd, \(J = 13.2, 6.4\) Hz, 2H), 1.59 (dd, \(J = 13.6, 9.2\) Hz, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 178.8, 170.3, 160.7, 149.9, 136.3, 134.7, 130.3, 128.5, 128.4, 124.2, 123.8, 120.7, 68.8, 66.5, 64.0, 52.3, 29.1; ESI-MS (m/z): (M\(^{+}\)+H) 699; HRMS calcd for C\(_{46}\)H\(_{35}\)N\(_4\)O\(_8\) (M+H) 699.2449, found 699.2471. The structure was further confirmed by its X-ray diffractional experiments.
Compound 17. To the solution of compound 16 (35 mg, 0.05 mmol) in dry THF (1 mL) at room temperature under nitrogen atmosphere was added HOAc (6 μL, 0.1 mmol). After 1 h, NaBH₃CN (18 mg, 0.3 mmol) was added and the mixture was stirred at reflux for 20 hours. The reaction was quenched with saturated aqueous NH₄Cl (1 mL) and extracted with Et₂O (3 × 2 mL). The organic phase was dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (2:1, v:v) as the eluent to give the reductive product (31 mg, 88% yield) as a white solid. Mp 206-208 °C; [α]²⁶ D = 245.5 (c 0.20, CHCl₃); IR (KBr): ν (cm⁻¹) 3324, 1726, 1695, 1604, 1455, 1412, 1356, 1279, 1223, 1106, 750, 693; ¹H NMR (400 MHz, CDCl₃) (mixture of rotamers) δ 7.29-7.12 (m, 10H), 7.05-6.94 (m, 4H), 6.68-6.51 (m, 4H), 5.28-4.76 (m, 8H), 4.47-4.33 (m, 2H), 3.04-2.95 (m, 6H), 2.86-2.76 (m, 2H), 2.52-2.34 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) (mixture of rotamers) δ 171.3/171.0, 154.4/153.7, 151.4/151.3/150.9/150.8, 136.3/136.2/136.1, 129.9/129.8, 128.7/128.6/128.4, 128.2/128.1, 127.8/127.7, 126.9/126.8/126.7, 126.2/126.1/125.9, 118.9/118.7/118.5/118.3, 110.0, 80.2/80.0/79.4/79.2, 67.4/67.2, 60.9/59.8/59.7, 59.3/59.1/59.0, 52.1/52.0, 35.8/35.6/35.2; ESI-MS (m/z): (M⁺+H) 703; HRMS calcd for C₄₀H₃₈N₄O₈Na (M+Na) 725.2582, found 725.2563.

The above reduction product was dissolved in a 5:1 mixture of MeOH/THF (6 mL), 10% Pd/C (50 mg) was added and the vessel purged three times with H₂. The mixture was stirred under 1 atm of H₂ overnight and then filtered over a pad of Celite. The precipitate was washed with MeOH and the combined filtrates concentrated in vacuo. The residue was purified by flash chromatography on silica gel with CH₂Cl₂/MeOH (10:1, v:v) as the eluent to give the product 17 (103 mg, 95% yield) as a white solid. Mp 164-166 °C. [α]²⁴ D = 192.6 (c 0.16, MeOH). IR (KBr): ν (cm⁻¹) 3377, 2946, 1731, 1604, 1487, 1473, 1321, 1236, 1103, 1013, 763, 743, 550. ¹H NMR (400 MHz, CD₃OD) δ 7.08 (d, J = 7.2 Hz, 2H), 6.92 (t, J = 7.6 Hz, 2H),
6.56 (t, J = 7.2 Hz, 2H), 6.44 (d, J = 7.6 Hz, 2H), 4.54 (s, 2H), 3.61 (dd, J = 8.0, 2.8 Hz, 2H), 3.15 (s, 6H), 2.72 (dd, J = 12.8, 8.4 Hz, 2H), 2.40 (dd, J = 12.8, 2.8 Hz, 2H); $^{13}$C NMR (100 MHz, CD$_3$OD) $\delta$ 174.0, 151.5, 129.6, 128.7, 125.8, 117.7, 109.4, 80.5, 61.8, 59.5, 51.0, 38.0.

