Synthesis of C14,15-Dihydro-25-*epi* North Unit of Cephalostatin 1 via "Red-Ox" Modifications of Hecogenin Acetate.

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Supporting Information

GENERAL PROCEDURES

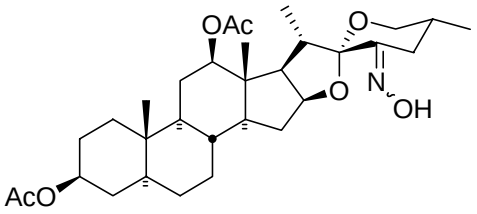
All reagents purchased were used as received. Tetrahydrofuran (THF) and diethyl ether were distilled from benzophenone ketyl. Benzene, toluene, and methylene chloride (CH_2Cl_2) were distilled from calcium hydride. Acetonitrile (CH_3CN) and methanol were spectra-grade. Dimethyl formamide (DMF) was distilled from calcium hydride. Sodium sulfate (Na_2SO_4) was anhydrous. All recrystalization, chromatographic, and workup solvents were distilled. Powdered 4A molecular sieves were oven and flame activated prior to use.

Unless otherwise indicated, all reactions were carried out under in a positive pressure of argon in anhydrous solvents and the reaction flasks were fitted with rubber septa for the introduction of substrates and reagents via syringe. Progress of reactions was monitored by thin layer chromatography (TLC) using silica gel 60 F-254 plates (EM reagents, 0.25 mm). The TLC plates were visualized with a UV lamp (254 nm) and/or with TLC visualizing solutions activated with heat. The two commonly employed TLC visualizing solutions were: (i) *p*-anisaldehyde solution (1350mL absolute ethanol, 50mL con- centrated H_2SO_4, 37mL *p*-anisaldehyde), and (ii) permanganate solution (weight percents of 1% $KMnO_4$ and 2% Na_2CO_3 in water).

^1H NMR and ^{13}C NMR spectra were recorded on General Electric QE-300 (300 MHz). NMR spectra were determined in chloroform-d_1 ($CDCl_3$), benzene-d_6 (C_6D_6) or pyridine-d_5 (C_5D_5N) solution and are reported in parts per million (ppm) from the residual chloroform (7.24ppm and 77.0ppm), benzene (7.16ppm and 128.39ppm) or pyridine (8.74ppm and 150.35ppm) standard respectively. Peak multiplicities in ^1H-NMR spectra, when reported, are abbreviated as s (singlet), d (doublet), t (triplet), m (multiplet), and/or ap (apparent) and/or br (broad). Melting points were obtained on a MEL-TEMP capillary melting point apparatus and are uncorrected. Mass spectra were run by the Purdue University campus wide mass spectrometry facility.

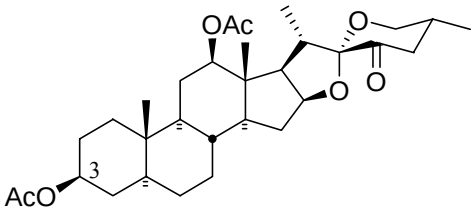
EXPERIMENTALS

Preparation of oxime spiroketal **8**



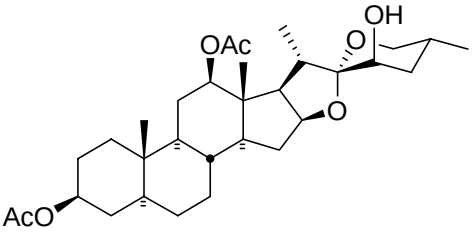
To a solution of rockogenin diacetate **7** (545 mg, 1 mmol) and *t*-BuONO (0.59 mL, 5 mmol, Aldrich) in acetic acid (10 mL), was added $BF_3 \cdot OEt_2$ (63μl, 0.5 mmol) dropwise for one minute at 25 ^oC. After stirring 10 minutes at 25 ^oC, the reaction mixture was poured into water (50 mL) and stirred 1 hour to give a copious white precipitate. The white solid was collected by filtration, washed with water, and subjected to flash silica gel chromatography to afford the desired oxime spiroketal **8** (489 mg, 89 %). R_f = 0.4 (Hexane:EtOAc = 2:1); Mp 155-159, ^1H NMR (300 MHz, $CDCl_3$) δ 4.65 (1H, m), 4.52 (1H, dd, *J* = 11.0, 4.6 Hz), 4.44 (1H, dd, *J* = 15.5, 7.2 Hz), 3.62-3.42 (2H, m), 3.30 (1H, dd, *J* = 13.9, 2.7 Hz), 2.73 (1H, dt, *J* = 15.8, 2.3 Hz), 2.01 (3H, s), 1.98 (3H, s), 0.88 (3H, d, *J* = 5.2 Hz), 0.86 (3H, d, *J*=5.2 Hz), 0.84 (3H, s), 0.81 (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.7, 170.6, 154.8, 108.6, 81.5, 81.2, 73.4, 65.7, 60.2, 54.7, 52.6, 44.9, 44.5, 36.5, 36.4, 35.6, 34.0, 33.8, 31.8, 31.6, 30.9, 28.2, 27.2, 26.7, 21.5, 21.4, 16.9, 13.5, 12.1, 11.6; MS (ESI) 546 (M + H); HRMS (ESI) calculated for $C_{31}H_{47}NO_7$ (M + H) 546.3431, found 546.3440.

Preparation of C23 ketone**9**



To a suspension of oxime spiroketal **8** (6.06 g, 10mmol) in EtOAc (20mL) and EtOH (60mL) and H_2O (20mL) was added and *p*-TsOH (0.19 g, 1mmol) and the mixture was vigorously stirred for 12 hours at reflux. After removal of the solvents under reduced pressure, the crude product (**C3-OH**, C22-ketone) was treated with Ac_2O and pyridine and stirred for 1 hour at 25 ^oC. Removal of pyridine and Ac_2O under reduced pressure followed by flash silica gel chromatography (1:8 EtOAc/Hex to 1:4 EtOAc/Hex) afforded the desired ketone **9** (4.72g, 89%). R_f = 0.3 (Hexane:EtOAc = 2:1); Mp 120-124 ^1H NMR (300 MHz, $CDCl_3$) δ 4.70-4.45 (3H, m), 3.71 (1H, t, *J* = 11.1 Hz), 3.54 (1H, dd, *J*=11.2, 4.3 Hz), 2.81 (1H, m), 2.01 (3H, s), 1.97 (3H, s), 0.90 (3H, d, *J*=6.5 Hz), 0.83 (3H, s), 0.81 (3H, s); ^{13}C NMR δ 201.4, 170.3, 170.2, 109.6, 82.7, 81.1, 73.1, 65.4, 60.6, 54.6, 52.5, 45.0, 44.9, 44.3, 36.4, 35.6, 35.3, 33.8, 33.6, 31.5, 30.9, 28.1, 27.1, 26.5, 21.3, 16.9, 13.3, 11.9, 11.3; MS (ESI) 530; HRMS (ESI) calculated for $C_{31}H_{46}O_7$ 530.3244, found 530.3247

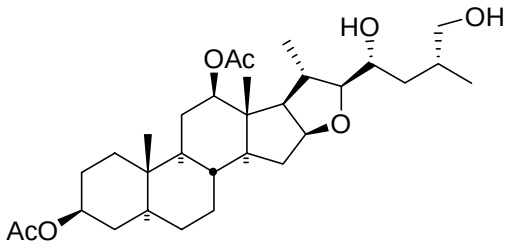
Preparation of C23 R alcohol **10**



A mixture of (*S*)-2-methyl-CBS-oxazaborolidine (2.5mL, 1M solution in toluene, Aldrich) and $BH_3{\cdot}SMe_2$ (2.5mL, 10M, Aldrich) in THF (200mL) was vigorously stirred for 30 minutes at 25 ^oC. C23 ketone **9** (26.50g, 50mmol) in THF (50mL) was added to the mixture of (*S*)-CBS and $BH_3{\cdot}SMe_2$ in one portion at 25 ^oC. After stirring for 30 minutes at 25^oC, the reaction

mixture was quenched with 10% aqueous NaOH solution (100mL) and extracted with EtOAc (3x100mL). Removal of the organic solvent under reduced pressure followed by flash silica gel chromatography (1:4 EtOAc/Hex to 1:3 EtOAc/Hex) afforded desired C23 *R* OH **10** (20.75g, 78%) and C23 *S* OH (3.46g, 13%). R_f = 0.3 (Hexane:EtOAc = 1:1); Mp 210-213, ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.55 (1H, m), 4.42 (1H, dd, *J*=10.9 Hz, 4.2 Hz), 4.35 (1H, dd, *J*=13.9, 7.5 Hz), 3.5.3-3.24 (3H, m), 2.14 (2H, m), 1.93 (3H, s), 1.91 (3H, s), 0.93 (3H, d, *J*=6.9 Hz), 0.77 (3H, s), 0.74 (3H, s), 0.69 (3H, d, *J*=6.5 Hz); ^{13}C NMR δ 170.4, 170,3, 108.1, 81.3, 80.7, 73.2, 70.4, 66.1, 63.1, 54.6, 52.4, 44.6, 44.3, 40.9, 36.3, 36.1, 35.4, 34.0, 33.6, 31.4, 31.2, 28.1, 27.1, 26.5, 23.9, 21.2, 16.6, 15.6, 11.9, 11.2; MS (ESI) 532; HRMS (ESI) calculated for $C_{31}H_{48}NO_7$ 515.3373, found 515.3383.

