SUPPORTING INFORMATION

A Practical Synthetic Route to Functionalized THBCs and Oxygenated Analogous via Intramolecular Friedel-Crafts Reactions

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General Remarks: ^{1}H-NMR spectra were recorded on Varian 200 (200 MHz) or Varian 300 (300 MHz) spectrometers. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as the internal standard (deuterochloroform: δ 7.27 ppm). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = duplet, t = triplet, q = quartet, br = broad, m = multiplet), coupling constants (Hz). ^{13}C-NMR spectra were recorded on a Varian 200 (50 MHz) or Varian 300 (75 MHz) spectrometers with complete proton decoupling. Chemical shifts are reported in ppm from tetramethylsilane with the solvent as the internal standard (deuterochloroform: δ 77.0 ppm). Mass spectra were performed at an ionizing voltage of 70 eV. Analytical high performance liquid chromatography (HPLC) was performed on a HP 1090 liquid chromatograph equipped with a variable wavelength UV detector (deuterium lamp 190-600 nm) and using a Daicel Chiralcel^{TM} OD and OF columns (0.46 cm I.D. x 25 cm) (Daicel Inc.). HPLC grade isopropanol and *n*-hexane were used as the eluting solvents. Elemental analyses were carried out by using a EACE 1110 CHNOS analyzer. All the commercially available reagents were used without further purification. Melting points were determined with Büchi 150 melting point unit and are not corrected. IR analysis were performed with a FT-IR NICOLET 205 spectrophotometer and the spectra are expressed by wavenumber (cm^{-1}). LC-electrospray ionization mass spectra were obtained with Agilent Technologies MSD1100 single-quadrupole mass spectrometer.

Typical procedure for the synthesis of *N*protected-allylindole (6).

A 50 mL two-necked flask equipped with a magnetic stirrer flamed under vacuum was charged, under nitrogen atmosphere, with 15 mL of anhydrous CH_2Cl_2, 1.52 mmol of allylamine.[1] Then 211 μL (1.52 mmol) of triethylamine, 18 mg (0.152 mmol) of DMAP and finally 111 μL (1.44 mmol) of the desired reagent (**6a**: $(Boc)_2O$, **6b**: ClCbz, **6c**: $ClCO_2Me$, **6d**: $(COCF_3)_2O$) were added. The mixture was stirred for 15 hs at rt and then judged complete by TLC analysis and finally quenched with H_2O (5 mL). The two phases separated and the aqueous phase was extracted with ethyl acetate (3 x 5 mL). The collected organic layers were dried with Na_2SO_4, concentrated under reduced pressure and the crude was purified by flash-chromatography.

2-[methylen-*N*-(*t*-butoxycarbonyl)-allylamine]-indole 6a (400 mg, 92%) as a pale brown solid, mp 76-77 °C; R_f 0.3 (cyclohexane/Et_2O 95/5); (Found: C, 71.22; H, 7.68; N, 9.75. $C_{17}H_{22}N_2O_2$ requires C, 71.30; H, 7.74; N, 9.78); ν_{max}(nujol)/cm^{-1} 3264m, 1671s, 1409m, 1318w, 1269m, 1251m, 1160s, 1125m, 914m and 864m; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.99 (1H, br s, NH), 7.56 (1H, d, *J* 7.8, Ar), 7.35 (1H, d, *J* 7.8 Hz, Ar), 7.05-7.22 (2H, m, Ar), 6.35 (1H, s, Ar), 5.65-5.80 (1H, m, $CH_2CH{=}CH_2$), 5.12-5.21 (2H, m, $CH_2CH{=}CH_2$), 4.37 (2H, s, CCH_2NBoc), 3.81 (2H, d, *J* 7.8, NCH_2CH), 1.51 (9H, s, *t*-Bu); δ_C(50 MHz; $CDCl_3$; Me_4Si) 156.8, 136.4, 135.8, 133.5, 127.7, 121.8, 120.2, 119.6, 116.7, 110.9, 101.5, 80.4, 49.7, 43.5, 28.4;

2-[methylen-*N*-(carbobenzoxy)-allylamine]-indole 6b (413 mg, 85%) as a brown viscous oil; R_f 0.3 (cyclohexane/Et_2O 9/1); (Found: C, 74.95; H, 6.25; N, 8.70. $C_{20}H_{20}N_2O_2$ requires C, 74.98; H, 6.29; N, 8.74); ν_{max}/cm^{-1} 3642w, 3403br, 3324br, 3078m, 3059m, 3025m, 2946br, 2243w, 1686s, 1613m, 1546m, 1447s, 1407s, 1334s, 1241s, 1136s, 990s, 910s and 738s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.93 (1H, br, NH), 7.60-7.04 (9H, m, Ar), 6.37 (1H, s, Ar), 5.78 (1H, m, $CH_2CH{=}CH_2$), 5.22 (2H, s, OCH_2Ph), 5.18-5.20 (2H, m, $CH_2CH{=}CH_2$), 4.51 (2H, s, CCH_2NCbz), 3.92 (2H, d, *J* 5.8, NCH_2CH); δ_C(50 MHz; $CDCl_3$; Me_4Si) 157.4, 136.3, 135.0, 134.4, 133.1, 128.9, 128.5, 128.2, 128.1, 127.6, 122.0, 120.3, 119.6, 117.3, 110.9, 101.9, 67.6, 49.3, 43.9;

