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SUPPORTING INFORMATION

Title: Total Synthesis of L-(+)-Swainsonine and Other Indolizidine Azasugars from D-Glucose
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Ref. No.: O200800649

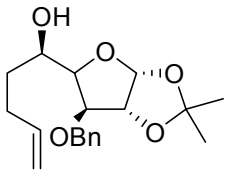
General Methods and Materials:

General: The ^{1}H NMR, COSY and NOE were recorded on JEOL-JNM 400 MHz and 500 MHz spectrometer. ^{13}C spectra were reported in 100 and 125 MHz spectrometer. The chemical shift values are reported in ppm using $CDCl_3$ as internal reference. Chemical shifts are reported in ppm downfield to tetramethyl silane. Coupling constants are reported and expressed in Hz; splitting patterns are designated as br (broad), s (singlet), d (doublet), dd (double doublet), q (quartet), dt (double triplet), ddd (doublet of a doublet of a doublet), m (multiplet). All reactions were carried out using freshly distilled and dry solvents. The visualization of spots on TLC plates was effected by exposure to iodine or spraying with 10% H_2SO_4 and charring. Column chromatography was performed over silica gel (100- 200 Mesh) using hexane and ethyl acetate as eluent. Rotation values were recorded on Autopol II automatic polarimeter at the wavelength of sodium D-line (589 nm) at 25 °C. Infrared spectra were recorded on Bruker Vector 22 FT–IR spectrometer and the absorption bands are reported in reciprocal centimeters (cm-1). Mass spectra were obtained from high resolution ESI mass spectrometer WATERS-HAB213.

General Procedure for inhibition assay: The enzymes and all the corresponding substrate were purchased from Sigma Aldrich Chemical Co. Inhibition studies of the bicyclic aza sugars **32, 33, 54** and **55** were determined by measuring the residual hydrolytic activities of the glycosidases. The substrate concentration (3 mM) were prepared in 0.025 M citrate buffer with pH 4.0, and test compounds were preincubated with the enzymes for 1 h at 37 ºC. The enzyme reaction was initiated by the addition of 100 µL substrate and the controls were run simultaneously in the absence of the test compound. The reaction was terminated at the end of the 10 min by the addition of 0.05 M borate buffer (pH 9.8) and the absorbance of the liberated *p*-nitrophenol was measured at 405 nm using Schimadzu spectrophotometer UV-160A. One unit of glycosidase activity is defined as the amount of enzyme that hydrolyzed 1 µM of p-nitrophenyl pyranoside per min at 25 ºC.[1]

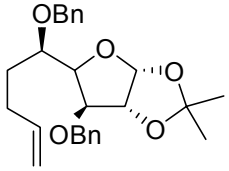
1. Y.-T. Li, S.C. Li. In *Methods in Enzymology*; Victor Ginsberg, Ed Academic, **1972**, 702.

1(1R)-1-((3aR,6S,6aR)-6-(Benzyloxy)-2,2-dimethyltetrahydrofuro[2,3-d][1,3]dioxol-5-yl)pent-4-en-1-ol (17):



A procedure similar to that described for the synthesis of **5** was employed (4.34 g, 95%). $[\alpha]^{25}_{D}$ + 1.5 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3410, 3066, 3031, 2984, 2931, 1640, 1497, 1454, 1382, 1311, 1217, 1092, 1023, 911, 739, 699. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (m, 5 H), 5.99 (d, *J* = 3.9 Hz, 1 H), 5.74 (m, 1 H), 4.93 (m, 2 H), 4.66 (d, *J* = 11.7 Hz, 1 H), 4.56 (d, *J* = 3.6 Hz, 1 H), 4.25 (d, *J* = 11.7 Hz, 1 H), 4.41 (d, *J* = 3.1 Hz, 1 H), 4.00 (d, *J* = 3.1 Hz, 1 H), 3.88 (m, 2 H), 2.20 (m, 1 H), 2.07 (m, 1 H) 1.66 (m, 2 H) 1.41 (s, 3 H), 1.25 (s, 3 H). ^{13}C NMR (100 MHz): δ 138.3 136.8, 128.7, 128.4, 128.0, 114.7, 111.6, 105.0, 82.0, 81.8, 71.8, 69.0, 33.4, 29.7, 26.7, 26.2. HMRS (ESI): calcd. for $C_{19}H_{26}O_5$ $[M+H]^+$ 335.1858, found 335.1821

