The "triamino-analogue" of methyl allocholate; a rigid, functionalised scaffold for supramolecular chemistry.

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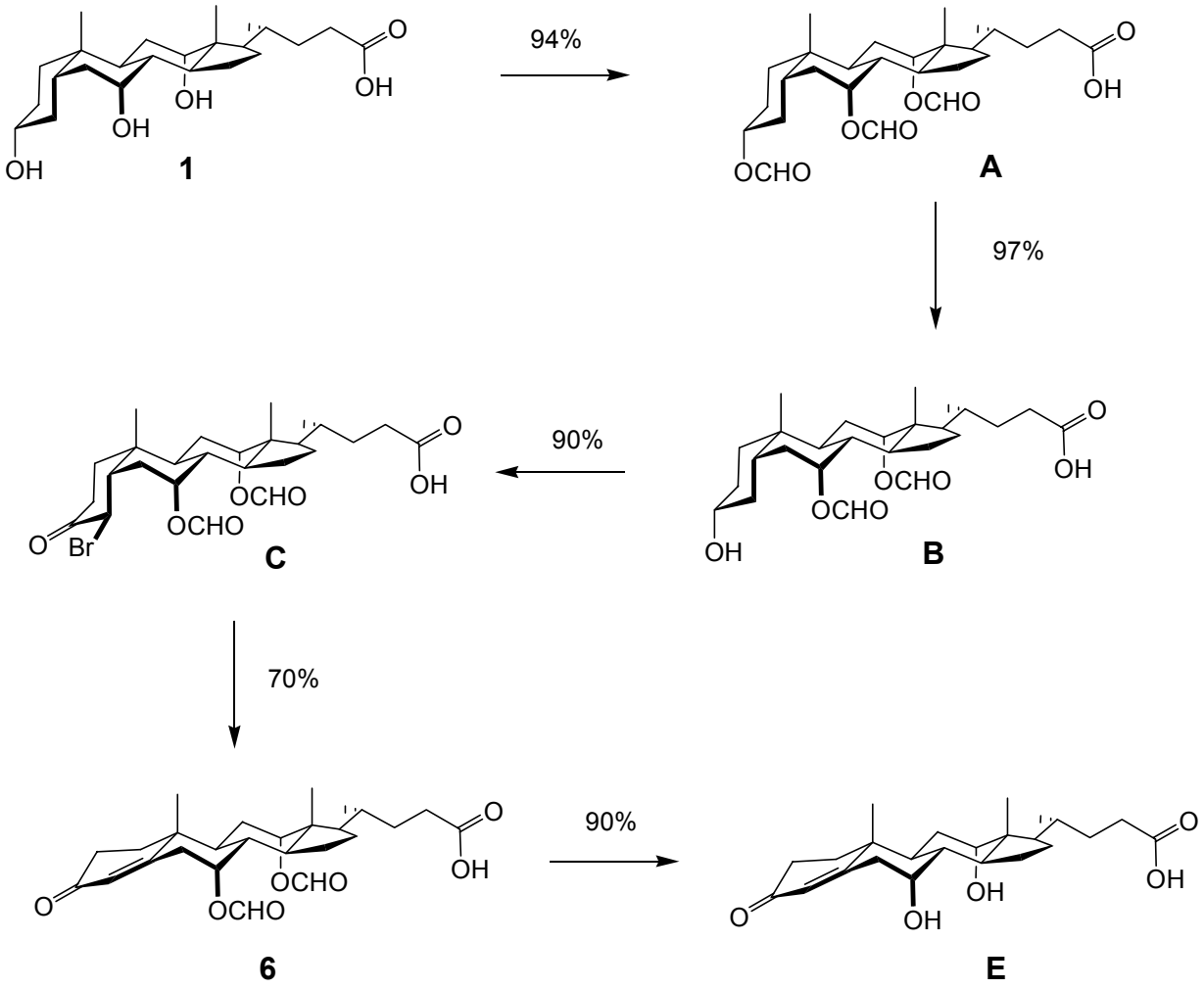
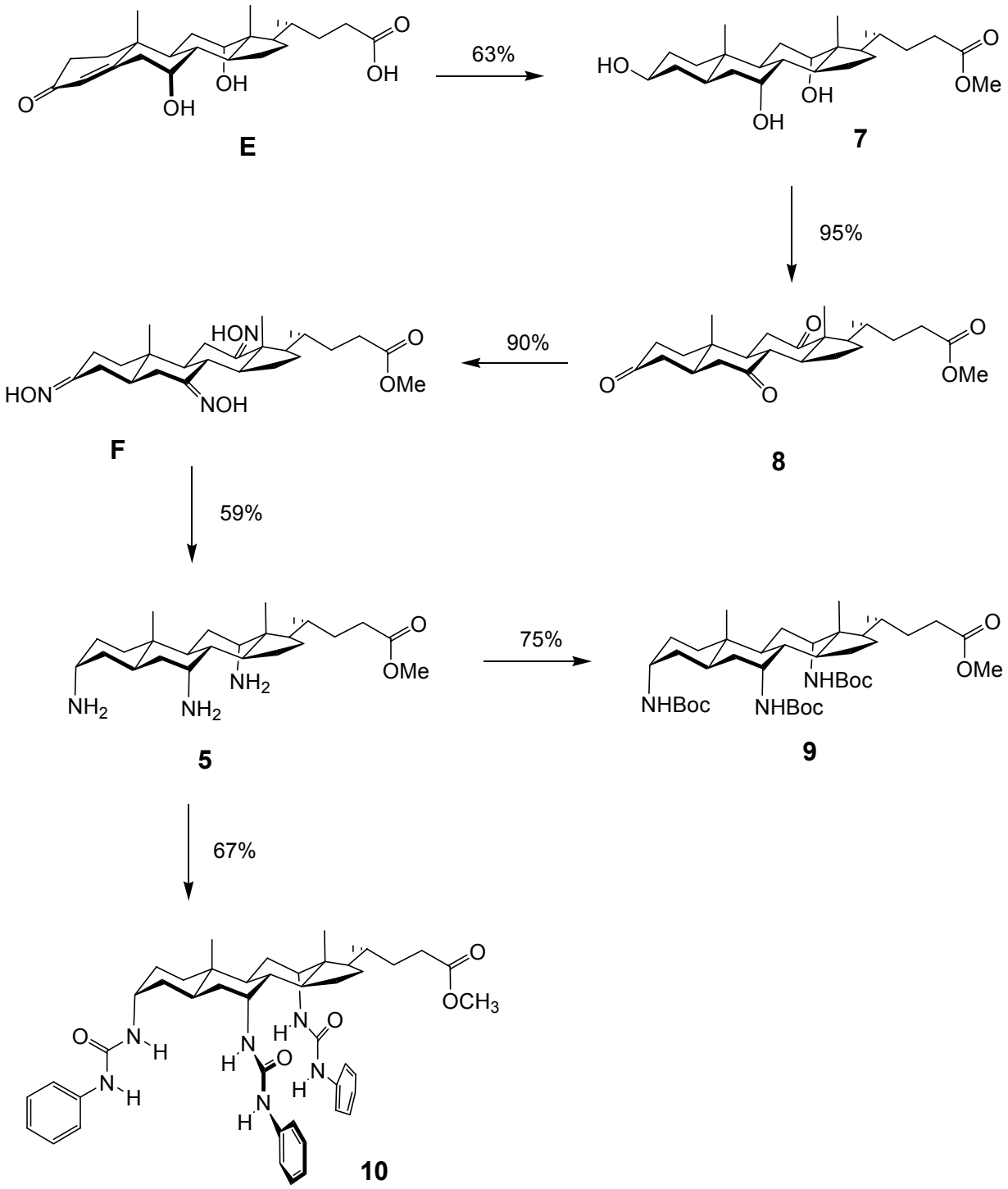
Supplementary Information