Allyl-(1H-indol-2-ylmethyl)-carbamic acid methyl ester 6c (327 mg, 88%) as a brown viscous oil; R_f 0.3 (cyclohexane/Et_2O 9/1); (Found: C, 68.83; H, 6.60; N, 11.47. $C_{14}H_{16}N_2O_2$ requires C, 68.80; H, 6.55; N, 11.45); ν_{max}/cm^{-1} 3324br, 3052s, 2952s, 2243m, 1693s, 1580m, 1547m, 1454br, 1235s, 1136s, 997m, 924s, 785s and725s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.95 (1H, br s, NH), 7.57 (1H, d, *J* 8.0, Ar), 7.35 (1H, d, *J* 8.0, Ar), 7.05-7.26 (2H, m, Ar), 6.37 (1H, s, Ar), 5.68-5.87 (1H, m, $CH_2CH{=}CH_2$), 5.15-5.25 (2H, m, $CH_2CH{=}CH_2$), 4.88 (2H, s, CCH_2NCO), 3.86 (2H, d, *J* 8.1, NCH_2CH), 3.79 (3H, s, OCH_3); δ_C(50 MHz; $CDCl_3$; Me_4Si) 158.7, 136.4, 134.8, 132.9, 127.6, 121.7, 120.1, 119.4, 116.9, 110.8, 101.6, 52.8, 48.8, 43.5;

2-[methylen-*N*-(trifluoroacetyl)-allylamine]-indole 6d (287 mg, 67%) as a pale pink solid, mp 68-69°C; R_f 0.3 (cyclohexane/AcOEt 8/2); (Found: C, 59.61; H, 4.61; N, 9.90. $C_{14}H_{13}F_3N_2O$ requires C, 59.57; H, 4.64; N, 9.92); ν_{max}(nujol)/cm^{-1} 3360s, 1672s, 1339m, 1299m, 1198s, 1170s, 1001w, 921m, 786s, 752m; δ_H(300 MHz; $CDCl_3$; Me_4Si) 8.78 (1H, br s, NH), 7.59 (1H, d, *J* 7.8, Ar), 7.37 (1H, d, *J* 8.1, Ar), 7.25-7.08 (2H, m, Ar), 6.44 (1H, s, Ar), 5.82 (1H, m, $CH_2CH{=}CH_2$), 5.40-5.45 (2H, dd, *J* 9.0, $CH_2CH{=}CH_2$), 4.64 (2H, s, CCH_2NCO), 4.03 (2H, d, *J* 5.7, NCH_2CH); δ_C(50 MHz; $CDCl_3$; Me_4Si) 158.0, 136.7, 132.4, 131.2, 130.4, 127.3, 122.7, 120.5, 119.9, 113.6, 111.2, 103.3, 49.6, 43.4.

Synthesis of 2-[(Phenyl)-methylen-*N*-(*t*-butoxycarbonyl)-allylamine]-indole 6f

In a flamed two-necked flask under N_2 and equipped with a condenser, were added 50 mL of dry toluene, 500 mg (3.5 mmol) of indole-2-carboxaldehyde, 2.0 g (17.5 mmol) of $MgSO_4$ and 260 µL (3.5 mmol) of allylamine. The reaction was refluxed for 24 h and, after elimination of $MgSO_4$ by filtration on pad of celite, the solvent was evaporated under reduced pressure and the crude imine was isolated as a brown viscous oil; ν_{max}/cm^{-1} 2923s, 2853s, 1713s, 1633s, 1447m, 1221s and 1001m; δ_H(200 MHz; $CDCl_3$; Me_4Si) 9.22 (1H, br s, CHN), 8.27 (1H, t, *J* 1.2, Ar), 7.65 (1H, d, *J* 7.4, Ar), 7.39-7.06 (2H, m, Ar), 6.79 (1 H, s, Ar), 6.21-5.96 (1H, m, $CH_2CH{=}CH_2$), 5.31-5.08 (2H, m, $CH_2CH{=}CH_2$), 4.27-4.23 (2H, m, NCH_2CH). The crude imine (3.5 mmol) was dissolved in anhydrous THF (30 mL) and the solution cooled to -23°C. Then $BF_3{\cdot}OEt_2$ (3.8 mmol) was added. After stirring for 15 min a solution of PhLi (2.1M, Et_2O) was added dropwise over 20 min and the mixture allowed stirring at -23°C over 4h. The reaction mixture was then quenched with NaOH (10%, 8 mL) and the phases separated. The aqueous layer was extracted with CH_2Cl_2 (3 x 15 mL) and the combined organic phases washed with brine and dried under Na_2SO_4. After evaporation the crude was purified by flash chromatography on silica using a mixture of cyclohexane/AcOEt 85:15 to give the intermediate deprotected amine-indole (596 mg, 65%); δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.56 (1H, br, NH), 7.53 (1H, d, *J* 6.8, Ar), 7.28-7.41 (7H, m, Ar), 7.03-7.18 (2H, m, Ar), 6.31 (1H, s, Ar), 5.89-6.05 (1H, m, $CH_2CH{=}CH_2$), 5.12-5.26 (2H, m, $CH_2CH{=}CH_2$), 5.08 (1H, s, PhCHNH), 3.29 (2H, dd, *J* 1.4 and 5.8, NCH_2CH); δ_C(50 MHz; $CDCl_3$; Me_4Si) 141.8, 140.5, 136.2, 135.8, 128.4, 128.7 (2 C), 127.6, 127.3 (2 C), 121.5, 120.2, 119.6, 116.6, 110.8, 100.4, 60.3, 50.0. The purifies allyliamine was monoprotected (Boc) as described for **6a**. Starting from 0.4 mmol of amine, **6f** was obtained (75 mg, 52%) as a yellow oil; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.00 (1H, d, *J* 8.8, NH), 7.50-7.55 (1H, m, Ar), 7.20-7.32 (8H, m, Ar), 6.69 (1H, s, Ar), 5.89-6.09 (m, 1H,

CH_2CH=CH_2), 5.64 (s, 1H, PhC*H*NH), 5.26-5.31 (1H, m, CH_2CH=C*H*$_2$), 5.10-5.19 (1H, m, CH_2CH=C*H*$_2$), 3.29-3.40 (2H, m, NC*H*$_2$CH), 1.53 (9H, s, *t*-Bu); *m/z* (LC -ESI-MS) 363 (MH^+).