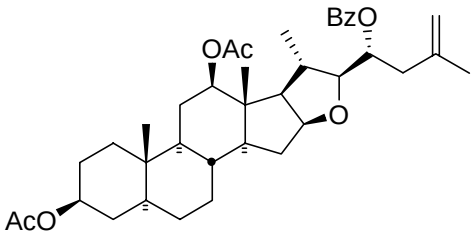
Preparation of diol **11**



To a CH_2Cl_2 solution of axial alcohol **10** (532 mg) and triethylsilane (3 equiv.) at 0^{o}C was added dropwise $BF_3{\cdot}OEt_2$ (3 equiv.). After stirring 6 hours at 0^{o}C, the reaction mixture was quenched by carefully adding saturated aqueous $NaHCO_3$, extracted twice with EtOAc, washed with brine, dried over Na_2SO_4 and concentrated. The residue was subjected to silica gel chromatography to give diol **11** (504 mg) in 94 % yield. R_f = 0.2 (Hexane:EtOAc = 1:2); ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.63 (1H, m), 4.53 (1H, dd, *J* = 11.1, 4.6 Hz), 4.33 (1H, m), 3.88 (1H, m), 3.59 (1H, m), 3.40 (1H, dd, J = 10.6, 7.7 Hz), 3.32 (1H, dd, *J* = 4.0, 8.3 Hz), 2.17 (1H, m), 2.02 (3H, s), 1.99 (3H, s), 0.98 (3H, d, *J* = 6.7 Hz), 0.84, (3H, d, *J* = 6.9 Hz),

0.88, (3H, s), 0.82, (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.7, 170.6, 92.9, 82.9, 81.5, 73.46, 71.7, 68.6, 64.9, 55.2, 52.7, 45.2, 44.5, 38.7, 36.6, 35.6, 34.6, 34.2, 33.8, 33.6, 31.6, 31.6, 28.3, 27.3, 26.6, 21.5, 21.4, 19.8, 18.0, 12.1, 11.8; MS (ESI) 557 (M + Na); HRMS (ESI) calculated for $C_{31}H_{50}O_7$ (M + Na) 557.3454, found 557.3458

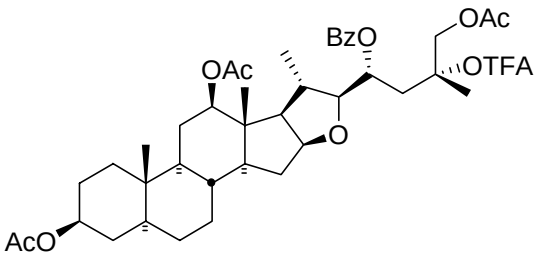
Preparation of 23-OBz-Δ^{25}-ene **13**



To a CH_2Cl_2 solution of diol **11** (1.01 g, 1.90 mmol), TsCl (1.1 equiv.), and TEA (3 equiv.) at room temperature was added DABCO (5 mol %) in one portion. After vigorously stirring for 30 min, the reaction was quenched by adding 1N HCl, extracted twice with EtOAc, washed with brine, and concentrated. The crude product mixture was purified by silica gel column chromatography to afford 23-OH-26-OTs (941 mg, 72 %; structure not shown), which reacted with benzoyl chloride to give 23-OBz-26-OTs (**12**). Conversion of tosyl group to terminal olefin was accomplished by one pot reaction; To a solution of tosylate **1**2 (435 mg, 0.63 mmol) in DMF was added NaI (5 equiv.) and the mixture was stirred for 12 hours at 50 ^{o}C. DBU (2 equiv.) was added to the same reaction pot and the reaction mixture was stirred for 3 hours at 50^{o}C. The reaction mixture was quenched by adding 1N HCl, extracted with EtOAc, washed with $NaHCO_3$ and brine, and concentrated. The crude product mixture was subjected to silica gel chromatography to provide terminal olefin **13** (449 mg, 0.57 mmol) in 90 % yield. R_f = 0.5 (Hexane:EtOAc = 4:1); ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85 (2H, d, *J* = 7.62 Hz) ,7.34 (1H, t, *J* = 7.3 Hz), 7.24 (2H, t, *J* = 7.6 Hz), 5.27 (1H, m), 4.56 (2H, s), 4.45 (1H, m), 4.37 (1H, dd, *J* = 11.1, 4.7 Hz), 4.17 (1H, m), 3.40 (1H, dd, *J* = 8.2, 5.3 Hz), 2.31 (2H, d, *J* = 8.2 Hz), 1.84 (3H, s), 1.81 (3H, s), 1.59 (3H, s), 0.81 (3H, d, *J* = 6.4 Hz), 0.72 (3H, s), 0.64 (3H,

s); ^{13}C NMR (75 MHz, $CDCl_3$) 170.3, 170.3, 165.7, 141.2, 132.7, 130.1, 129.5, 128.1, 113.3, 90.2, 83.1, 81.1, 81.1, 73.2, 72.7, 64.2, 55.5, 44.9, 44.3, 39.3, 36.4, 35.5, 35.4, 34.1, 33.6, 31.5, 31.4, 28.1, 27.1, 26.5, 22.5, 22.3, 21.2, 18.9, 13.9, 11.9, 11.6; MS (ESI) 665 (M + Na); HRMS (ESI) calculated for $C_{38}H_{54}O_9$ (M + Na) 655.3846, found 665.3861.

Preparation of 25-OTFA-26-OAc **15**



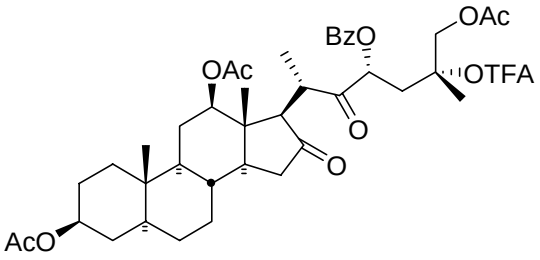
$(DHQ)_2PHAL$, $K_3Fe(CN)_6$, K_2CO_3, and $K_2OsO_2H_2O$ were dissolved in a 1:1 mixture of water and tert-butyl alcohol at room temperature. The vigorously stirred mixture was then cooled to 0 ^oC ant the olefin **13** (551 mg, 0.89 mmol) was added in one portion. The heterogeneous slurry was stirred for 8h at 0 ^oC. The reaction mixture was quenched at 0 ^oC by addition of Na_2SO_3 and then warmed to room temperature and stirred for 30 min. The reaction mixture was extractracted with EtOAc, washed with brine, dried over Na_2SO_4 and concentrated to give crude 25,26-diols. The diol mixture, without further purification, was dissolved in pyridine and then treated with Ac_2O at room temperature and vigorously stirred. After 1h, the reaction was quenched by adding MeOH and concentrated in vacuo. The residue was partitioned between EtOAc and water, washed with 1N HCl, sat $NaHCO_3$, water, and brine, dried over Na_2SO_4, and concentrated to give 25-OH-26-OAc (not shown) which was used for the next step without further purification. To a CH2Cl2 solution of 25-OH-26-OAc was added TEA (5 equiv.) and trifluoroacetic anhydride (2 equiv.) and stirred for 30 min at room temperature. The reaction was quenched by adding sat $NaHCO_3$ and extracted with EtOAc, washed with

brine, and concentrated. Purification by silica gel column chromatography afforded 25-OAc-26-OTFA **15** (445 mg, 0.56 mmol) in 63 % yield from **13**.

Diol **14** ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.84 (2H, d, *J* = 7.6 Hz), 7.34 (1H, t, *J* = 7.3 Hz), 7.24 (2H, t, *J* = 7.6 Hz), 5.18 (1H, m), 4.45 (1H, m), 4.34 (1H, dd, *J* = 11.1, 4.6 Hz), 4.21 (1H, m), 3.43 (1H, t, *J* =7.4 Hz), 3.21 (1H, d, *J* = 18.7 Hz), 3.16 (1H, d, *J* = 18.7 Hz), 2.00 (1H, dd, *J* = 15.2, 5.3 Hz), 1.79 (3H, s), 1.73 (3H, s), 1.10 (3H, s), 0.81 (3H, d, *J* = 6.4 Hz), 0.71 (3H, s), 0.61 (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) 170.5, 170.4, 165.9, 133.2, 129.7, 129.6, 128.4, 91.0, 83.6, 81.1, 73.3, 73.3, 71.2, 70.4, 64.3, 55.1, 52.5, 44.9, 44.4, 41.6, 36.7, 36.4, 35.5, 34.1 , 33.7, 31.5, 31.5, 28.1, 27.2, 26.5, 24.1, 22.5, 21.3, 21.2, 19.3, 14.0, 12.0, 11.6; MS (ESI) 665 (M + Na); HRMS (ESI) calculated for $C_{38}H_{54}O_9$ (M + Na) 655.3846, found 665.3861.