Synthesis of steroids 5, 9 and 10

Scaffolds **5** and **9**, and anion receptor **10**, were prepared as shown in the following schemes.





3α,7α,12α-triformyloxy-5β-cholan-24-oic acid (A):[1] The procedure described is slightly modified from that of Tserng.[1] To a suspension of technical cholic acid **1** (100 g, 0.245 mol) in 90 % formic acid (100 ml) at 40 ^{o}C (oil bath temp) under vigorous stirring, 70 % perchloric acid (0.25 ml) was added dropwise. The bath temperature was raised to 60-65 ^{o}C and the mixture stirred for 3 h at the same temperature. The reaction mixture was cooled to *ca* 40 ^{o}C (internal temp) and acetic anhydride (155 ml) was added dropwise, the internal reaction temperature being maintained between 40 and 50 ^{o}C. During the course of addition of acetic anhydride, a fall in the reaction temperature and the brisk evolution of gas (possibly CO) was observed. The resulting viscous reaction mixture was cooled to 30 ^{o}C, slowly poured into *ca* 3 litres of ice cold water containing ice chips. The precipitated solid was filtered and washed with water till the washings were neutral. The solid was then dissolved in ethyl acetate, and the solution was washed with water and saturated brine, dried (Na_2SO_4) and filtered through a short pad of silica. Filtrate and silica pad washings were collected and concentrated to a small volume. Crystallisation was induced by addition of hexane to give **A** (4 crops, 113 5 g, 94 %), mp. 198-200^{o}C (lit.[1] 209-210 ^{o}C from methanol/water); TLC R_f = 0.56, (toluene/acetone, 8/2); IR (Neat): ν_{max} = 3400, 1710, 1165 cm^{-1}; ^{1}H NMR (400 M Hz, $CDCl_3$): δ = 0.76 (s, 3 H, 18-Me), 0.85 (d, 3 H, J = 7 Hz, 21-Me), 0.95 (s, 3 H, 19-Me), 4.72 (m, 1 H, 3β-H), 5.07 (br s, 1 H, 7β-H), 5.27 (br s, 1 H, 12β-H), 8.03, 8.11, and 8.17 (s, 1 H each, 3, 7 and 12 HCO), 9.2- 9.7 (br s, 1 H, COOH).