Typical procedure for the synthesis of *O*-allylindole (10).

In a flamed two-necked flask was added, under a nitrogen atmosphere, 15 mL of anhydrous THF and NaH (69 mg, 3.0 mmol). This suspension was cooled to 0°C and 2.0 mmol of *N*-methyl-indolyl alcohol[1] were carefully added at once. After 2 h stirring at 0°C, 345 µL of allylbromide (4.0 mmol) were introduced by syringe and the temperature was allowed to warm at room temperature by removing the cooling bath. The reaction course was monitored by TLC and after 20 h, 10 mL of a saturated $NaHCO_3$ were added to the solution at 0°C to quench the reaction. After evaporation of THF and usual work-up (Et_2O, brine, Na_2SO_4) the crude mixture was purified by flash chromatography to afford **10a**; R_f 0.35 (cyclohexane/Et_2O 70:30) (Found: C, 77.52; H, 7.45; N, 6.96. $C_{13}H_{15}NO$ requires C, 77.58; H, 7.51; N, 6.96); ν_{max}/cm^{-1} 3050s, 2949s, 2853m, 1738m, 1649s, 1546m, 1462m, 1064m and 738m; δ_H(200 MHz; $CDCl_3$; Me_4Si) 7.56-7.65 (1 H, d, *J* 8.8 Ar), 7.25-7.40 (1 H, m, Ar), 7.01-7.21 (2 H, m, Ar), 6.49 (1 H, s, Ar), 5.85-6.05 (1 H, m, CH_2C*H*=CH_2), 5.22-5.41 (2 H, m, CH_2CH=C*H*$_2$), 4.71 (2 H, s, CC*H*$_2$O), 4.02 (2 H, dt, *J* 1.8 and *J* 5.6, OC*H*$_2$CH), 3.81 (3 H, s, NC*H*$_3$); δ_C(50 MHz; $CDCl_3$; Me_4Si) 138.0, 135.6, 134.4, 127.1, 121.7, 120.6, 119.3, 117.3, 109.0, 102.8, 70.2, 63.9, 29.8.

2-Allyloxymethyl-5-chloro-1-methyl-1H-indole 10b was obtained (165 mg, 75%) as a pale yellow solid; R_f 0.3 (cyclohexane/Et_2O 9/1); (Found: C, 66.20; H, 5.95; N, 5.95. $C_{13}H_{14}ClNO$ requires C, 66.24; H, 5.99; N, 5.94); ν_{max}/cm^{-1} 3051s 2955m, 2850s, 1739s, 1648m, 1550m, 1462m, 1064w and 738w; δ_H(300 MHz; $CDCl_3$; Me_4Si) 7.55 (1H, s, Ar), 7.18-7.26 (3H, m, Ar), 5.87-6.00 (1H, m, CH_2C*H*=CH_2), 6.42 (1H, s, Ar), 5.21-5.34 (2H, m, CH_2CH=C*H*$_2$), 4.66 (2H, s, CC*H*$_2$O), 4.02 (2H, d, *J* 5.4, OC*H*$_2$CH), 3.81 (3H, s, NC*H*$_3$); δ_C(50 MHz; $CDCl_3$; Me_4Si) 137.5, 136.8, 134.6, 128.4, 125.4, 122.4, 120.3, 118.0, 110.5, 102.7, 70.8, 64.2, 30.4.

Typical CM procedure for the synthesis of indolyl enones (8/12).

To a 50 mL flamed two-necked flask, equipped with a magnetic stirrer, was added 2.5 mL of anhydrous CH_2Cl_2. The solvent was degassed by freezing-pump procedure and then a solution of protected allylindole derivative **6**/**10** (0.2 mmol, CH_2Cl_2), 13 mg (0.016 mmol, 8 mol%) of ruthenium carbene catalyst and 1.2 mmol (6 equiv.) of the desired enone (**7a**/**7b**) were added and the deep brown mixture was refluxed for 1 hr. The solution was then cooled to rt and a second drop of catalyst (0.007 mmol) was added. The procedure was repeated for the third time after a subsequent hour of refluxing. After the third addition, the mixture was stirred and refluxed for 15 hs and then judged complete by TLC analysis. The crude was diluted with CH_2Cl_2, concentrated under reduced pressure and finally purified by flash-chromatography thus affording:

8aa (43 mg, 65%) as a brown viscous oil [recovered starting = 26%]; R_f 0.3 (cyclohexane/AcOEt 8/2); (Found: C, 69.45; H, 7.31; N, 8.52. $C_{19}H_{24}N_2O_3$ requires C, 69.49; H, 7.37; N, 8.53); ν_{max}/cm^{-1} 3330br, 3085m, 3058m, 2979s, 2926s, 2302w, 1699s, 1627s, 1547m, 1448s, 1401s, 1361s, 1242s, 1151s, 1109m, 950m, 877m and 744s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.90 (1H, br s, NH), 7.56 (1H, d, *J* 7.4, Ar), 7.35 (1H, d, *J* 7.8, Ar), 7.23-7.05 (2H, m, Ar), 6.62 (1H, dt, J_1 15.8 and J_2 4.4, CH_2CH=CH), 6.35 (1H, s, Ar), 6.08 (1H, d, *J* 15.8, $CH_2CH=CH$), 4.45 (2H, s, CCH_2N), 4.00 (2H, d, *J* 4.2, NCH_2CH), 2.18 (3H, s, CH_3), 1.51 (9H, s, *t*-Bu); δ_C(50 MHz; $CDCl_3$; Me_4Si) 197.4, 156.5, 142.2, 136.6, 135.2, 131.1, 128.0, 122.0, 120.3, 119.7, 111.0, 101.8, 80.9, 48.4, 44.3, 28.2, 27.0; *m/z* (LC -ESI-MS) 363 (MH^+), 351 (MNa^+);