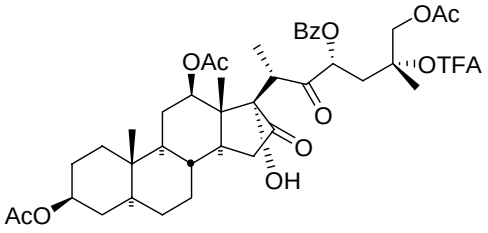
15 R_f = 0.5 (Hexane:EtOAc = 2:1); ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.01 (2H, d, *J* = 7.6 Hz), 7.55 (1H, t, *J* = 7.4 Hz), 7.42 (2H, t, *J* = 7.6 Hz), 5.44 (1H, dd, *J* = 7.6, 4.1 Hz), 4.65 (1H, m), 4.53 (1H, dd, *J* = 11.1, 4.5 Hz), 4.47 (1H, d, *J* = 11.7 Hz), 4.30 (2H, d, *J* =12.3 Hz), 3.56 (1H, dd, *J* = 8.8, 4.1 Hz), 2.57 (1H, d, *J* = 15.8 Hz), 2.33 (1H, dd, *J* = 16.1, 8.6 Hz), 2.02 (3H, s), 1.99 (3H, s), 1.97 (3H, s), 1.54 (3H, s), .97 (3H, d, *J* = 4.5 Hz), 0.89 (3H, s), 0.82 (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) 170.5, 170.4, 170.0, 165.6, 133.2, 129.6, 129.5, 128.4, 90.5, 86.6, 83.4, 81.1, 73.2, 70.4, 66.1, 63.5, 55.0, 52.5, 44.9, 44.4, 36.4, 36.7, 35.5, 35.3, 34.1, 33.7, 31.4, 28.1, 27.1, 26.5, 21.3, 21.1, 20.7, 20.4, 18.1, 12.0, 11.5; MS (ESI) 815 (M + Na); HRMS (ESI) calculated for $C_{42}H_{55}O_{11}$ (M + Na) 815.3594, found 815.3578.

Preparation of diketone **16**



Anhydrous chromium trioxide (6 equiv.) was finely ground in CH_3CN under a positive pressure of argon at ambient temperature. The chromium trioxide suspension was cooled to –40 ^oC and then added a CH_2Cl_2 (2.5 mL) solution of **15** (792 mg, 1 mmol), followed by dropwise addition of CH_3CN solution of Bu_4NIO_4 (6 equiv.) to the mixture solution of CrO_3 and substrate for 10 minutes. As soon as addition of Bu_4NIO_4 was finished, the reaction temperature was adjusted to -20 ^oC and further stirred for 3 hours. The dark orange reaction mixture was quenched by addition of saturated aqueous Na_2SO_3, extracted with EtOAc, washed with water, brine, dried over Na_2SO_4, concentrated and purified by silica gel column chromatography to give diketone **16** (679 mg, 84%). R_f = 0.4 (Hexane:EtOAc = 2:1); ^1H NMR (300 MHz, $CDCl_3$) δ 8.02 (2H, d, *J* = 7.6 Hz), 7.58 (1H, t, *J* = 7.4 Hz), 7.44 (2H, t, *J* = 7.6 Hz), 5.85 (1H, d, *J* = 7.6 Hz), 4.81 (1H, dd, *J* = 11.1, 4.6 Hz), 4.66 (1H, m), 4.50 (1H, d, *J* = 12 Hz), 4.38 (1H, d, *J* = 12 Hz), 2.95 (1H, d, *J* =15.9 Hz),2.69 (2H, d, *J* = 2.7 Hz), 2.51 (1H, dd, *J* =16.2, 9.6 Hz), 2.23 (1H, dd, *J* = 18.4, 7.3 Hz), 2.05 (3H, s), 1.99 (3H, s), 1.89 (3H, s), 1.64 (3H, s), 0.82 (6H, s); ^{13}C NMR (75 MHz, $CDCl_3$) 216.4, 206.7, 170.4, 170.0, 169.7, 165.3, 133.5, 129.6, 128.8, 128.4, 86.4, 79.2, 73.5, 73.1, 66.3, 65.9, 51.7, 48.9, 45.9, 44.1, 40.3, 36.4, 36.0, 35.3, 33.2, 31.4, 27.9, 27.1, 27.0, 22.5, 21.3, 21.2 21.0, 20.3, 16.2, 13.9, 11.8, 9.3; MS (ESI) 829 (M + Na); HRMS (ESI) calculated for $C_{42}H_{53}F_3O_{12}$ (M + Na) 829.3387, found 829.3390.

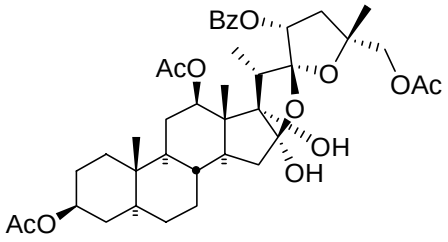
Preparation of 17-OH-16,22-diketone **18**



To 16,23-diketone **16** (122 mg) in MeCN was added hexamethyldisilazane (3 equiv.) and TMSI (2 equiv.) at room temperature and the mixture was stirred for 1h. The reaction was

quenched by adding saturated aqueous $NaHCO_3$, extracted with EtOAc, washed with brine, and concentrated to give silylenol ether which was used for the next step without further purification. To the silylenolether in MeCN/H_2O (1.5:1) was added oxone/$NaHCO_3$ (6 equiv./9 equiv.) over 1h at 0 ^oC. The reaction was quenched by adding aqueous Na_2SO_3, the mixture was partitioned between EtOAc and H_2O, washed with brine, dried over Na_2SO_4, and concentrated. The residue was purified by silica gel chromatography to give 17-OH-16,22-diketone **18** (57 mg, 45 %) R_f = 0.3 (Hexane:EtOAc = 2:1); ^1H NMR (300 MHz, $CDCl_3$) δ 8.02 (2H, d, *J* = 7.6 Hz), 7.58 (1H, t, *J* = 7.4 Hz), 7.44 (2H, t, *J* = 7.6 Hz), 5.84 (1H, d, *J* = 6.2 Hz), 5.25 (1H, dd, *J* = 10.5, 4.6 Hz), 4.93 (1H, s), 4.65 (1H, m), 4.48 (1H, d, *J* = 12.3 Hz), 4.38 (1H, d, *J* = 12.3 Hz), 2.92 (1H, d, *J* = 15.8 Hz), 2.71 (1H, dd, *J* = 14.0, 6.9 Hz), 2.52-2.36 (2H, m), 2.05 (3H, s), 1.99 (3H, s), 1.96 (1H, s), 1.62 (1H, s), 1.23 (3H, d, *J* = 7 Hz), 0.79 (3H, d, *J* = 7.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 216.3, 211.9, 170.5, 170.0, 169.4, 165.3, 133.7, 129.7, 128.7, 128.6, 87.5, 86.5, 76.5, 73.4, 73.2, 71.3, 65.9, 51.4, 49.6, 44.4, 44.2, 39.7, 36.1, 35.8, 35.4, 34.6, 33.6, 33.4, 31.5, 31.3, 28.1, 27.1, 26.9, 21.6, 21.3, 21.0, 20.4, 11.9, 9.3; MS (ESI) 845 (M + Na); HRMS (ESI) calculated for $C_{42}H_{53}F_3O_{13}$ (M + Na) 845.3336, found 845.3346.