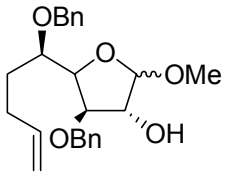
(3aR,6S,6aR)-6-(Benzyloxy)-5-((R)-1-(benzyloxy)pent-4-enyl)-2,2-dimethyltetrahydrofuro [2,3-d][1,3]dioxole (18):



A procedure similar to that described for the synthesis of **6** was employed (4.92g, 97% yield): $[\alpha]^{25}_{D}$ = - 6.7 (c = 0.7 CH_2Cl_2). IR (thin film, cm^{-1}): 3064, 3031, 2987, 2929, 1861, 1640, 1496, 1453, 1373, 1310, 1255, 1215, 1165, 1076, 1027, 911, 858, 736, 698. ^{1}H NMR (400 MHz, $CDCl_3$), δ 7.33-7.24 (m, 10 H), 5.90 (d, *J* = 3.6 Hz, 1 H), 5.87 (m, 1 H), 5.03 (dd, *J* = 1.7, 17.3 Hz, 1 H), 4.94 (dd, *J* = 1.7, 10.0 Hz, 1 H), 4.65 (d, *J* = 11.4 Hz, 1 H), 4.62 (d, *J* = 3.9 Hz, 1 H), 4.57 (d, *J* = 11.2 Hz, 1 H), 4.49 (d, *J* = 11.6 Hz, 1 H), 4.42 (d, *J* = 11.2 Hz, 1 H), 4.15 (dd, *J* = 2.9, 9.0 Hz, 1 H), 4.09 (d, *J* = 2.9

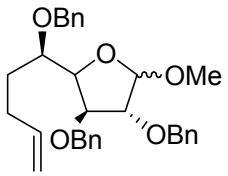
Hz, 1 H), 3.93 (m, 1 H), 2.24 (m, 2 H), 1.92 (m, 1 H), 1.79 (m, 1 H), 1.48 (s, 3 H), 1.31 (s, 3 H). ^{13}C NMR (100 MHz): δ 138.8, 137.6, 128.4, 128.3, 127.8, 127.5, 127.4, 114.3, 111.6, 104.9, 81.8, 81.1, 75.1, 71.8, 30.6, 28.5, 26.8, 26.3. HRMS (ESI): calcd. for $C_{26}H_{32}O_5$ $[M+H]^+$ 425.2328, found 425.2315.

(3R,4R)-4-(Benzyloxy)-5-((R)-1-(benzyloxy)pent-4-enyl)-2-methoxytetrahydrofuran-3-ol (19):



A procedure similar to that described for the synthesis of **7** was employed (4.22 g, 98% yield). $[\alpha]^{25}_D$ = - 1.5 (c = 0.50, CH_2Cl_2). IR (thin film, cm^{-1}): 3428, 3064, 3030, 2924, 1741, 1640, 1453, 1396, 1208, 1109, 1027, 931, 809, 736, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34-7.24 (m, 10 H), 5.83 (m, 1 H), 5.05-4.99 (m, 2 H), 4.93 (m, 1 H), 4.70 (d, *J* = 11.7 Hz, 1 H), 4.52 (d, *J* = 12.2 Hz, 1 H), 4.46 (m, 2 H), 4.24 (m, 1 H), 4.18 (dd, *J* = 4.6, 7.6 Hz, 2 H), 4.03 (dd, *J* = 1.9, 4.3 Hz, 1 H), 3.86 (dd, *J* = 3.6, 7.3 Hz, 1 H), 3.46 (s, 3 H), 2.98 (m, 1 H), 2.22 (m, 2 H), 1.86 (m, 1 H), 1.74 (m, 1 H). ^{13}C NMR (100 MHz): δ 138.8, 138.6, 137.5, 130.4, 128.4, 128.3, 127.9, 127.8, 127.5, 127.4, 127.4, 127.0, 126.8, 126.3, 114.3, 111.5, 108.4, 104.8, 81.9 81.8, 81.0, 75.0, 72.8, 71.8, 71.7, 48.8, 30.6, 29.6, 28.4, 27.7, 26.2. HRMS (ESI): calcd. for $C_{24}H_{30}O_5$ $[M+H]^+$ 399.2179, found 399.2159.