8ba (25 mg, 34%) as a brown viscous oil [recovered starting = 41%] R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{22}H_{22}N_2O_3$: C, 72.91; H, 6.12; N, 7.73. Found: C, 72.85; H, 6.08; N, 7.70); ν_{max}/cm^{-1} 3403br, 3310br, 3051s, 2952s, 2913s, 2236w, 1706s, 1666s, 1586m, 1474s, 1427s, 1355s, 1262s, 1097s, 910s and 738s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.87 (1H, br, NH), 7.60-7.04 (9H, m, Ar), 6.61 (1H, dt, J_1 15.4 and J_2 5.2, CH_2CH=CH), 6.36 (1H, s, Ar), 6.06 (1H, d, *J* 16.6, $CH_2CH=CH$), 5.22 (2H, s, CCH_2N), 4.52 (2H, s, OCH_2Ph), 4.08 (2H, d, *J* 4.4, NCH_2CH), 2.18 (3H, s, *t*-Bu); δ_C(50 MHz; $CDCl_3$; Me_4Si) 207.9, 156.1, 136.4, 136.2, 130.2, 128.8, 128.6, 128.2, 128.0, 125.7, 125.1, 123.2, 122.0, 119.8, 118.8, 117.9, 111.5, 111.0, 67.4, 46.2, 42.2, 29.7; *m/z* (LC -ESI-MS) 362 (MH^+);

8ca (27 mg 50%) as a brown viscous oil [recovered starting = 27%]; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{16}H_{18}N_2O_3$: C, 67.12; H, 6.34; N, 9.78. Found: C, 7.05; H, 6.29; N, 9.76); ν_{max}/cm^{-1} 3330br; 1669s, 1638s, 1546s, 1432m, 1228s, 1161m, 1067m and 739s; δ_H(300 MHz; $CDCl_3$; Me_4Si) 8.88 (1H, br s, NH), 7.56 (1H, d, *J* 7.8, Ar), 7.35 (1H, d, *J* 8.1, Ar), 7.22-7.05 (2H, m, Ar), 6.62 (1H, dt, $J_1$15.9 and J_2 5.1, CH_2CH=CH), 6.36 (1H, s, Ar), 6.09 (1H, dd, $J_1$16.2 and J_2 1.5, $CH_2CH=CH$), 4.50 (2H, s, CCH_2N), 4.04 (2H, d, *J* 4.5, NCH_2CH), 3.79 (3H, s, OMe), 2.18 (3H, s, Me); δ_C(50 MHz; $CDCl_3$; Me_4Si) 195.6, 156.3, 139.1, 136.1, 135.2, 129.2, 127.6, 121.8, 120.6, 119.6, 111.0, 102.9, 51.5, 50.1, 48.0, 24.8;

8da (27 mg, 41%) as a brown viscous oil [recovered starting = 18%]; R_f 0.3 (cyclohexane/AcOEt 9/1); (Anal.: Calcd for $C_{16}H_{15}F_3N_2O_2$: C, 59.26; H, 4.66; N, 8.64. Found: C, 59.20; H, 4.63; N, 8.60); ν_{max}/cm^{-1} 3327br, 1689s, 1663s, 1548s, 1223s, 1067m and 734s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.68 (1H, br s, NH), 7.45 (1H, d, *J* 7.8, Ar), 7.35-7.05 (3H, m, Ar), 6.72 (1H, dt, J_1 15.6 and J_2 1.8, CH_2CH=CH), 6.36 (1H, s, Ar), 6.04 (1H, dd, J_1 16.0 and J_2 1.8, $CH_2CH=CH$), 4.53 (2H, s, C*CH₂*N), 4.04 (2H, d, *J* 4.5, N*CH₂*CH), 2.18 (3H, s, Me); δ_C(50 MHz; $CDCl_3$; Me_4Si) 197.0, 169.7, 140.1, 136.6, 135.2, 129.2, 127.5, 123.8, 121.7, 120.5, 119.7, 111.0, 102.9, 48.7, 45.4, 24.9;

8ab (30 mg, 38%) as a brown viscous oil; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{24}H_{26}N_2O_3$: C, 73.82; H, 6.71; N, 7.17. Found: C, 73.80; H, 6.66; N, 7.15); ν_{max}/cm^{-1} 3395br, 3316br, 2226s, 2847s, 1683s, 1616m, 1452s, 1418m, 1362s, 1277s, 1243s, 1158s, 1017m, 864w, 797m, 752s and 695s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 9.08 (1H, br s, NH), 8.00-7.07 (9H, m, Ar), 6.83-6.91 (2H, m, $CH_2CH{=}CH$), 6.38 (1H, s, Ar), 4.52 (2H, s, CCH_2N), 4.12 (2H, d, *J* 3.2, NCH_2CH), 1.51 (9H, s, *t*-Bu); δ_C(50 MHz; $CDCl_3$; Me_4Si) 187.8, 156.7, 143.7, 137.3, 136.3, 133.1, 132.8, 128.6, 128.4, 128.1, 122.1, 121.8, 120.2, 119.6, 111.0, 101.7, 80.9, 45.0, 44.1, 28.2; *m/z* (LC -ESI-MS) 391 (MH^+), 413 (MNa^+), 429 (MK^+);