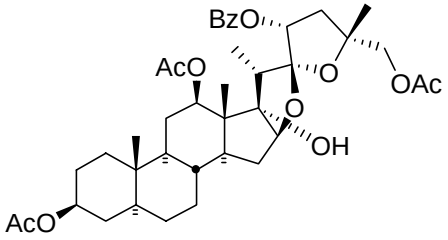
Preparation of hemiacetal **19**



To 17-OH-16,22-diketone **18** (82 mg, 0.10 mmol) in MeOH was added solid $NaHCO_3$ (10 equiv.) in one portion and the mixture was stirred for 1h at ambient temperature. After removal of MeOH in vacuo, the residue was subjected to silica gel chromatography to afford hemiacetal **19** (39 mg, 54 %)**.** R_f = 0.4 (Hexane:EtOAc = 2:1); ^1H NMR (300 MHz, $CDCl_3$) δ 8.02 (2H, d, *J* = 7.6 Hz), 7.58 (1H, t, *J* = 7.4 Hz), 7.44 (2H, t, *J* = 7.6 Hz), 5.53 (1H, d, *J*

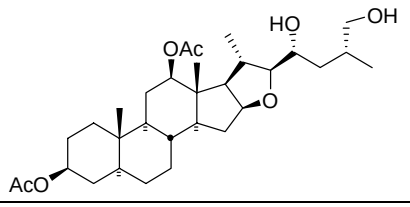
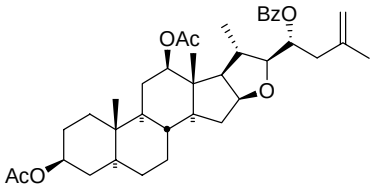
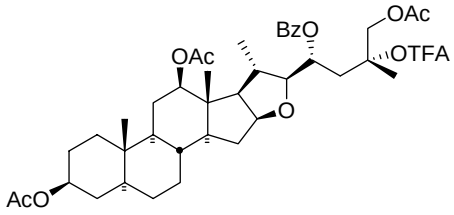
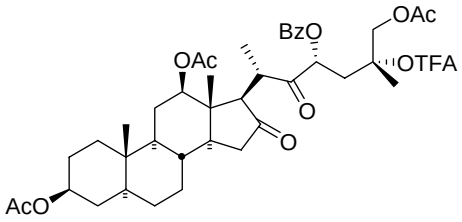
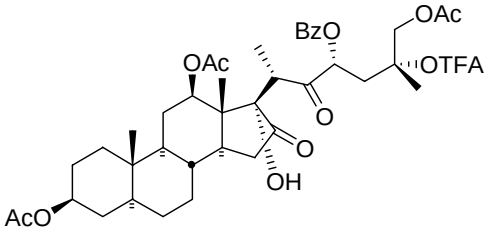
= 5.4Hz), 5.06 (1H, dd, *J* = 4.9, 11.7 Hz), 4.66 (1H, m), 4.15 (1H, d, *J* = 10.8Hz), 4.03 (1H, d, *J* = 11.3 Hz), 3.76 (1H, s), 3.13 (1H, s), 2.62 (1H, q, *J* = 6.8 Hz), 2.37 (1H, dd, *J* = 5.8, 14.6 Hz), 2.04 (3H, s), 2.01 (3H, s), 1.90 (3H, s), 1.49 (3H, s), 0.91 (3H, s), 0.88 (3H, d, *J* = 7.3Hz), 0.82 (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.2, 170.9, 165.7, 133.8, 129.9, 129.7, 129.0, 120.5, 114.5, 87.9, 83.5, 79.6, 74.7, 69.4, 52.0, 50.6, 50.4, 44.6, 40.1, 39.5, 36.7, 35.8, 34.4, 34.0, 31.5, 28.5, 26.7, 26.1, 21.6, 21.1, 12.3, 11.5, 10.5; MS (ESI) 749 (M + Na); HRMS (ESI) calculated for $C_{40}H_{54}O_{12}$ (M + Na) 749.3513, found 749.3504.

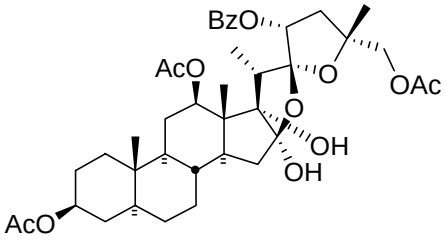
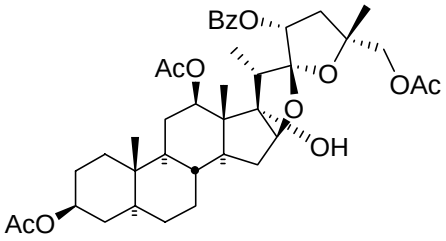
Preparation of 14,15-dihydro-17-OH-25-epi North 1 **20**

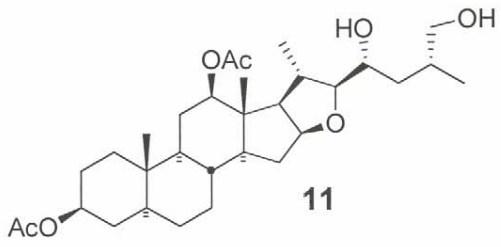


To hemiacetal **19** (11 mg) and triethylsilane in CH_2Cl_2 at -78 ^{o}C was added dropwise TMSOTf over 10 min and the mixture was stirred for 1h. The reaction mixture was poured into cold saturated aq. $NaHCO_3$, extracted with EtOAc, washed with brine, dried over Na_2SO_4, and concentrated *in vacuo*. Purification by chromatography on silica gel yielded 14,15-dihydro-17-OH-25-epi North 1 **20** (10 mg, 93%). R_f = 0.5 (Hexane:EtOAc = 2:1); ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.02 (2H, d, *J* = 7.6 Hz), 7.58 (1H, t, *J* = 7.4 Hz), 7.44 (2H, t, *J* = 7.6 Hz), 5.53 (1H, d, *J* = 5.4Hz), 4.98 (1H, dd, J = 6.4, 11.3 Hz), 4.64 (1H, m), 4.13 (1H, d, *J* = 10.8 Hz), 4.03 (1H, d, *J* = 10.7 Hz), 2.43 (1H, 1, *J* = 6.9 Hz), 2.31 (1H, dd, *J* = 5.8, 14.6 Hz), 2.01 (3H, s), 1.99 (3H, s), 1.91 (3H, s), 1.39 (3H, s), 0.86 (3H, d, *J* = 6.8 Hz), 0.85 (3H, s), 0.82 (3H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ 172.0, 171.1, 170.9, 165.8, 133.7, 129.9, 128.9, 119.4, 89.7, 88.8, 82.5, 80.0, 74.8, 73.6, 69.9, 52.4, 51.5, 50.0, 44.6, 40.2, 36.8, 35.7, 34.7, 34.0, 31.5, 30.8, 29.9, 28.5, 27.5, 27.2, 26.4, 21.7, 21.2, 12.3, 11.5, 9.6; MS (ESI) 733 (M + Na); HRMS (ESI) calculated for $C_{40}H_{54}O_{11}$ (M + Na) 733.3564, found 733.3558.

Compound Characterization Check List

#	Structure	1H	13C	MS	HRMS
11		O	O	O	O
13		O	O	O	O
15		O	O	O	O
16		O	O	O	O
18		O	O	O	O

#	Structure	1H	13C	MS	HRMS
19		O	O	O	O
20		O	O	O	O



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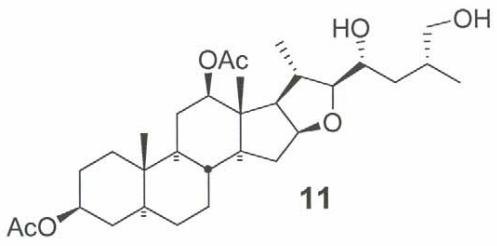
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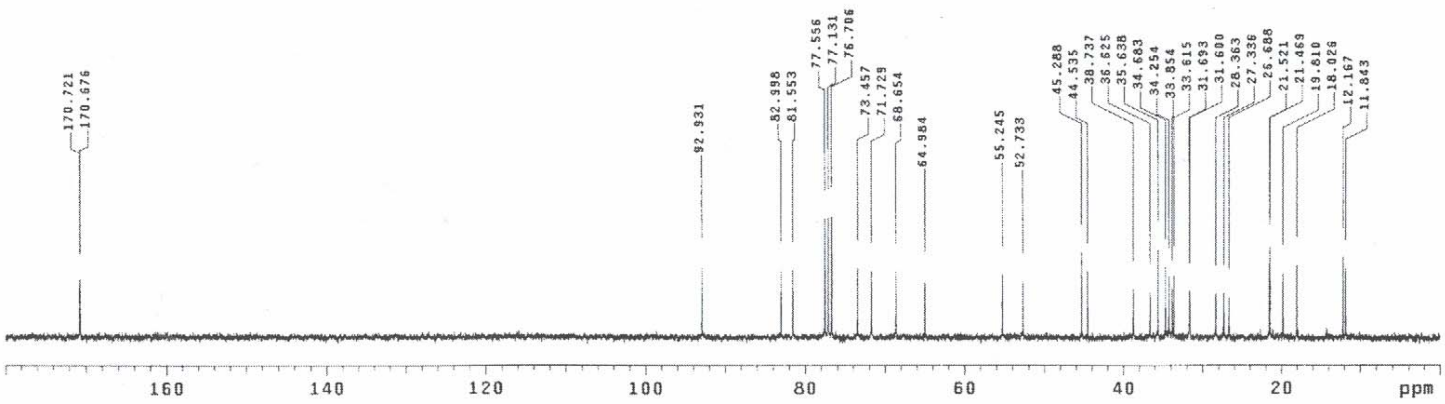
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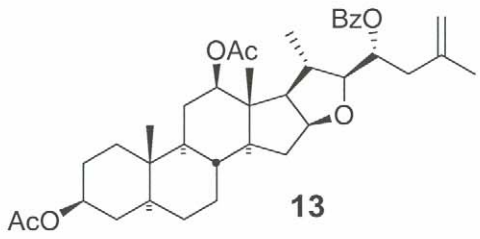