(+)-WIN 64821 (3). HATU (84 mg, 0.22 mmol) and Et$_3$N (40 $\mu$L, 0.26 mmol) were added to the solution of the N-Fmoc-L-phenylalanine (85 mg, 0.22 mmol) in DMF (1 mL). The mixture was cooled to -10 $^\circ$C. After 15 min, compound 17 (43 mg, 0.1 mmol) was added. The mixture was stirred at -10 $^\circ$C for 2 h, then warmed up to room temperature and stirred overnight. The reaction was quenched by the addition of H$_2$O (5 mL) and extracted with CH$_2$Cl$_2$ by three times. The combined organic phases were dried over anhydrous Na$_2$SO$_4$ and the solvents were removed under reduced pressure. The residue was then directly used in the next step without further purification. Diethylamine (0.2 mL) was added to the solution of the crude condensation product in MeOH (3 mL) and the mixture was stirred for 10 h at room temperature. The solvents were removed under reduced pressure and the residue was purified by flash chromatography on silica gel with CH$_2$Cl$_2$-acetone-hexane (6:1:0.5, v:v:v) as the eluent to afford product 3 (43 mg, 65% combined yield over the two steps) as a white solid. Mp 180-182 $^\circ$C (lit.$^7a$ mp 193-196 $^\circ$C). [$\alpha$]$^26_D$ = 253.8 (c 0.15, MeOH) (lit.$^7a$ [$\alpha$]$^{20}_D$ = 227 (c 0.15, MeOH)). IR (KBr): $\nu$ (cm$^{-1}$) 3376, 1670, 1406, 1314, 1182, 1095, 749, 701. $^1$H NMR (400 MHz, CD$_3$CN) $\delta$ 7.38 (d, J = 7.6 Hz, 2H), 7.21-7.13 (m, 12H), 6.77 (t, J = 7.2 Hz, 2H), 6.72 (d, J = 8.0 Hz, 2H), 5.99 (s, 2H), 5.91 (s, 2H), 4.92 (s, 2H), 4.19 (t, J = 5.6 Hz, 2H), 4.10 (t, J = 8.8 Hz, 2H), 3.14 (dd, J = 14.8, 4.8 Hz, 2H), 3.06-2.99 (m, 4H), 2.55 (dd, J = 14.0, 8.0 Hz, 2H); $^{13}$C NMR (100 MHz, CD$_3$CN) $\delta$ 168.8, 168.0, 149.1, 136.5, 130.5, 129.4, 129.2, 128.4, 126.7, 125.1, 119.3, 117.3, 109.5, 79.7, 60.1, 56.9, 56.0, 35.8, 35.2. ESI-MS (m/z): (M$^+$+H) 665; HRMS calcd for C$_{40}$H$_{36}$N$_6$O$_4$Na (M+Na) 687.2690, found 687.2682.
(+-)WIN 64745. HATU (42 mg, 0.11 mmol) and Et$_3$N (30 µL, 0.2 mmol) were added to the solution of N-Fmoc-L-leucine (42 mg, 0.11 mmol) in DMF (0.5 mL) and the mixture was cooled down to -10 °C. After 15 min, a solution of compound 17 (43 mg, 0.1 mmol) in DMF (0.5 mL) was added. The reaction mixture was stirred at -10 °C for 5 h and then warmed up to 0 °C, N-Fmoc-L-phenylalanine (46 mg, 0.12 mmol), Et$_3$N (30 µL, 0.2 mmol) and HATU (46 mg, 0.12 mmol) were added. After 2 hours, the resulting mixture was warmed up to room temperature and stirred overnight. The reaction mixture was quenched by H$_2$O (5 mL) and extracted with CH$_2$Cl$_2$ for three times. The combined organic phases were dried over anhydrous Na$_2$SO$_4$. After the removal of solvents under reduced pressure, the residue was then directly used in the next step without further purification. Diethylamine (0.2 mL) was added into the solution of the crude product in MeOH (3 mL) and the mixture was stirred for 10 h at room temperature. The solvents were removed under reduced pressure and the residue was purified by flash chromatography on silica gel with hexane-ethyl acetate (1:4, v:v) as the eluent to give (+)-WIN 64745 (34 mg, 54% combined yield over the two steps) as a white solid. Mp 186-188 °C (lit.$^7a$ mp 190-192 °C). $[^26]D = 265.3$ (c 0.012, MeOH) (lit.$^7a$ $[^27]D = 301$ (c 0.012, MeOH). IR (neat): $\nu$ (cm$^{-1}$) 3383, 2956, 1671, 1606, 1408, 1339, 1314, 1188, 1096, 747, 701. $^1$H NMR (400 MHz, CD$_3$CN) $\delta$ 7.44 (d, $J = 7.6$ Hz, 1H), 7.40 (d, $J = 7.6$ Hz, 1H), 7.19-7.10 (m, 7H), 6.80-6.75 (m, 2H), 6.70 (d, $J = 8.0$ Hz, 1H), 6.65 (d, $J = 7.6$ Hz, 1H), 6.25 (s, 1H), 6.08 (s, 1H), 5.92 (br s, 1H), 5.84 (br s, 1H), 4.95 (s, 1H), 4.94 (s, 1H), 4.22-4.11 (m, 3H), 3.88 (q, $J = 4.4$ Hz, 1H), 3.14 (dd, $J = 14.8$, 4.8 Hz, 1H), 3.09-2.99 (m, 3H), 2.80 (dd, $J = 14.4$, 7.2 Hz, 1H), 2.57 (dd, $J = 13.6$, 7.6 Hz, 1H), 1.82-1.69 (m, 2H), 1.42-1.35 (m, 1H), 0.86 (dd, $J = 6.4$, 2.8 Hz, 6H); $^{13}$C NMR (100 MHz, CD$_3$CN) $\delta$ 169.8, 169.3, 169.0, 168.0, 149.1, 149.1, 136.4, 130.5, 130.4, 129.4, 129.2, 128.4, 126.7, 125.2, 125.2, 119.2, 119.2, 117.3, 109.5, 79.7, 79.6, 60.4, 60.1, 57.1, 56.9, 56.1, 53.6, 37.7, 35.8, 35.2, 35.1, 24.2, 22.1, 20.9. ESI-MS (m/z): (M$^+$+H) 631; HRMS calced for C$_{37}$H$_{39}$N$_6$O$_4$ (M+H) 631.3027, found