12a (35 mg, 72%) as yellow viscous oil [recovered starting = 17%]; R_f 0.3 (cyclohexane/AcOEt 9/1); (Anal.: Calcd for $C_{15}H_{17}NO_2$: C, 74.05; H, 7.04; N, 5.76. Found: C, 74.00; H, 6.99; N, 5.75); ν_{max}/cm^{-1} 3397 br, 3026s, 2207m, 1720s, 1431s, 1323s, 1256s, 1179s, 1156s and 741s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 7.60 (1H, d, *J* 7.8,Ar), 7.36-7.06 (3H, m, Ar), 6.77 (2H, dt, J_1 16.0 and J_2 4.4, $CH_2CH{=}CH$), 6.51 (1H, s, Ar), 6.32 (1H, dt, J_1 16.2 and J_2 1.8, $CH_2CH{=}CH$), 4.75 (2H, s, CCH_2O), 4.18 (2H, dd, J_1 4.4 and J_2 2.0, OCH_2CH), 3.81 (3H, s, NMe), 2.26 (3H, s, Me); δ_C(50 MHz; $CDCl_3$; Me_4Si) 198.1, 138.2, 134.9, 130.4, 129.3, 127.0, 122.1, 119.6, 118.3, 109.2, 103.4, 67.7, 64.8, 44.2, 27.2;

12b (24 mg, 39%) as a yellow viscous oil, see ref. 1;

12c (23 mg 42%) as a pale brown viscous oil [recovering starting = 26%]; R_f 0.3 (cyclohexane/AcOEt 75/25); (Anal.: Calcd for $C_{15}H_{16}ClNO_2$: C, 64.87; H, 5.81; N, 5.04. Found: C, 64.85; H, 5.78; N, 5.00); ν_{max}/cm^{-1} 3401br, 3030s, 1722s, 1428s, 1326s, 1260s 1185s and 748s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 7.55-7.56 (1H, m, Ar), 7.20-7.26 (3H, m, Ar), 6.77 (1H, dt J_1 16.2 and J_2 5.6, $CH_2CH{=}CH$), 6.44 (1H, s, Ar), 6.21-6.35 (1H, m, $CH_2CH{=}CH$), 4.71 (2H, s, CCH_2O), 4.18 (2H, dd, J_1 4.4 and J_2 1.8, OCH_2CH), 3.77 (3H, s NMe), 2.56 (3H, s, Me); δ_C(75 MHz; $CDCl_3$; Me_4Si) 198.0, 142.3, 136.6, 136.3, 130.4, 127.9, 125.2, 122.4, 120.1, 110.2, 102.8, 68.0, 65.8, 64.7, 27.2; *m/z* (LC -ESI-MS) 278 (MH^+);

9: the procedure described for **8/12** but starting from 0.12 mmol (45 mg) of **6f**, afforded **9** (20 mg, 43%) as a pale yellow viscous oil [10 mg of **6f** were also recovered from the flash chromatography]; R_f 0.3 (cyclohexane/AcOEt 92/8); (Found: C, 73.40; H, 7.15; N, 7.10. $C_{24}H_{28}N_2O_3$ requires C, 73.44; H, 7.19; N, 7.14); δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.00 (1H, dd, J_1 1.8 and J_2 7.6, Ar), 7.49-7.54 (1H, m, Ar), 7.19-7.33 (7H, m, Ar), 6.70 (1H, s, Ar), 5.63 (1H, s, C*H*Ph), 3.06 (1H, dt, J_1 6.2 and J_2 12.2, NCH_2CH_2), 2.92 (1H, dt, J_1 5.4 and J_2 12.2, NCH_2CH_2), 2.71 (2H, t, *J* 6.2, NCH_2CH_2), 2.54 (3H, s, Me), 1.56 (s, 9H, *t*-Bu); δ_C(75 MHz; $CDCl_3$; Me_4Si) 208.5, 150.2, 142.8, 142.0, 136.9, 128.8, 128.2(2C), 127.9(2C), 127.1, 123.7, 122.6, 120.5, 115.4, 108.9, 84.0, 70.0, 44.0, 42.9, 30.1, 28.0(3C); *m/z* (LC -ESI-MS) 393 (MH^+);

Typical experimental procedure for the catalytic intramolecular Michael reaction catalyzed by $InBr_3$.

A two-necked flask was charged, under a nitrogen atmosphere, with 5 mL of anhydrous CH_2Cl_2, $InBr_3$ (3.5 mg, 0.01 mmol, 10 mol%) and 0.1 mmol of indolyl enone. After completion of the reaction (judged by TLC, HPLC), the mixture was quenched with a saturated solution of $NaHCO_3$ (3 mL) and extracted with Et_2O (3 x 3 mL). The organic phases were combined, dried over Na_2SO_4, concentrated under reduced pressure and the crude mixture was purified by flash chromatography to afford:

1aa (39 mg, 90%) as a brown viscous oil; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{19}H_{24}N_2O_3$: C, 69.49; H, 7.37; N, 8.53. Found: C, 69.50; H, 7.32; N, 8.50); ν_{max}/cm^{-1} 3337s, 2355w, 1706s, 1666s, 1275s, 1242m, 1149m, 1102s, 1010m, 904m, 798w, 731s, and 659m; δ_H(300 MHz; $CDCl_3$; Me_4Si) 8.34 (1H, br s, NH), 7.50-7.05 (4H, m, Ar), 5.07-5.12 (1H, m, $CH_2C\mathit{H}CH_2$), 4.24-4.31 (2H, m, $C\mathit{CH_2}N$), 3.54-3.60 (1H, m, $N\mathit{CH_2}CH$), 3.26-3.29 (1H, m, $N\mathit{CH_2}CH$), 2.74 (2H, d, *J* 9.3, $CHC\mathit{H_2}CO$), 2.18 (3H, s, Me), 1.50 (9H, s, *t*-Bu); δ_C(75 MHz; $CDCl_3$; Me_4Si) 207.7, 155.5, 136.2, 130.7, 125.9, 121.8, 119.6, 117.8, 111.4, 111.0, 80.3, 46.4, 46.2, 41.7, 30.4, 28.4, 28.1, 26.9;