3α-hydroxy-7α,12α-diformyloxy-5β-cholan-24-oic acid (B).[1] To a stirred solution of **A** (10.7 g, 21.8 mmol) in acetone (100 ml) at 0 ^{o}C NaOH (210 ml, 0.2 M) was added dropwise over 40 min. The mixture was stirred at 25 ^{o}C for 1 h, then acidified with dilute acetic acid [glacial acetic acid (1.2 ml) in 10 ml of water]. The mixture was poured into ice cold water and the precipitate was collected, washed with water and dried (Na_2SO_4). The dry crude product **B** (9.82 g, 97 %) was satisfactory for further synthetic elaboration. Mp. 96-99 ^{o}C (lit.[1] 94-98 ^{o}C); TLC: R_f = 0.31

(toluene-acetone, 8/2); IR (Neat): ν_{max} = 3400, 1710, 1165 cm^{-1}; ^{1}H NMR (400 M Hz, $CDCl_3$): δ = 0.75 (s, 3 H, 18-Me), 0.85 (d, 3 H, J = 6 Hz, 21-Me), 0.93 (s, 3 H, 19-Me), 3.51 (m, 1 H, 3βH), 5.06 (br s, 1 H, 7-βH), 5.27 (br s, 1 H, 12-βH), 8.10 (s, 1 H, 7-HCHO) and 8.15 (s, 1 H, 12 HCHO).

3-oxo-4β-bromo-7α,12α-diformyloxy-5β-cholan-24-oic acid (C). The procedure is based on that of Hanze et al for brominated pregnane-3-ones.[2] Hydroxy-acid **B** (0.335 g, 0.69 mmol) was dissolved in warm *t*-butanol (12 ml). The solution was cooled, water (0.5 ml), HBr (60 %, 0.095g, 60 μl, 0.72 mmol) and *N*-bromosuccinimide (0.38 g, 2.13 mmol) were added. The solution was stirred at 40 ^{o}C for 24 h, after which a precipitate of succinimide had formed and the test for active halogen (starch iodide paper) was negative. The reaction mixture was evaporated and dried under high vacuum, and the resulting solid was washed with ether several times. The ethereal washings were collected, washed with water and brine, and dried (Na_2SO_4). Evaporation gave crude bromoketone **C** (0.35 g, 90 %). A portion of the vacuum dried product was recrystallised from chloroform/hexane to give a pure sample, mp 93-95 ^{o}C (lit.[3] 92-93 ^{o}C, decomp.); IR: ν_{max} = 1718 cm^{-1}; ^{1}H NMR (400 M Hz, $CDCl_3$): δ = 0.77 (s, 3 H, 18-Me), 0.82 (d, 3 H, J = 6 Hz, 21-Me), 1.08 (s, 3 H, 19-Me), 5.21 (br s, 1 H, 7-βH), 5.32 (s and d, 2 H, 12-βH and 4αH), 8.11 (s, 1 H, 7-HCHO) and 8.15 (s, 1 H, 12 HCHO).

3-oxo-7α,12α-diformyloxy-4-cholen-24-oic acid (6). The procedure is based on that of Magerlein et al for 4-pregnene-3-ones.[4] A solution of bromoketone **C** (0.388 g, 0.7 mmol) in THF (40 ml) was degassed and blanketed with nitrogen. To this was added a solution prepared by dissolving semicarbazide hydrochloride (0.164 g, 1.42 mmol) and sodium bicarbonate (0.120 g, 1.4 mmol) in t-butanol (5 ml) and degassed water (1 ml). After stirring for 12 h analysis by TLC (hexane/EtOAc, 1/1) showed complete disappearance of starting bromoketone. A solution of pyruvic acid (1 ml) in water (6 ml) was added and the resulting mixture stirred at room temperature. After 24 hour, the solution was poured into water (100 ml), and the aqueous mixture was extracted

with DCM. The extract was washed with water till neutral, then with saturated brine. After drying (Na_2SO_4) and filtration, evaporation afforded the crude **6** (0.316 g) contaminated with some polyene (4,6-diene and 1,4,6-triene). Chromatography employing hexane/ethyl acetate, 6/4 to 4/6 (gradient elution) afforded pure **6** (0.231 g, 70 %), mp 155-157 ^{o}C (ethyl acetate/hexane; lit.[3] 159-160); IR (Neat): ν_{max} = 1715, 1653, cm^{-1}; ^{1}H NMR (400 M Hz, $CDCl_3$): δ = 0.82 (s, 3 H, 18-Me), 0.85 (d, 3 H, J = 6 Hz, 21-Me), 1.21 (s, 3 H, 19-Me), 5.21 (br s, 1 H, 7-βH), 5.29 (br s, 1 H, 12-βH), 5.73 (s, 1 H, 4H), 8.08 (s, 1 H, 7-HCHO) and 8.12 (s, 1 H, 12 HCHO).