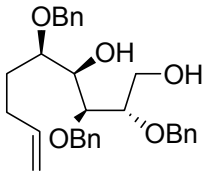
(3S,4R)-3,4-Bis(benzyloxy)-2-((R)-1-(benzyloxy)pent-4-enyl)-5-methoxytetrahydrofuran (20):



A procedure similar to that described for the synthesis of **8** was employed (4.65 g, 95% yield). $[A]^{25}_D$ = + 30 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3064, 3030, 2923, 1496, 1453, 1357, 1205, 1191, 1098, 1050, 735, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.58-78.15 (m, 15 H), 5.82 (m, 1 H),

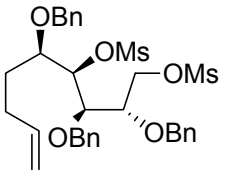
5.15 (dd, *J* = 10.2, 18.8 Hz, 1 H), 4.98 (d, *J* = 17.0 Hz, 1 H), 4.91 (m, 2 H), 4.65 (d, *J* = 11.9 Hz, 1 H), 4.58-4.45 (m, 4 H), 4.29 (t, 1 H), 4.24 (t, *J* = 4.1 Hz, 1 H), 3.79 (t, *J* = 4.1 Hz, 1 H), 3.79 (d, *J* = 3.4 Hz, 1 H), 3.41 (s, 3 H), 2.19 (m, 2 H), 1.78 (m, 2 H). ^{13}C NMR (100 MHz): δ 143.5, 141.1, 139.0, 138.7, 138.0, 137.6, 129.8, 129.4, 128.0, 127.8, 127.5, 127.3, 127.1, 114.3, 101.0, 83.8, 82.1, 76.6, 76.2, 72.6, 72.1, 71.5, 59.2, 55.3, 29.8, 29.0. HRMS (ESI): calcd. for $C_{31}H_{36}O_5$ $[M+H]^+$ 489.2641, found 489.2635.

(2S,3S,4R,5R)-2,3,5-Tris(benzyloxy)non-8-ene-1,4-diol (21):



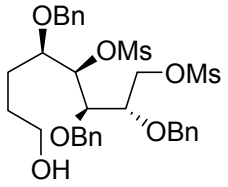
A procedure similar to that described for the synthesis of **9** was employed (2.90 g, 88% yield) as a viscous liquid. $[\alpha]^{25}_D$ = + 2.87 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3435, 3063, 3030, 2924, 2868, 1639, 1495, 1453, 1395, 1207, 1098, 1068, 911, 735, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (m, 15 H) 5.83 (m, 1 H), 5.03 (m, 2 H), 4.57 (m, 4 H), 4.42 (d, *J* = 11.4, 1 H), 4.29 (d, *J* = 11.4 Hz, 1 H), 3.90 (d, *J* = 5.6 Hz, 1 H), 3.79 (br s, 3 H), 3.62 (m, 1 H), 3.49 (m, 1 H), 2.81 (m, 1 H), 2.63 (m, 1 H), 2.19 (m, 1 H), 1.82 (m, 2 H,), 1.25 (br s, 1 H,). ^{13}C NMR (100 MHz): δ 138.6, 138.4, 137.9, 137.7, 128.4, 128.3, 127.9, 127.9, 128.8, 127.6, 127.5, 114.5, 78.7, 77.9, 75.3, 73.5, 72.0, 71.1, 69.7, 60.5, 28.9, 28.5. HRMS (ESI): calcd. for $C_{30}H_{36}O_5$ $[M+H]^+$ 477.2641, found 477.2638.