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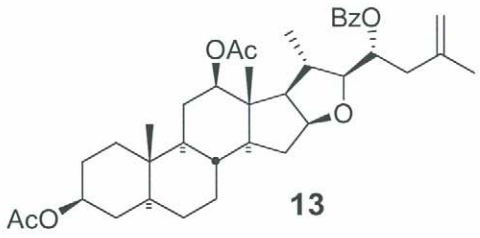

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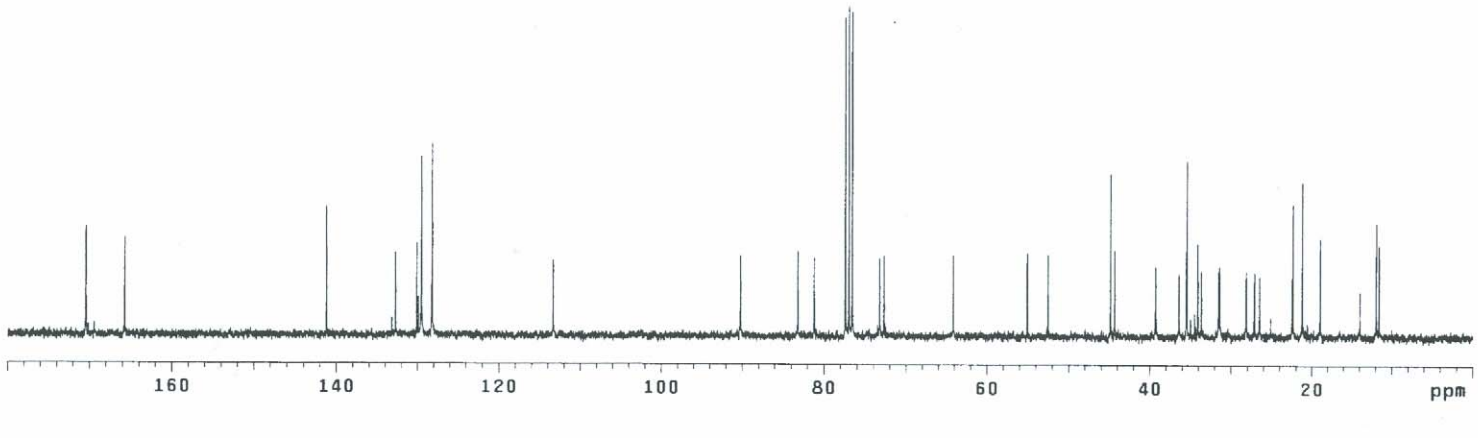

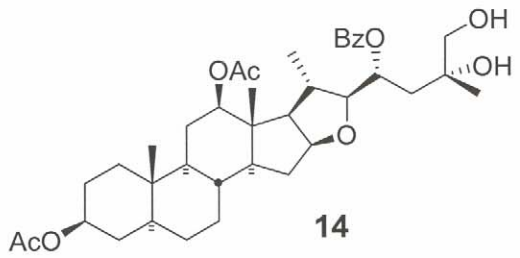

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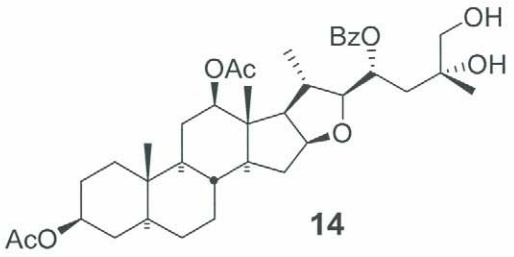

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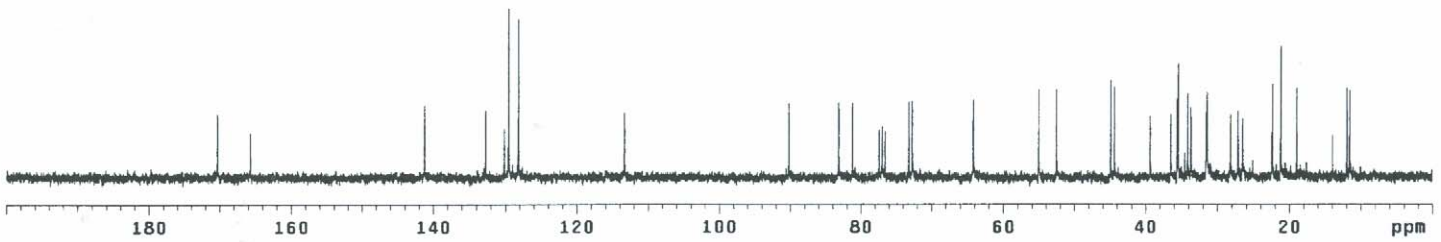

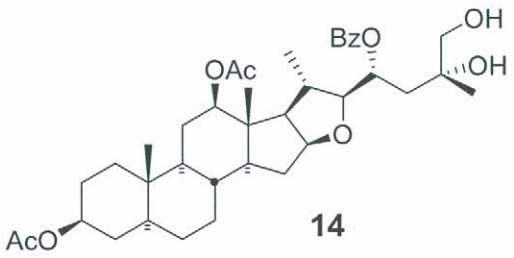

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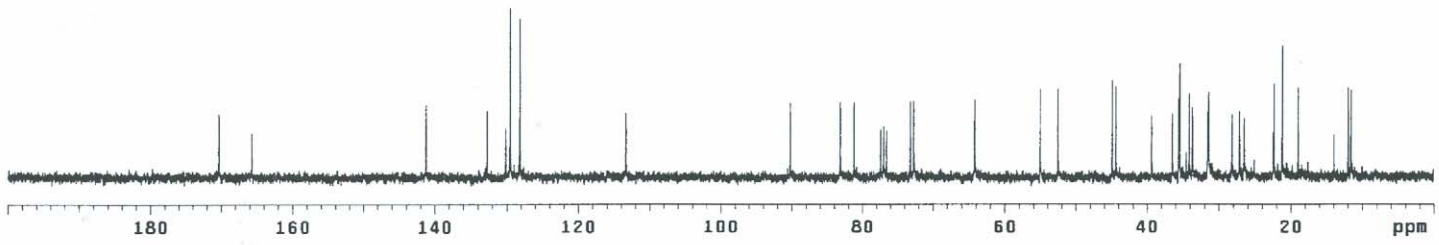