3-oxo-7α,12α-dihydroxy-4-cholen-24-oic acid (E).[3] Enone **6** (0.48 g, 1.03 mmol) was dissolved in sodium hydroxide solution (25 ml, 0.2 M), and stirred at room temperature for 25 min. The mixture was diluted with water (100 ml), ammonium chloride was added until the solution was acidic to litmus. The mixture was extracted with 5 % ethanol in chloroform (3 × 100 ml), and the organic phases were combined and washed with water (100 ml). Evaporation of the solvent under reduced pressure gave an oily residue which was mixed with ethyl acetate to give an immediate precipitation of **E** (0.38 g, 90 %); R_f = 0.24, (EtOAc/AcOH: 50/1); mp 235-237 ^{o}C (lit.[3] 234-236 ^{o}C); IR (Neat): ν_{max} = 3500, 1720, 1710, 1650 cm^{-1}; ^{1}H NMR (400 M Hz, $CDCl_3$): δ = 0.72 (s, 3 H, 18-CH_3), 0.98 (d, 3 H, J = 6 Hz, 21-CH_3), 1.16 (s, 3 H, 19-CH_3), 3.96 (b s, 1 H, 7β-H), 4.00 (br s, 1 H, 12β-H), 5.84 (s, 1 H, 4-H).

Methyl 3β,7α,12α-trihydroxy-5α-cholan-24-oate (7). A suspension of enone **E** (1.00 g, 2,47 mmol) in THF (20 ml) and t-butanol (2 ml) was added dropwise to a solution prepared by dissolving lithium wire (0.40 g, 57 mmol) in liq. ammonia (150 ml) maintained at -20 ^{o}C. After 1 h the blue colour was discharged by addition of excess ammonium chloride under vigorous stirring, and the ammonia was allowed to evaporate. The bile salts obtained were dissolved in water, precipitated by adding dilute sulphuric acid under cooling and extracted with chloroform containing 5% of methanol. The organic extracts were washed with saturated ammonium chloride aq., dried

over sodium sulphate and filtered. Evaporation of the filtrate gave a residue, which was dissolved in 2% sulphuric acid in methanol (20 ml) and left overnight. The acid was neutralised by portionwise addition of solid $NaHCO_3$, and the methanol was evaporated to give a crude residue. The residue was taken up in chloroform containing 5% ethanol and washed with water till neutral, then brine. After drying (Na_2SO_4) the solution was evaporated to give a residue (0.64 g), which was purified by chromatography using ethyl acetate/hexane (gradient elution 6/4 to 8/4) to afford triol **7** (0.54 g, 52 %); R_f = 0.2 (3% methanolic ethyl acetate); mp 184-5°C (lit.[5] 186-7°C); IR (Neat): ν_{max} = 3400, 1735, 1710, cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 0.68 (s, 3 H, 18-CH_3), 0.79 (s, 3 H, 19-CH_3), 0.98 (d, 3 H, J = 6.3 Hz, 21-CH_3), 3.61 (bm, 1 H, 3α-H), 3.66 (s, 3 H, COOMe), 3.82 (bd, 1 H, 7β-H), 3.93 (bs, 1 H, 12β-H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.01 (*C*H_3), 12.48 (*C*H_3), 17.28 (*C*H_3), 23.05 (*C*H_2), 27.32 (*C*H_2), 28.56 (*C*H_2), 30.89 (*C*H_2), 31.05 (*C*H_2), 31.26 (CH_2),35.13 (*C*H), 35.18 (C), 36.52 (CH_2), 36.64 (CH_2) 37.17(CH), 37.64 (CH_2), , 39.18, 39.69 (*C*H), 41.97 (*CH*), 46.45 (*C*), 47.13 (*C*H), 51.40 (O*C*H_3), 67.68 (CH), 70.96 (CH), 72.79 (CH), 174.68 (CO-Me); *m/z* (%): (ES^+): 423.3 (20) $[M+H]^+$, 445.3 (100%) $[M+Na]^+$; HRMS (ES^+): *m/z* mass calculated for $[M+H]^+$ = 423.3105, found 423.3106.

Methyl 3,7,12-trioxo-5α-cholan-24-oate (8). To a solution of the crude triol **7** (0.53 g, 1.25 mmol) in glacial acetic acid (10 ml) was added a few crystals of KBr. The mixture was cooled to 0 °C, followed by dropwise addition of calcium hypochlorite (65 % by weight, 0.66 g, 2.9 mmol) suspended in H_2O (5 mL) over a period of 5 min, maintaining the internal temperature of the reaction around 15-18 °C. The resulting pale yellow solution was left overnight at room temperature under stirring. Isopropanol was added until the mixture tested negative for hypochlorite (starch iodide paper). After a further 1 h the turbid solution was poured slowly into an ice-water mixture (20 ml) under vigorous stirring. The resulting white solid precipitate was filtered under suction, washed thoroughly with water until the last drop of filtrate showed neutral to litmus, then dried to give triketone **8** as a white powder (0.49 g, 95 %); TLC: R_f = 0.25 (hexane/EtOAc,