1ba (34 mg, 95%) as a brown viscous oil; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{22}H_{22}N_2O_3$: C, 72.91; H, 6.12; N, 7.73. Found: C, 72.90; H, 6.11; N, 7.75); ν_{max}/cm^{-1} 3303br, 2959s, 2912s, 2859m, 2249w, 1699s, 1626s, 1547m, 1421s, 1354m, 1262s, 1089s and 791s; δ_H(300 MHz; $CDCl_3$; Me_4Si) 8.01 (1H, br s, NH), 7.60-7.05 (9H, m, Ar), 5.22-5.35 (3H, m, $CH_2C\mathit{H}CH_2$+ $C\mathit{CH_2}N$), 4.32 (2H, m, $O\mathit{CH_2}Ph$), 4.08-4.12 (1H, m, $N\mathit{CH_2}CH$), 3.63-3.69 (1H, m, $N\mathit{CH_2}CH$), 3.31 (1H, m $CHC\mathit{H_2}CO$), 2.74 (1H, m, $CHC\mathit{H_2}CO$), 2.18 (3H, s, Me); δ_C(50 MHz; $CDCl_3$; Me_4Si) 207.9, 156.1, 136.4, 136.2, 130.2, 128.6, 128.4, 128.2, 128.0, 125.9, 122.0, 120.4, 119.8, 117.9, 111.7, 111.0, 67.4, 46.2, 45.7, 42.2, 27.9, 26.9;

1ca (27 mg, 95%) as a brown viscous oil; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{16}H_{18}N_2O_3$: C, 67.12; H, 6.34; N, 9.78. Found: C, 67.10; H, 6.29; N, 9.78); ν_{max}/cm^{-1} 3330br, 1679s, 1653s, 1546s, 1268s, 1096m and 711s; δ_H(300 MHz; $CDCl_3$; Me_4Si) 8.05 (1H, br s, NH), 7.52-7.08 (4H, m, Ar), 5.08-5.13 (1H, m, $CH_2C\mathit{H}CH_2$), 4.27-4.30 (2H, m, $C\mathit{CH_2}N$), 3.79 (3H, s, OMe), 3.64-3.70 (1H, m, $N\mathit{CH_2}CH$), 3.37-3.49 (1H, m, $N\mathit{CH_2}CH$), 2.80 (2H, m, $CHC\mathit{H_2}CO$), 2.18 (3H, s, Me); δ_C(75 MHz; $CDCl_3$; Me_4Si) 208.0, 156.8, 136.2, 130.2, 125.9, 122.0, 119.8, 117.9, 111.6, 110.0, 52.9, 46.4, 46.2, 42.1, 30.9, 30.5, 29.7, 28.0;

1da (23 mg, 70%) as brown viscous oil; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{16}H_{15}F_3N_2O_3$: C, 56.47; H, 4.44; N, 8.23. Found: C, 56.40; H, 4.41; N, 8.22); ν_{max}/c,$^{-1}$ 3327br, 1689s, 1663s, 1548s, 1223s, 1067m and 734s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.05 (1H, br s, NH), 7.55-7.04 (4H, m, Ar), 5.05-5.12 (1H, m, CH_2*CH*CH_2), 4.254.31 (2H, m, C*CH₂*N), 3.613.65 (1H, m, N*CH₂*CH), 3.32-3.39 (1H, m, N*CH₂*CH), 2.79 (2H, m, CH*CH₂*CO), 2.18 (3H, s, Me); δ_C(75 MHz; $CDCl_3$; Me_4Si) 207.1, 169.4, 136.2, 135.3, 131.5, 123.2, 121.7, 120,6m 119.6, 112.8, 111.0, 57.1, 48.6, 44.2, 26.7, 25.1;

1ab (37 mg 95%) as a brown solid, mp 142-143 °C; R_f 0.3 (cyclohexane/AcOEt 8/2); (Anal.: Calcd for $C_{24}H_{26}N_2O_3$: C, 73.82; H, 6.71; N, 7.17. Found: C, 73.75; H, 6.66; N, 7.15); ν_{max}/cm^{-1} 3324br, 2979s, 2935s, 1679s, 1646s, 1454m, 1414s, 1367m, 1275s and 738s; δ_H(200 MHz; $CDCl_3$; Me_4Si) 8.29 (1H, br s, NH), 7.99 (1H, d, *J* 7.8, Ar), 7.60-7.05 (8H, m, Ar), 5.18-5.22 (1H, m, CH_2*CH*CH_2), 4.32-4.40 (2H, m, CCH_2N), 3.80-3.85 (1H, m, NCH_2CH), 3.35-3.40 (3H, m, NCH_2CH+ CHCH_2CO), 1.51 (9H, s, *t*-Bu); δ_C(50 MHz; $CDCl_3$; Me_4Si) 198.9, 156.8, 136.9, 136.4, 135.0, 133.5, 128.8, 128.2, 122.0, 119.8, 116.2, 113.5, 111.2, 81.5, 64.0, 46.2, 41.3, 29.8, 28.2;

2a (24 mg, 98%) as yellow viscous oil; R_f 0.3 (cyclohexane/AcOEt 8:2); (Anal.: Calcd for $C_{15}H_{17}NO_2$: C, 74.05; H, 7.04; N, 5.76. Found: C, 73.99; H, 7.01; N, 5.75); ν_{max}/cm^{-1} 3403br, 3045s, 2926s, 2243m, 1712s, 1460s, 1434s, 1354s, 1256s, 1182s, 1156s, 1083s and 738s; δ_H(300 MHz; $CDCl_3$; Me_4Si) 7.49 (1H, d, *J* 7.8, Ar), 7.36-7.07 (3H, m, Ar), 4.81-4.87 (1H, m, CCH_2O), 4.01-4.15 (1H, m, CCH_2O), 3.85-3.90 (2H, m, OCH_2CH), 3.60 (3H, s, NMe), 3.52-5.55 (1H, m, CH_2*CH*CH_2), 2.93 (2H, s, CHCH_2CO), 2.18 (3H, s, Me); δ_C(50 MHz; $CDCl_3$; Me_4Si) 208.3, 142.7, 137.0, 133.1, 121.3, 119.3, 118.0, 109.3, 108.9, 69.6, 63.1, 46.8, 30.6, 29.4, 28.2;