(2S,3R,4R,5R)-2,3,5-Tris(benzyloxy)non-8-ene-1,4-diyl dimethanesulfonate (22):



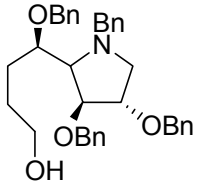
A procedure similar to that described for the synthesis of **10** was employed (3.30 g, 96% yield). $[\alpha]^{25}_{D}$ = + 2.3 (c = 0.3, CH_2Cl_2). IR (thin film, cm^{-1}): 3088, 3063, 3031, 2934, 2873, 1817, 1496, 1454, 1353, 1210, 1173, 1065, 936, 823, 742, 700. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (m, 15 H), 5.70 (m, 1 H), 5.20 (dd, *J* = 2.2, 5.1 Hz, 1 H), 4.64 (m, 2 H), 4.82 (d, *J* = 11.2 Hz, 1 H), 4.66 (d, *J* = 11.4 Hz, 1 H), 4.60 (d, *J* = 10.7 Hz, 1 H), 4.52 (d, *J* = 11.2, 1 H), 4.47 (d, *J* = 11.4 Hz, 1 H), 4.39 (d, *J* = 11.76 Hz, 1 H), 4.34 (d, *J* = 11.7 Hz, 1 H), 4.31 (d, *J* = 11.7 Hz, 1 H), 3.77 (dd, *J* = 4.4, 9.0 Hz, 1 H), 3.69 (dd, *J* = 4.4, 7.3 Hz, 1 H), 3.61 (d, *J* = 9.76 Hz, 1 H), 3.01 (s, 3 H), 2.92 (s, 3 H), 2.48 (m, 1 H), 1.96 (m, 1 H), 1.70 (m, 1 H), 1.53 (m, 1 H). ^{13}C NMR (100 MHz): δ 138.2, 137.8 137.5, 137.2 128.9, 128.8, 128.7, 128.6, 128.5, 128.4, 128.2, 115.6, 82.9, 78.0, 77.6, 76.6, 75.2, 73.3, 72.3, 68.4, 39.4, 37.5, 30.0, 29.4. HRMS (ESI): calcd. for $C_{39}H_{40}O_9S_2$ $[M+H]^+$ 633.2192, found 633.2180.

(2S,3R,4R,5R)-2,3,5-Tris(benzyloxy)-8-hydroxyoctane-1,4-diyl dimethanesulfonate (24):



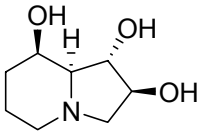
A procedure similar to that described for the synthesis of **11** was employed (1.35 g, 90% yield). $[A]^{25}_{D}$ = - 35 (c = 0.25, CH_2Cl_2). IR (thin film, cm^{-1}): 3064, 3031, 2936, 1745, 1640, 1496, 1355, 1174, 1069, 938, 825, 747, 699. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35-7.25 (m, 15 H), 4.92 (t, *J* = 4.8, Hz, 1 H), 4.70 (s, 3 H), 4.67 (d, *J* = 6.3 Hz, 1 H), 4.58 (d, *J* = 11.4 Hz, 1 H), 4.51 (d, *J* = 11.72 Hz 1 H), 4.44- 4.39 (m, 2 H), 4.31 (dd, *J* = 4.1, 11.0, 1 H), 3.95 (t, *J* = 5.1 Hz, 1 H), 3.86 (q, *J* = 5.1, 9.0 Hz, 1 H), 3.70 (q, *J* = 5.3, 10.4 Hz, 1 H), 3.56 (m, 2 H), 2.94 (s, 3 H), 2.91 (s, 3 H), 1.60 (m, 2 H), 1.55-1.46 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 137.2, 128.5, 128.2, 128.1, 128.0, 80.2, 76.4, 75.6, 74.5, 73.1, 71.7, 68.6, 62.3, 38.6, 37.2, 27.8, 25.7. HRMS (ESI): calcd. for $C_{31}H_{40}O_{10}S_2$ $[M+H]^+$ 637.2141, found 637.2121.