1/1); IR (Neat): ν_{max} 1735, 1699 cm^{-1}; ^1H NMR (400 M Hz, $CDCl_3$): δ = 0.84 (d, J = 6 Hz, 3 H, 21CH_3), 1.07 (s, 3 H, CH_3), 1.40 (s, 3 H, CH_3), 2.84 (bt, 2 H, J = 10 and 13 Hz), 3.66 (s, 3 H, CO_2CH_3); ^{13}C NMR (100 M Hz, $CDCl_3$): δ = 10.47 (CH_3), 11.63 (CH_3), 18.44 (CH_3), 25.06 (CH_2), 27.33 (CH_2), 30.31 (CH_2), 31.07 (CH_2), 35.30 (CH), 36.25 (q C), 36.47(CH_2), 37.01 (CH_2), 38.46 (CH_2), 43.65 (CH_2), 45.28 (CH_2), 45.48 (CH), 46.78 (CH), 48.84 (CH), 51.13 (-OCH_3), 51.42 (CH), 56.47 (CH), 56.51 (C), 174.11 (CO), 207.32 (C), 207.35 (C), 208.02 (C); *m/z* (%): EI: 261.1 (100 %), 398 (35 %), 416.3 (25 %); CI: 417.3 (10 %) $[M + H]^+$, 434.4 (100 %) $[M + NH_4]^+$, 435.04 (25 %), 436.4 (7 %), HRMS (ES^+): *m/z* mass calculated for $[M+NH_4]^+$ = 434.2901, found 434.2903.

Methyl 3,7,12-trioximino-5α-cholan-24-oate F. The triketone **8** (0.34 g, 0.8 mmol) was taken up in methanol (20 ml). Hydroxylamine hydrochloride (0.26 g, 3.74 mmol) and sodium acetate (0.46 g, 5.61 mmol) were added sequentially to give a pale yellow suspension. The mixture was refluxed for 24 h, cooled to 0 °C, and filtered under suction to give a white solid. The solid was washed thoroughly with ice cold methanol, suction dried and added portion-wise to water containing ice chips (20 ml), under vigorous stirring. The insoluble solid (trioxime) was isolated by suction filtration, washed with ice cold water and suction dried. Drying under high vacuum gave trioxime **F** (0.349 g, 90 %) as a white powder; R_f = 0.15, (DCM/EtOAc, 4/1); IR (Neat): ν_{max} = 3264, 2934, 1737 cm^{-1}; ^1H NMR (400 M Hz, DMSO-d_6): δ = 0.88 (cm, 6 H, CH_3), 1.08 (s, 3 H, CH_3), 2.90 (dd, 1 H, J = 4 Hz, 14 Hz, H α to oximino carbon), 3.00 (dd, 1 H, J = 4 Hz, 14 Hz, H α to oximino carbon), 3.25 (dd, 1 H, J = 4 Hz, 14 Hz, H α to oximino carbon), 3.57 (s, 3 H, CO_2CH_3), 10.10 (s, 1 H, NO*H*), 10.20 (s, 0.5 H, NO*H*), 10.30 (s, 0.5 H, NO*H*).

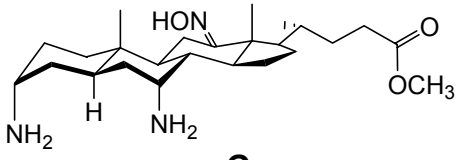
Methyl 3α,7α,12α-triamino-5α-cholan-24-oate 5. A mixture of the trioximino compound **F** (0.270 g, 0.59 mmol) and platinum (IV) oxide monohydrate (Adams' catalyst) (0.027 g, 10 % by weight) in glacial acetic acid (10 mL) was degassed by evacuation and refilling with nitrogen (3 cycles). Hydrogen (~1 atmosphere) was introduced from a balloon, and the mixture was stirred