2b (30 mg, 97%) as viscous yellow oil; R_f 0.3 (cyclohexane/AcOEt 80:20); (Anal. calcd. for ($C_{20}H_{19}NO_2$): C, 78.66; H, 6.27; N, 4.59; Found: C, 78.62; H, 6.22; N, 4.58); ν_{max}/cm^{-1} 3045s, 2926s, 2846m, 1739s, 1666m, 1600w, 1461s, 1374m, 1242m, 1082s, 1036w and 738m; δ_H(300 MHz; $CDCl_3$; Me_4Si) 7.98 (2H, dd, *J* 1.5 and 7.2, Ar), 7.54-7.59 (2H, m, Ar), 7.46 (2H, t, *J* 6.9, Ar), 7.32 (1H, d, *J* 8.1,Ar), 7.22 (1H, t, *J* 8.1, Ar), 7.11 (1H, t, *J* 8.4, Ar), 4.92 (1H, d, *J* 14.4, CCH_2O), 4.81 (1H, d, *J* 14.4, CCH_2O), 4.12 (1H, dd, *J* 1.8 and 11.4, OCH_2CH), 3.92 (1H, dd, *J* 3.3 and 11.4, OCH_2CH), 3.73-3.76 (m, 1H, CH_2*CH*CH_2), 3.62 (s, 3H, NMe), 3.45-3.51(m, 2H, CHCH_2CO); δ_C(75 MHz; $CDCl_3$; Me_4Si) 199.5, 137.0, 133.3, 133.1, 131.5, 128.5(2C), 128.1(2C), 125.8, 121.3, 119.3, 118.1, 109.6, 108.9, 69.6, 63.2, 41.8, 29.7, 28.6;

2c (27 mg, 98%) as a yellow viscous oil; R_f 0.3 (cyclohexane/AcOEt 7:3); (Anal.: Calcd for $C_{15}H_{16}ClNO_2$: C, 64.87; H, 5.81; N, 5.04. Found: C, 63.80; H, 5.78; N, 5.00); δ_H(300 MHz; $CDCl_3$; Me_4Si) 7.44 (1H, s, Ar), 7.13-7.22 (m, 2H, Ar), 4.78-4.82 (2H, m, CCH_2O), 4.03 (1H, dd, J_1 1.8 and J_2 11.4, OCH_2CH), 3.85 (1H, dd, J_1 8.2 and J_2 11.4, OCH_2CH), 3.58 (3H, s, NMe), 3.45-3.58 (1H, m, CH_2CHCH_2), 2.90 (2H, d, *J* 7.0, $CHCH_2CO$), 2.19 (3H, s, Me); δ_C(75 MHz; $CDCl_3$; Me_4Si) 198.8, 142.5, 136.8, 136.5, 130.4, 122.0, 120.2, 110.3, 102.9 70.0, 63.5, 46.7, 30.8, 29.0, 28.6.

Typical conditions for intramolecular FC reaction catalyzed by [SalenAlCl]-lutidine.

A 25 mL two-necked flask equipped with a magnetic stirrer flamed under vacuum was charged, under nitrogen atmosphere, with 1 mL of anhydrous CH_2Cl_2, 0.012 mmol of catalyst **13a**/**b** and 0.012 mmol of 2,6-lutidine. The mixture was stirred for 5 min to ensure the formation of the complex, then 0.06 mmol of substrate (**8**/**10**) were added. After stirring at rt until the reaction was judged complete by HPLC, the mixture was quenched with a saturated solution of $NaHCO_3$ (3 mL). The two phases were separated and the aqueous phase was extracted with diethyl ether (3 x 5 mL). Finally the organic layers were collected, dried with Na_2SO_4 and then concentrated under reduced pressure and the crude was purified by flash-chromatography.

1aa (19 mg, 98%; ee 26%); $[\alpha]_D^{20}$ +6.0° (*c* 0.1, $CHCl_3$); chiral HPLC**:** OD column *n*-hex/IPA 90/10, flow 0.5 mL/min (225 nm), t_1 13.9 min and t_2 19.9 min;
1ba (15 mg, yield 69%; ee 11%); chiral HPLC**:** OD column *n*-hex/IPA 80/20, flow 0.5 mL/min (225 nm), t_1 18.7 min and t_2 26.1 min;
1ca (17 mg, yield 98%; ee 11%); chiral HPLC**:** OD column *n*-hex/IPA 80/20, flow 0.6 mL/min (225 nm), t_1 14.5 min and t_2 20.3 min;
1da (10 mg, yield 47%; ee 0%); chiral HPLC**:** OF column *n*-hex/IPA 90/10, flow 0.6 mL/min (225 nm), t_1 42.0 min and t_2 47.5 min;
1ab (23 mg, yield 98%; ee 27%); chiral HPLC**:** OD column *n*-hex/IPA 85/15, flow 0.5 mL/min (225 nm), t_1 11.4 min and t_2 13.6 min;

Typical conditions for intramolecular FC reaction with $[SalenAlCl]_2$-$InBr_3$.