(4R)-4-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-4-(benzyloxy)butan-1-ol (25):



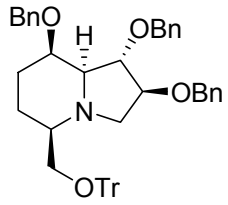
A procedure similar to that described for the synthesis of **14** was employed (1.56 g, 90% yield). $[\alpha]^{25}_{D}$ = +5.6 (c = 1.2, CH_2Cl_2). IR (thin film, cm^{-1}): 3391, 3062, 3029, 2924, 1604, 1495, 1453, 1369, 1208, 1091, 1027, 736, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (m, 20 H),m 4.93 (d, J = 12.3 Hz, 1 H), 4.54- 4.40 (m, 5 H), 4.31 (d, J = 13.4 Hz, 1 H), 4.08 (d, J = 4.9 Hz, 1 H), 3.93 (d, J = 4.6 Hz, 1 H), 3.67 (d, J = 2.4 Hz, 1 H), 3.57 (d, J = 5.8 Hz, 2 H), 3.25 (d, J = 13.4 Hz, 1 H), 3.10 (d, J = 11.2 Hz, 1 H), 2.81 (dd, J = 2.6, 5.1 Hz, 1 H), 2.43 (dd, J = 5.3, 10.9 Hz, 1 H), 1.77- 1.62 (m, 5 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.1, 138.7, 138.2, 138.1, 128.4, 128.3, 128.2, 128.1, 127.8, 127.6, 127.5, 127.4, 126.8, 85.0, 81.2, 78.1, 72.5, 72.4, 71.6, 70.7, 62.8, 59.6, 57.5, 29.6, 28.1. HRMS (ESI): calcd. for $C_{36}H_{41}NO_4$ $[M+H]^+$ 552.3114, found 552.3108.

(1S,2S,8R,8aS)-Octahydroindolizine-1,2,8-triol (26):



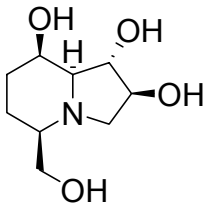
A procedure similar to that described for the synthesis of **2** was employed (149 mg, 78% yield). $[\alpha]^{25}_{D}$ = + 60.0 (c = 1.0, MeOH). IR (thin film, cm^{-1}): 3430, 2924, 2854, 1635, 1547, 1463, 1382, 1164, 1020. ^{1}H NMR (400 MHz, 50% $CDCl_3$ in DMSO): δ 3.85 (br s, 1 H), 3.83 (br s, 1 H), 3.76 (d, J = 6.3 Hz, 1 H), 2.85 (d, J = 9.0 Hz, 1 H), 2.75 (d, J = 9.7 Hz, 1 H), 2.39 (dd, J = 6.8, 9.5 Hz, 1 H), 1.90 (m, 1 H), 1.77 (m, 2 H), 1.38-1.17 (m, 3 H). ^{13}C NMR (100 MHz, 50% $CDCl_3$ in DMSO): δ 78.9, 76.1, 73.6, 62.7, 61.6, 52.7, 31.1, 19.2. HRMS (ESI): calcd. for $C_8H_{15}NO_3$ $[M+H]^+$ 174.1130, found 174.1118.