3a-Bromo-1-((2-nitrophenyl)sulfonyl)-1,2,3,3a-tetrahydropyrrolo[2,3-b]indole (18). The solution of 5 (2.506 g, 7.3 mmol) in dry THF (73 mL) was cooled to -78 °C under nitrogen atmosphere. A LiHMDS solution (1.0 M solution in THF, 8.0 mL, 8.0 mmol) was added slowly. After 30 min, NBS (1.424 g, 8 mmol) was added and the mixture was stirred for 3 h at -78 °C. The reaction was quenched with water (50 mL) and extracted with CH₂Cl₂ (3 × 100 ml). The combined organic phases were dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (2:1, v:v) as the eluent to give the product (2.557 g, 83% yield) as a yellow solid. Mp 94-96 °C (dec.). IR (KBr): \(\nu\) (cm⁻¹) 1630, 1590, 1552, 1447, 1383, 1259, 1179, 1067, 998, 787, 764, 744, 607. \(^1\)H NMR (400 MHz, CDCl₃) \(\delta\) 8.62-8.59 (m, 1H), 7.82-7.77 (m, 2H), 7.72-7.70 (m, 1H), 7.42 (d, \(J = 7.6\) Hz, 1H), 7.30 (d, \(J = 4.0\) Hz, 2H), 7.12-7.08 (m, 1H), 4.76 (td, \(J = 10.4, 4.4\) Hz, 1H), 4.60 (dd, \(J = 10.8, 7.6\) Hz, 1H), 2.72 (dd, \(J = 13.6, 4.4\) Hz, 1H), 2.28 (ddd, \(J = 13.6, 10.0, 7.2\) Hz, 1H). \(^{13}\)C NMR (100 MHz, DMSO-d₆) \(\delta\) 176.0, 156.4, 147.4, 136.4, 136.3, 133.0, 131.4, 130.9, 129.2, 125.0, 124.9, 124.2, 120.0, 64.4, 56.9, 33.9. ESI-MS \((m/z)\): (M⁺+H) 422. HRMS calcd for C₁₆H₁₃O₄N₃BrS (M+H) 421.9805, found: 421.9800.

Compound 5 (34 mg, 0.1 mmol) and anhydrous LiI (26 mg, 0.2 mmol) were dissolved in dry
THF (1 mL), and the mixture was cooled to -40 °C under nitrogen atmosphere. A LiHMDS solution (1.0 M solution in THF, 0.12 mL, 0.12 mmol) was added slowly. After 30 min, the reaction mixture was warmed up to room temperature, and compound 18 was added. After stirring overnight, the reaction was quenched with water (2 mL) and extracted with CH₂Cl₂ (4 × 5 ml). The combined organic phases were dried over anhydrous Na₂SO₄. After the removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel with hexane-ethyl acetate (4:3, v:v) as the eluent to give the mixture of 6 and 7 (32 mg, 47% yield, 6:7 = 3:2).

6. References for Known Compounds.

<table>
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<th>No.</th>
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<td>3</td>
<td>Barrow, C. J.; Cai, P.; Snyder, J. K.; Sedlock, D. M.; Sun, H. H.; Cooper, R. <em>J. Org. Chem.</em> 1993, 58, 6016.</td>
<td>3, 4</td>
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<tr>
<td>6</td>
<td>Pérez-Balado, C.; de Lera, Á. R. <em>Org. Lett.</em> 2008, 10, 3701.</td>
<td>17</td>
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</table>
7. X-Ray Crystal Structure of 6, 7 and 16.
Compound 16
8. $^1$H and $^{13}$C NMR Spectra.

Compound 5

![NMR spectra of Compound 5](image-url)
Compound 6
Compound 8

[Graphical representation of the compound]

[Chemical structures of the compound]
Compound 12
Compound 1

meso-chimonanthine

meso-chimonanthine
Compound 10
Compound 13
Compound 2

(±)-chimonanthine

(2)-chimonanthine
Compound 15
Compound 16
Compound 17

\[
\begin{align*}
\text{HN} & - \text{N} - \text{NH} - \text{CO}_2\text{Me} \\
\text{HN} & - \text{N} - \text{HN} - \text{MeO}_2\text{C} \\
\end{align*}
\]
Compound 3
Compound 4

![Chemical Structure]

WIN 64745