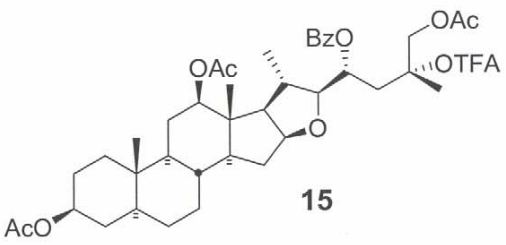

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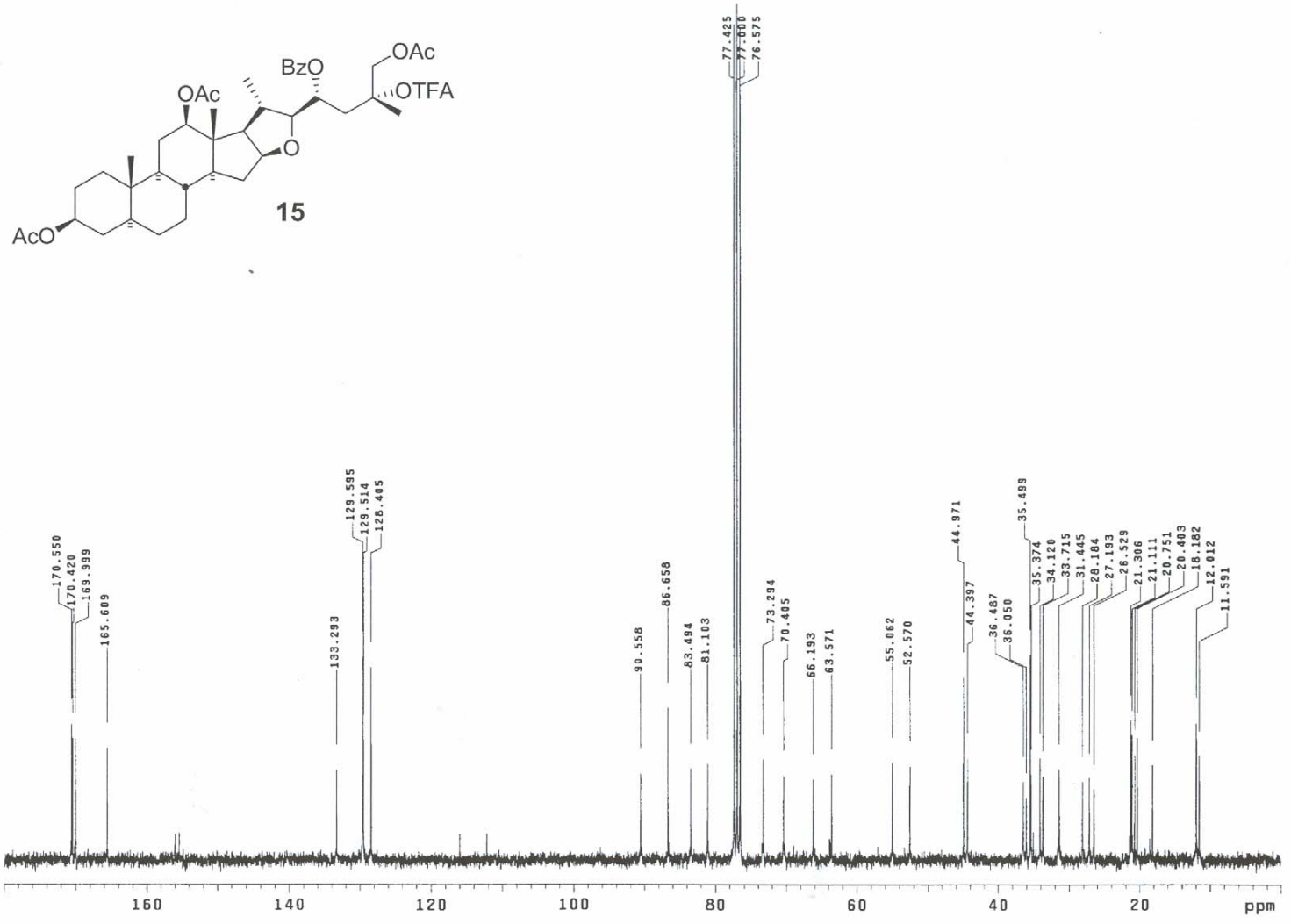
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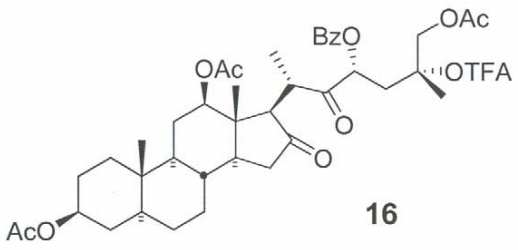

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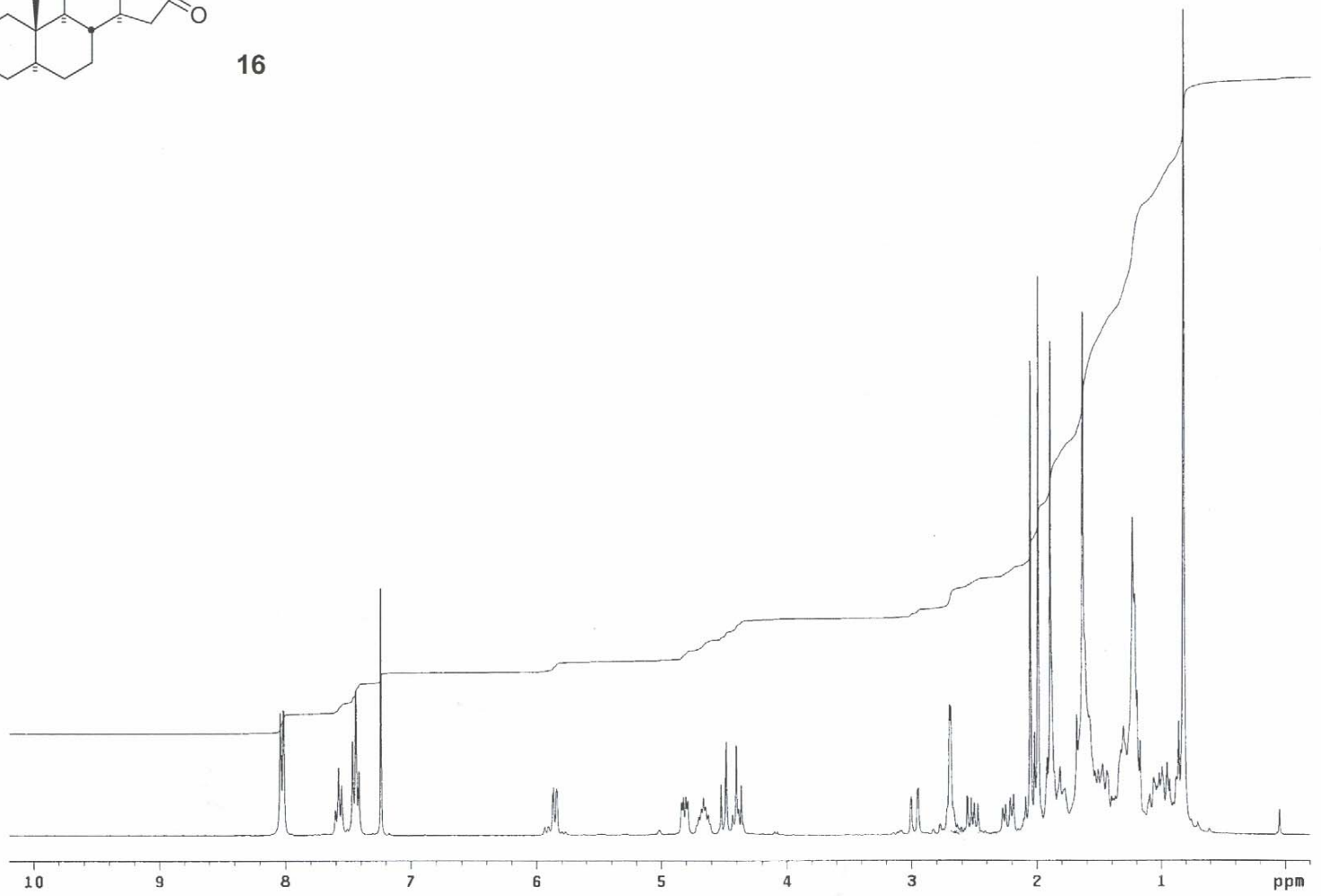

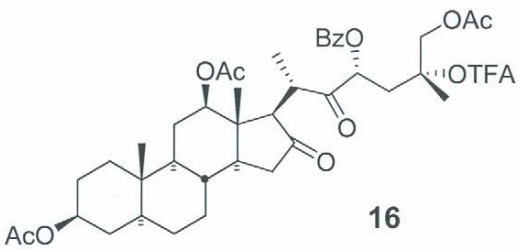

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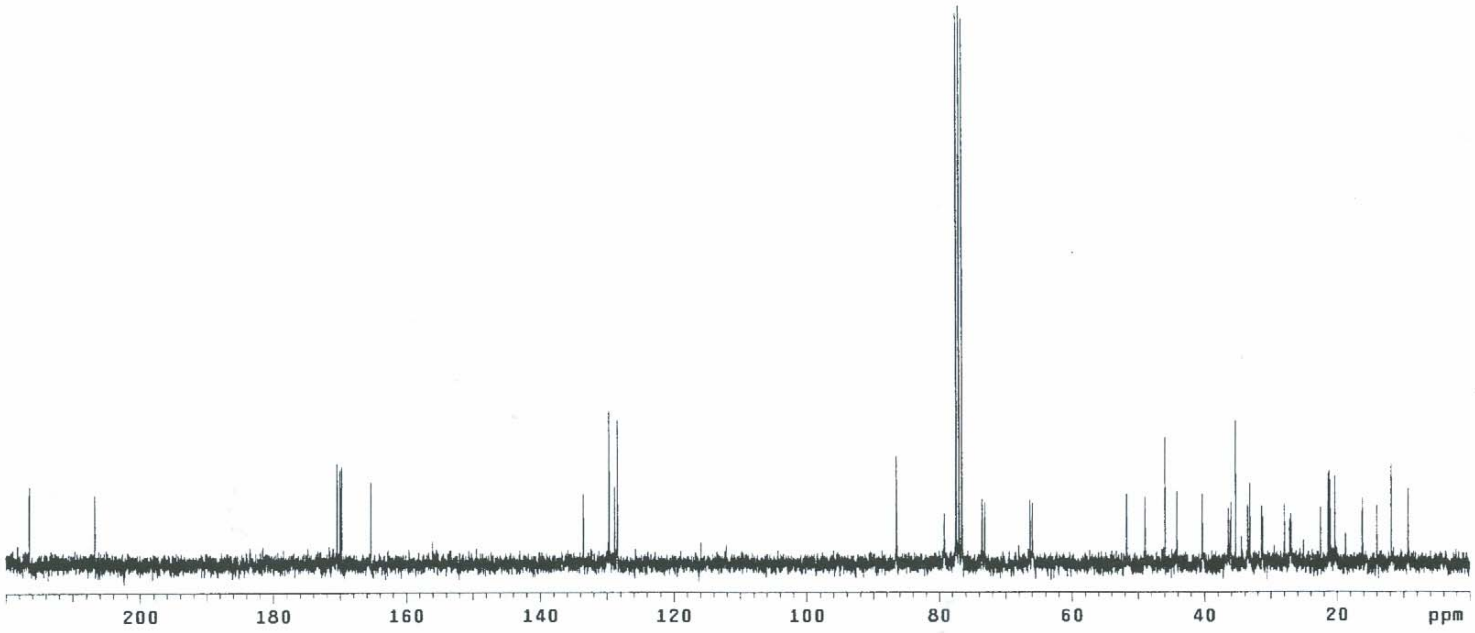