vigorously for 6 days. The reaction mixture was filtered and washed thoroughly with acetic acid. Zinc powder (2 g) was added to the combined filtrates (volume ca. 20 ml). The mixture was stirred for 48 h at room temperature. The zinc was removed by filtration, and the acetic acid was evaporated under reduced pressure. The residue was taken up in ether and washed with dilute sodium hydroxide, water and brine. The solution was dried (Na_2SO_4), filtered and concentrated to give a residue, which was purified by flash chromatography as follows: Column equilibrated with 3 % methanol in chloroform, sample introduced in chloroform, elution with chloroform/methanol-NH_3* (97/3, 100 ml; 96/4, 100 ml; 95/5, 100 ml; 93/7, 100 ml; 91/9, 100 ml; 89/11, 100 ml; 87/13, 100 ml; 85/15, 100 ml). The purification afforded triamine **5** as an oil (0.145 g, 59 %); R_f = 0.13, (DCM/methanol-NH_3*, 10:1); IR (Neat): ν_{max} = 3500, 3400,3371, 1708 cm^{-1}; ^1H NMR (400 M Hz, $CDCl_3$): δ = 0.73 (s, 3 H, -CH_3), 0.78 (s, 3 H, -CH_3), 0.96 (d, 3 H, J = 6.4 Hz, , 21-CH_3), 2.18- 2.30 (m, 1 H), 2.30-2.44 (m, 1 H), 2.97 (br d, 1 H, 7β-H), 3.14 (br s, 1 H, 12β-H), 3.20 (br s, 1 H, 3β-H), 3.66 (s, 3 H, CO_2CH_3); ^{13}C NMR (100 M Hz, $CDCl_3$): δ = 10.33 (CH_3), 13.71 (CH_3), 17.20 (CH_3), 23.26 (-CH_3), 27.51(CH_2), 28.29 (CH_2), 29.01 (CH_2), 30.93 (CH_2), 31.11 (CH_2), 31.54 (CH), 32.01 (CH_2), 35.16 (CH), 36.11 (CH_2), 36.45 (C), 36.90 (CH_2), 39.12 (CH), 39.51 (CH), 42.33 (CH), 45.74 (CH), 46.19 (C), 47.72 (CH), 47.78 (CH), 51.42 (-OCH_3), 53.76 (CH), 174.53 (CO_2CH_3).

Also isolated was methyl 3α,7α-diamino-12-oximino-5α-cholan-24-oate (**G**) (0.075 g, 29 %); R_f = 0.38, (DCM/methanol-NH_3*, 10:1); IR (Neat): ν_{max} = 3500, 3400, 3371, 3260, 2929, 1708 cm^{-1}; ^1H NMR (400 M Hz, $CDCl_3$): δ = 0.85 (s, 3 H, CH_3), 0.89 (s, 3 H, CH_3), 0.92 (d, 3 H, J = 6.4 Hz, 21-CH_3), 3.07 (br s, 1 H, 7β-H), 3.23 (br s, 1 H, 3β-H), 3.30 (bd, 1 H, J = 8 Hz, 11αH), 3.66 (s, 3 H, CO_2CH_3); ^{13}C NMR (100 M Hz, $CDCl_3$): δ = 10.33 (CH_3), 12.34 (CH_3), 19.70 (CH_3), 19.82 (CH_2), 23.89 (CH_2), 27.88 (CH_2), 29.10 (CH_2), 30.99 (CH_2), 31.55 (CH), 31.87 (CH_2), 32.03 (CH_2), 36.01

* methanol-NH_3 refers to methanol which has been saturated with gaseous ammonia.

(CH), 36.22 (CH_2), 37.02 (CH_2), 37.70 (C), 39.22 (CH), 46.00 (CH), 46.58 (CH), 47.29 (CH), 48.07 (CH), 49.56 (C), 51.63 (CH_3), 54.08 (CH), 164.26 (12C=NOH), 174.95 (C). Diamine **G** could be further reduced to triamine **5** under the conditions described above, increasing the overall yield of the triamine.



G

Methyl 3α,7α,12α-tri[*N*-(*t*-butyloxycarbonyl)amino]-5α-cholan-24-oate (9). To a solution of triamine, **5** (0.145 g, 0.35 mmol) in THF (10 ml) was added saturated aqueous sodium bicarbonate (5 ml) followed by di-*tert*-butyl dicarbonate (0.32 g, 1.46 mmol) dissolved in THF (5 ml), under stirring at room temperature. After 24 h the organic phase was separated and the aqueous phase was extracted with EtOAc (3 × 10 mL). The organic phases were combined, washed with water, brine and dried ($MgSO_4$). Evaporation gave a residue which was purified by flash chromatography (hexane/ethyl acetate, 8/2) to afford pure **9** (0.19 g, 75 %) as a white powder; IR (solid state): ν_{max} = 3391, 3371, 1738, 1708 cm^{-1}; ^1H NMR (400 M Hz, $CDCl_3$): δ = 0.79 (s, 3 H, 18-CH_3), 0.80 (s, 3 H, 19-CH_3), 0.89 (d, J = 6.4 Hz, 3 H, 21-CH_3), 1.43 [s, 9 H, $(CH_3)_3C$], 1.45 [s, 9 H, $(CH_3)_3C$], 1.47 [s, 9 H, $(CH_3)_3C$], 3.68 (s, 3 H, CO_2CH_3), 3.75 (br s, 1 H, 7β-H), 3.84 (br s, 1 H, 12β-H), 3.95 (br s, 1 H, 3β-H), 4.6-5.3 (broad hump of triplet, 3 H, N*H*Boc); ^{13}C NMR (100 M Hz, $CDCl_3$): δ = 10.70 (-CH_3), 13.78 (CH_3), 17.26 (*C*H_3), 23.00 (CH_2), 24.67 (CH_2), 26.14 (CH_2), 26.69 (CH_2), 27.18, 27.20 (CH_2), 28.37 (CH), 28.46 [(*C*H_3)$_3$C], 30.81 (*C*H_2), 31.25 (CH_2), 32.67, 32.73, 32.74 and 32.77 (CH_2), 34.27, 34.30, 34.35 and34.38 (CH_2), 34.99 (CH), 35.82 (C), 36.66 (CH_2), 37.45 (CH), 44.68 (C), 48.58 (CH), 51.45 (-O*C*H_3), 79.08, 79.13, 79.20, 79.24, 79.32,and 79.33[$(CH_3)_3C$], 155.11, 155.27 and 155.29 (NHCO), 174.82 (*C*O_2CH_3); *m/z* (%): ES^+: 720.5 (40),721.5 (20) $[M+H]^+$, 737.5 (45 %) $[M+NH_4]^+$, 742.5 (100) $[M+Na]^+$; HRMS (ES^+): *m/z* mass calculated for