(1S,2S,5S,8R,8aS)-1,2,8-Tris(benzyloxy)-5-(trityloxymethyl)octahydroindolizine (31):



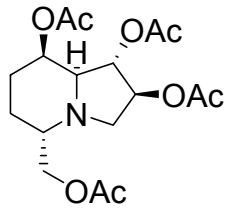
(0.43 g, 38% yield). $[\alpha]^{25}_{D}$ + 5.3 (c = 0.6, CH_2Cl_2). IR (thin film, cm^{-1}): 3366, 3060, 3030, 2926, 1600, 1492, 1450, 1359, 1206, 1152, 1089, 1028, 744, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.44-7.11 (m, 30 H), 4.53 (d, *J* = 12.4 Hz, 1 H), 4.50 (d, *J* = 11.9 Hz, 1 H), 4.37-4.28 (m, 3 H), 4.21 (d, *J* = 11.2 Hz, 1 H), 4.08 (dd, *J* = 2.6, 9.2 Hz, 1 H), 3.83 (dd, *J* = 2.6, 6.1 Hz, 1 H), 3.66 (br s, 1 H), 3.28 (dd, *J* = 5.4, 9.2 Hz, 1 H), 3.17 (d, *J* = 10.7 Hz, 1 H), 3.08 (dd, *J* = 6.1, 15.6 Hz, 1 H), 2.34 (dd, *J* = 6.8, 10.5 Hz, 1 H), 2.23 (m, 1 H), 2.10-2.03 (m, 2 H), 1.70 (m, 1H), 1.57 (m, 1 H), 1.28 (m, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 137.2, 137.0, 125.5, 128.3, 128.1, 127.9, 127.7, 127.5, 126.7, 79.4, 79.3, 76.2, 75.6, 74.4, 73.2, 72.1, 71.1, 68.8, 39.3, 38.6, 37.2, 29.6, 22.0. HRMS (ESI): calcd. for $C_{49}H_{49}NO_4$ $[M+H^+]$ 716.3740, found 716.3732.

(1S,2S,5R,8R,8aS)-5-(Hydroxymethyl)octahydroindolizine-1,2,8-triol (33):



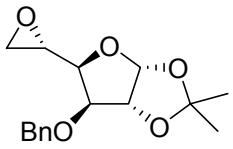
$[\alpha]^{25}_{D}$ = + 0.82 (c = 0.2 CH_2Cl_2). IR (thin film, cm^{-1}): 3384, 3060, 2933, 1678, 1492, 1453, 1266, 1204, 1057, 738, 700. HRMS (ESI): calcd. for $C_9H_{17}NO_4$ $[M+H]^+$ 204.1236, found 204.1222.

(1S,2S,5S,8R,8aS)-5-(Acetoxymethyl)octahydroindolizine-1,2,8-triyl triacetate (35):



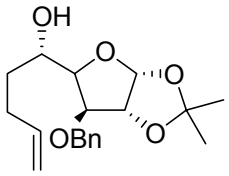
A procedure similar to that described for the synthesis of **34** was employed (25 mg, 97 % yield). $[\alpha]^{25}_{D}$ = + 0.93 (c = 0.3 CH_2Cl_2). IR (thin film, cm^{-1}): 2960, 2927, 2855, 1739, 1651, 1551, 1428, 1374, 1260, 1104, 1028. ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.18 (dd, *J* = 3.2, 8.6 Hz, 1 H), 5.07 (dd, *J* = 3.4, 6.3 Hz, 1 H), 5.01 (d, *J* = 2.4 Hz, 1 H), 4.10 (dt, *J* = 6.1, 11.7 Hz, 2 H), 3.29 (d, *J* = 11.4 Hz, 1 H), 2.72 (dd, *J* = 7.3, 11.4 Hz, 1 H) 2.34-2.28 (m, 2 H), 2.17 (s, 3 H), 2.10 (s, 3 H), 2.08-2.09 (m, 1 H), 2.07 (s, 3 H), 2.06 (s, 3 H), 2.05 (s, 3 H), 1.63-1.53 (m, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ170.9, 170.8, 170.6, 170.0, 76.2, 75.7, 68.9, 66.7, 65.0, 61.6, 58.0, 27.6, 23.2, 21.2, 21.0, 20.9, 20.7. HRMS (ESI): calcd. for $C_{17}H_{25}NO_7$ $[M+H]^+$ 372.1658, found 372.1657.