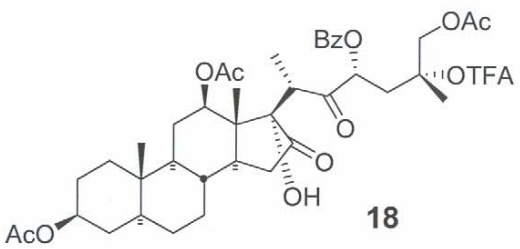

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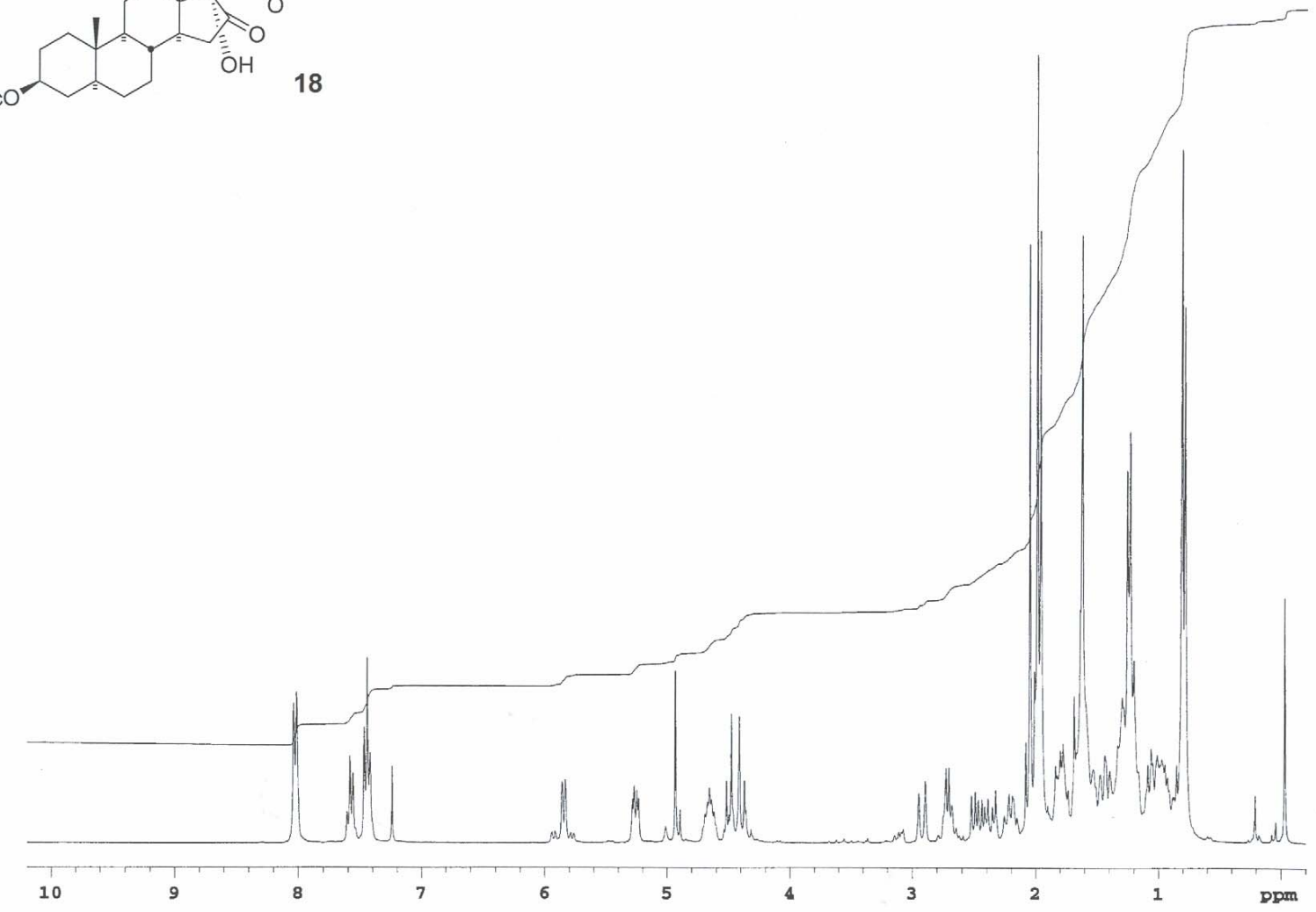

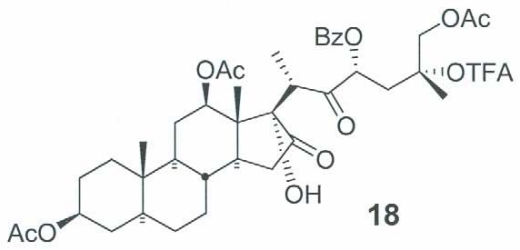

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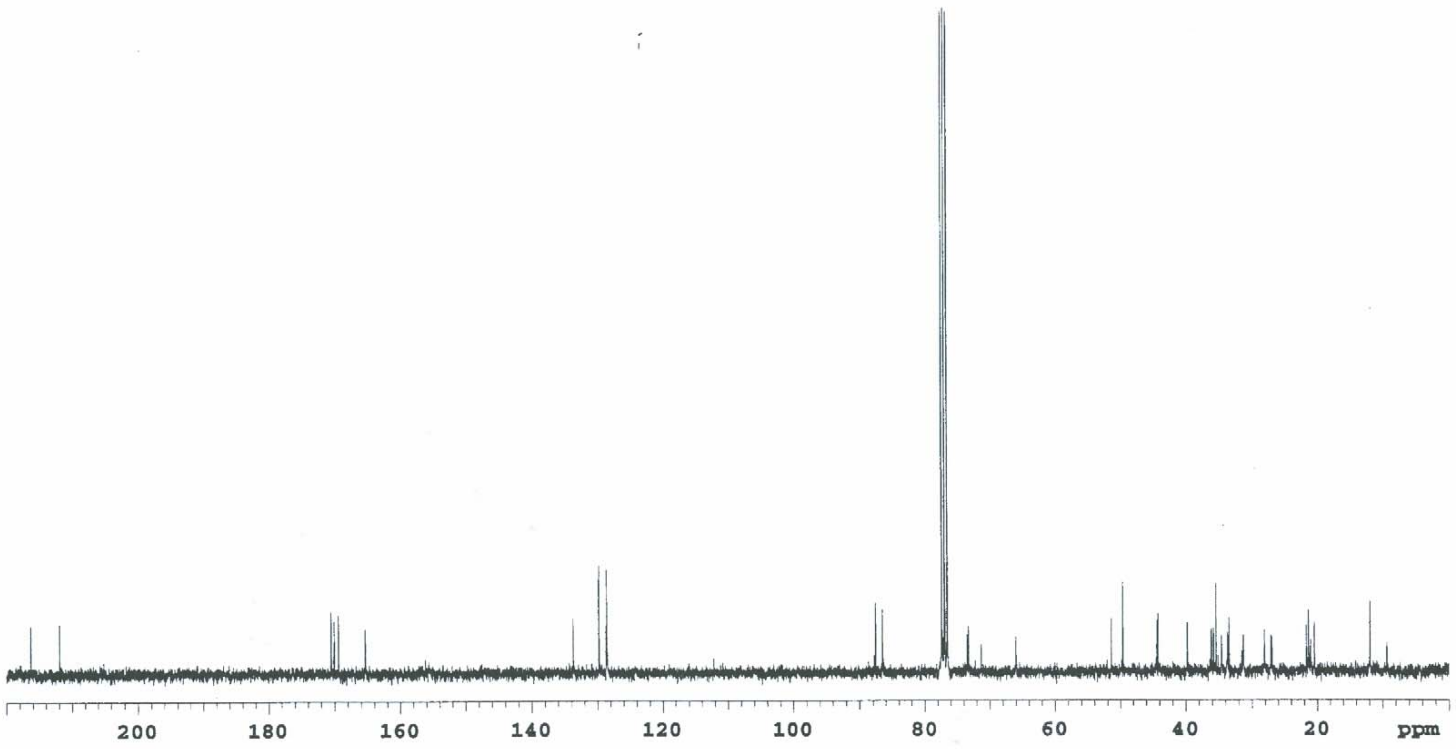