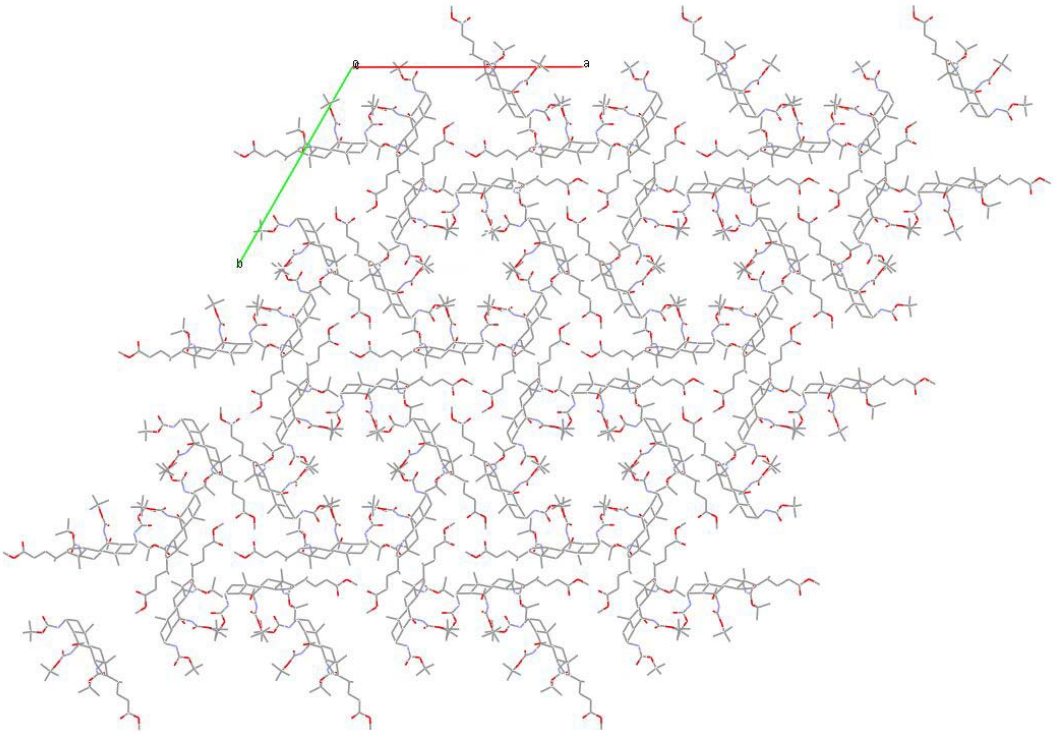
$[M+H]^+$ = 720.5157, found 720.5166. The sample for X-ray crystallography was recrystallised from dichloromethane/methanol.

Methyl 3α,7α,12α-tris-[(phenylaminocarbonyl)amino]-5α-cholan-24-oate (10). Freshly distilled phenyl isocyanate (0.042 g, 39 μl, 0.36 mmol) was added to a stirred solution of triamine **5** (0.043 g, 0.10 mmol) in dry tetrahydrofuran (4 ml). The mixture was stirred overnight, the solvent was removed under reduced pressure and the residue was purified by flash chromatography with gradient elution (DCM/ethyl acetate, 97/3, followed by increasing proportions of ethyl acetate). The tris-urea **10** was isolated as glassy solid (0.053 g, 67 %); R_f = 0.13 (DCM/methanol-NH_3, 10/1); IR (Neat): ν_{max} = 3329, 2920, 1730, 1664, 1600 cm^{-1}; ^1H NMR (400 M Hz, CD_3COCD_3): δ = 0.82-0.91 (s, 9 H, 18-, 19- and 21-CH_3), 2.18-2.30 (m, 1 H), 2.15-2.26 (m, 2 H), 3.56 (s, 3 H, CO_2CH_3), 3.87 (br s, 1 H, 7β-H), 4.10-4.12 (br d, 2 H, 3β-H and 12β-H), 5.71 (1 H, d, NH), 5.83 (1 H, d, NH), 6.07 (1 H, bd, NH), 6.83-6.96 (complex multiplet, 3 H, aryl H), 7.14-7.26 (complex multiplet, 6 H, aryl H), 7.39-7.51 (complex muliplet, 6 H, aryl H), 7.67 (s, 1 H, 1H), 7.84 (s, 1 H, NH), 8.03 (d, 2 H, NH); ^{13}C NMR (100 M Hz, CD_3COCD_3): δ = 10.23 (CH_3), 13.36 (CH_3), 16.70 (CH_3), 23.29 (CH_2), 26.08 (CH_2), 26.24 (CH_2), 27.06 (CH_2), 30.47 (CH_2), 30.83 (CH_2), 32.82 (CH_2), 33.09 (CH_2), 34.45 (CH), 34.79 (CH). 35.05 (CH_2), 36.09 (C), 38.06 (CH), 41.61 (CH), 44.71 (C), 44.76 (CH), 45.75 (CH), 46.56 (CH), 48.32 (CH), 50.64 (CH), 52.58 (CH_3), 54.08 (CH); 117.70, 117.82 and 170.96 (CH aryl); 121.22,121.35 and 121.44 (CH aryl); 128.65, 128.70 and 128.76 (CH aryl); 140.66, 140.78 and 141.04 (C aryl); 154.42, 154.69 and 155.03 (CO); 174.53(CO_2CH_3); *m/z* (%): ES^+: 777.469 (10) $[M+H]^+$, 799.4 (100), 800.4 (70), 801.3 (10) $[M + Na]^+$; HRMS (ES^+): *m/z* mass calculated for $[M + H]^+$ = 777.4698, found 777.4705.