A 25 mL two-necked flask equipped with a magnetic stirrer flamed under vacuum was charged, with 1 mL of anhydrous CH_2Cl_2, 0.012 mmol of catalyst **13a** and 0.012 mmol of 2,6-lutidine. The mixture was stirred for 5 min, then 0.12 mmol of substrate (**12**) were added. After 16 h stirring, a solution 0.30 M (20 µL, 5 mol%) of $InBr_3$ in Et_2O was added and the reaction stirred for the times indicated. The mixture was then quenched with a saturated solution of $NaHCO_3$ (3 mL). The two phases separated and the aqueous phase extracted with diethyl ether (3 x 5 mL). Finally the organic layers were collected, dried with Na_2SO_4, concentrated under reduced pressure and the crude **2** was purified by flash-chromatography.

2a: Yield 80%; Ee = 60%; $[\alpha]_D^{20}$: +15.4° (c = 0.5, $CHCl_3$); chiral HPLC**:** OD column; *n*-hex/IPA 90:10; flow 0.5 mL/min (225 nm), t_{major} = 22.2 min, t_{minor} = 25.1 min.

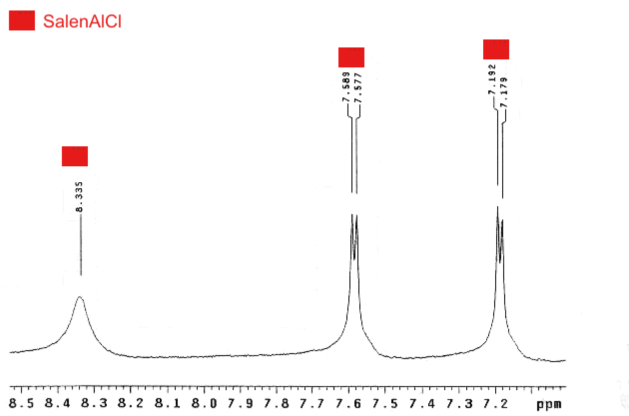
2b: Yield 61%; Ee = 20%; $[\alpha]_D^{20}$: +17.5 (c = 0.8, $CHCl_3$); chiral HPLC**:** OD column; *n*-hex/IPA 95:5; flow 0.5 mL/min (225 nm), t_{major} = 45.5 min, t_{minor} = 49.2 min.

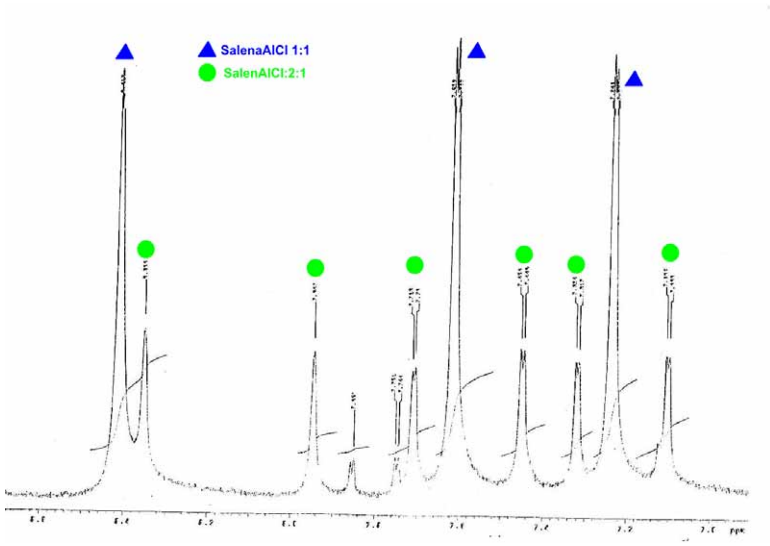
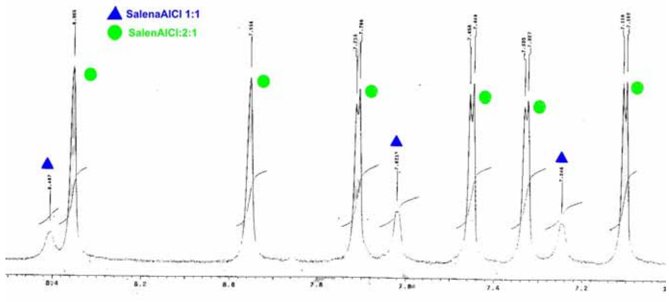
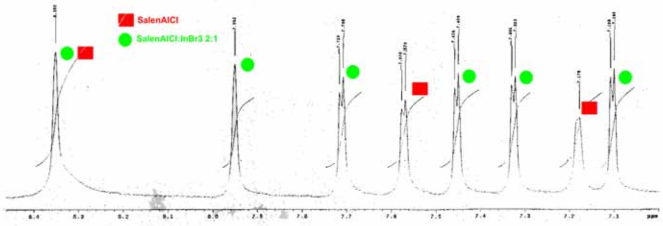
2c: Yield 80%; Ee = 60%; $[\alpha]_D^{20}$: +18.1 (c = 0.5, $CHCl_3$); chiral HPLC**:** OF column; *n*-hex/IPA 80:20; flow 0.9 mL/min (225 nm), t_{major} = 24.2 min, t_{minor} = 29.9 min.

^{1}H NMR investigation on {[SalenAlCl]$_x$(InBr$_3$)$_y$} species.

To a solution of **13a** (11 mg, 0.02 mmol) in anhydrous DCM were added the desired volume of a preformed solution of InB_3 in dry Et_2O (0.3 mM). The clear yellow mixture was stirred for 2h rt the solvent removed under vacuum and replaced with anhydrous CD_2Cl_2 (700 µL). The resulting solution was transferred into a flamed NMR tube and the spectra recorded at rt.

13a



13a:$InBr_3$ 1:1	
13a:$InBr_3$ 2:1	
13a:$InBr_3$ 4:1	

[1] For the synthesis of indolyl-alcohols precursors see ref. M. Agnusdei, M. Bandini, A. Melloni, A. Umani-Ronchi, *J. Org. Chem.* 2003, **68**, 7126.