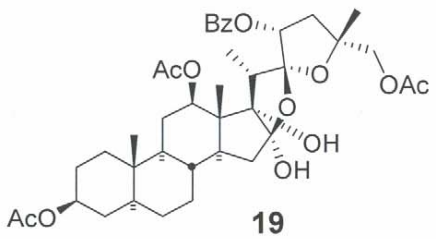

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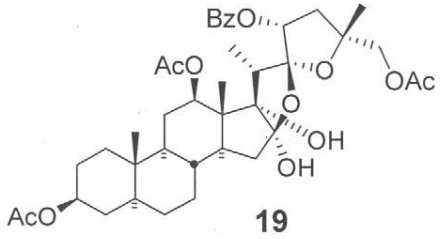
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AcO

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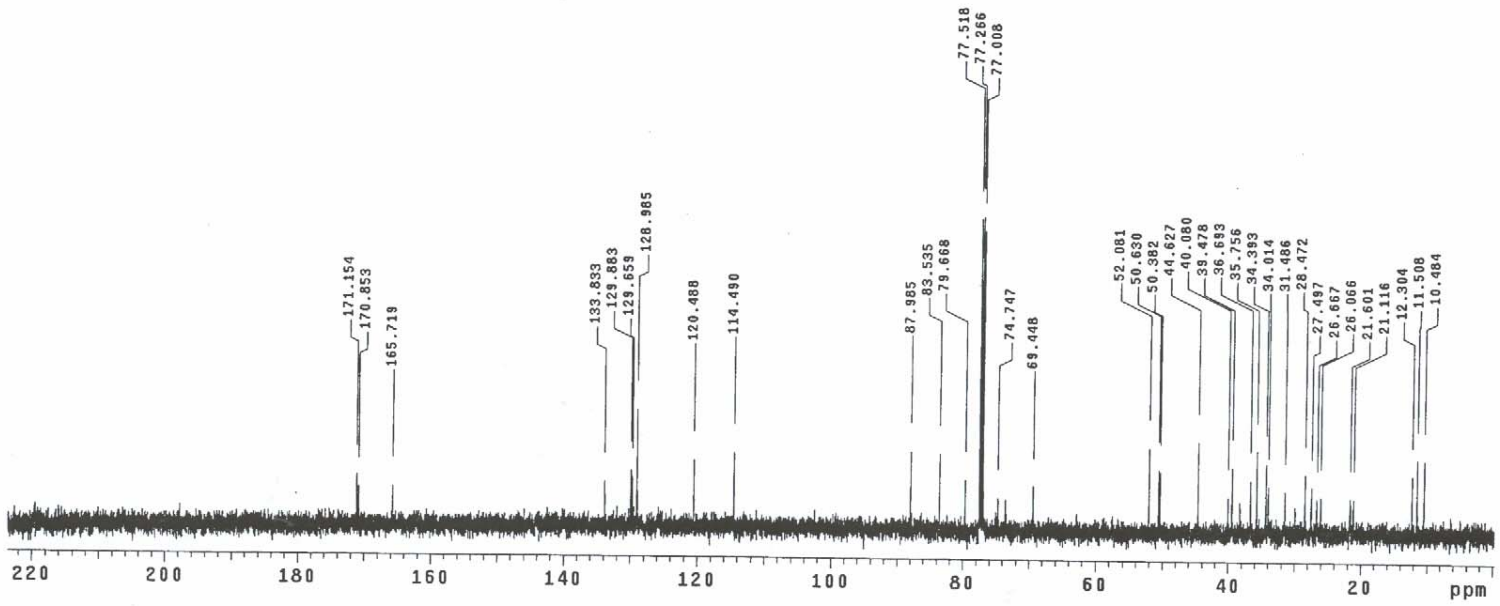
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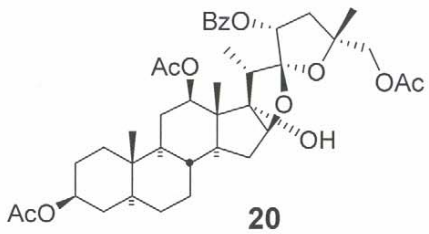

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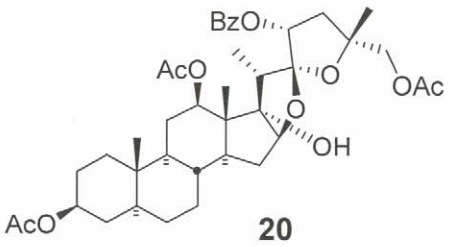
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OH
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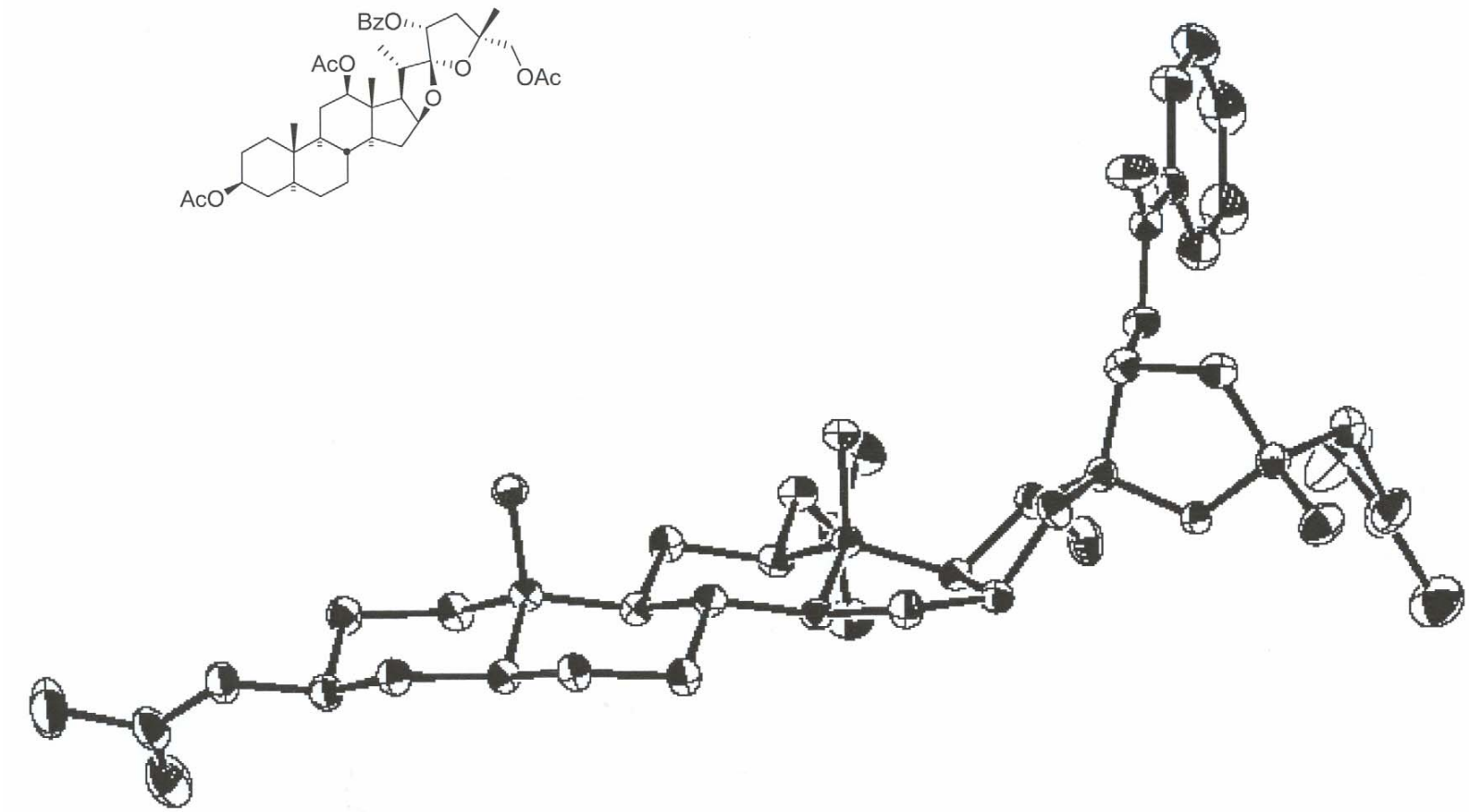
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