***Crystallography of Methyl 3α,7α,12α-tri[N-(t-butyloxycarbonyl)amino]-5α-cholan-24-oate* 9**

Crystallographic data are presented in the accompanying .cif file. Crystal packing, highlighting the channels which permeate the structure, is shown in Figure S1.

(a)



(b)

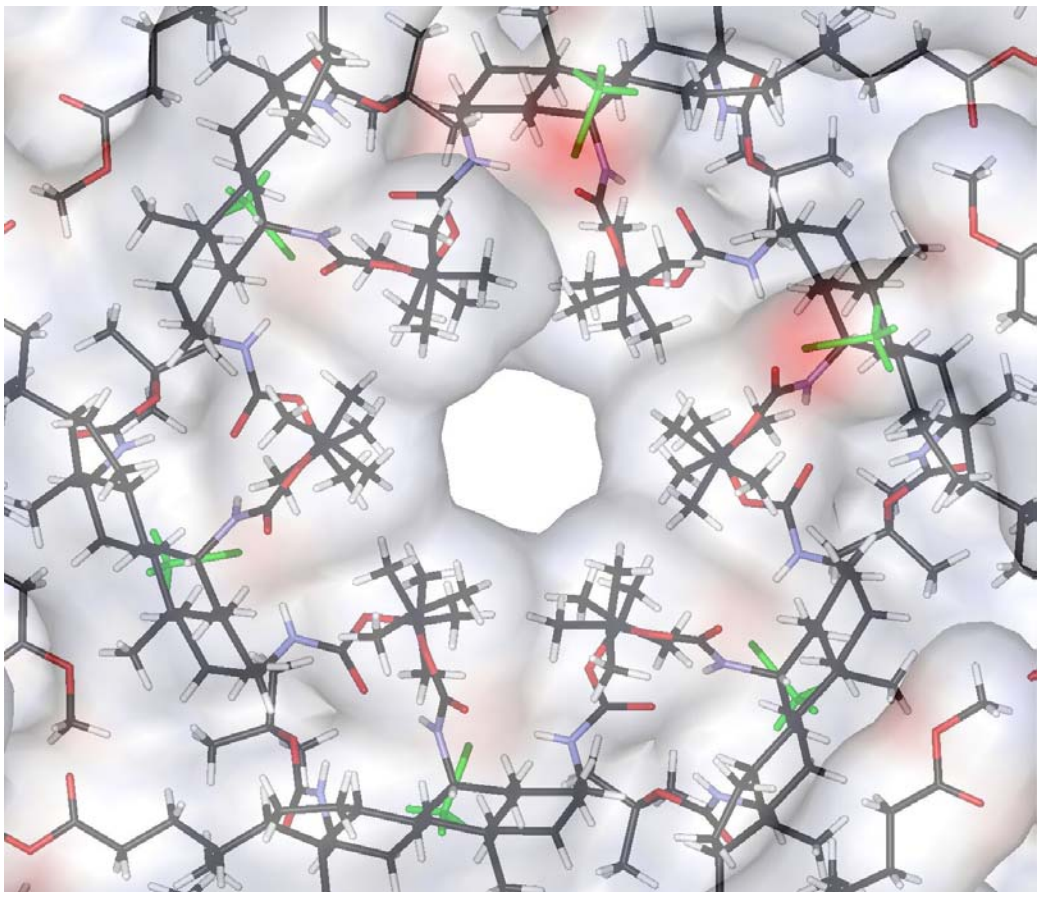


Figure S1. (a) Crystal packing for **9**, viewed down the c-axis. Hydrogens have been omitted for clarity. (b) Interior surface of a channel. Methanol solvent is highlighted in green.

References and Notes

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