(3aR,5R,6S,6aR)-6-(Benzyloxy)-2,2-dimethyl-5-((S)-oxiran-2-yl)tetrahydrofuro[2,3-d] [1,3]dioxole (37):



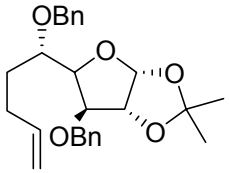
A procedure similar to that described for the synthesis of **4** was employed (5 g, 69 % yield). $[\alpha]^{25}_{D}$ = - 5.2 (c = 0.8, CH_2Cl_2). IR (thin film, cm^{-1}): 3061, 3030, 2988, 2933, 1603, 1455, 1375, 1216, 896, 857, 740, 699. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37-7.28 (m, 5 H), 5.00 (d, *J* = 3.6 Hz, 1 H), 4.74 (d, *J* = 12.2 Hz, 1 H), 4.64 (d, *J* = 3.6 Hz, 1 H), 4.52 (d, *J* = 12.2 Hz, 1 H), 3.97 (d, *J* = 3.6 Hz, 1 H), 3.80 (dd, *J* = 3.6, 6.3 Hz, 1 H), 3.27 (m, 1 H), 2.76 (t, *J* = 4.3 Hz, 1 H), 2.54 (dd, *J* = 2.6, 4.8 Hz, 1 H), 1.54 (s, 3 H), 1.32 (d, 3 H). ^{3}C NMR (100 MHz, $CDCl_3$): δ 137.2, 128.4, 128.0, 127.6, 111.8, 105.4, 105.3, 71.9, 71.9, 71.8, 50.1, 50.0, 43.0, 26.8, 26.2.

(1S)-1-((3aR,6S,6aR)-6-(Benzyloxy)-2,2-dimethyltetrahydrofuro[2,3-d][1,3]dioxol-5-yl) pent-4-en-1-ol (38):



A procedure similar to that described for the synthesis of **5** was employed (5.5 g, 95 % yield) $[\alpha]^{25}_{D}$ + 3.2 (c = 1.0, CH_2Cl_2). IR (thin film, cm^{-1}): 3428, 2985, 2950, 2935, 2902, 2872, 1456, 1374, 1317, 1287, 1248, 1220, 1162, 1120, 1065, 1031, 963, 885, 847, 784. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31-7.19 (m, 5 H), 5.92 (d, *J* = 3.8 Hz, 1 H), 5.72 (m, 1 H), 4.95 (d, *J* = 17.3 Hz, 1 H), 4.87 (d, *J* = 10.2 Hz, 1 H), 4.65 (d, *J* = 11.7 Hz, 1 H), 4.59 (d, *J* = 3.8 Hz, 1 H), 4.39 (d, *J* = 11.7 Hz, 1 H), 3.95 (dd, *J* = 3.6, 5.6 Hz, 1 H), 3.91 (m, 1 H), 3.88 (d, *J* = 3.6 Hz, 1 H), 2.20 (m, 1 H), 2.07 (m, 1 H), 1.52 (m, 1 H), 1.42 (s, 3 H), 1.35 (m, 1 H), 1.26 (s, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 138.3, 136.8, 128.7, 128.3, 128.0, 114.7, 111.5, 105.0, 82.1, 82.0, 81.9, 81.8, 71.9, 71.8, 71.7, 69.0, 33.5, 29.7, 26.7. HRMS (ESI): calcd. for $C_{19}H_{26}O_5$ $[M+H]^+$ 335.1858, found 335.1822.

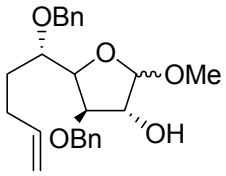
(3aR,6S,6aR)-6-(Benzyloxy)-5-((S)-1-(benzyloxy)pent-4-enyl)-2,2-dimethyltetra hydrofuro[2,3-d][1,3]dioxole (39):



A procedure similar to that described for the synthesis of **6** was employed (5 g, 97 % yield) $[\alpha]^{25}_{D}$ = - 9.7 (c = 1.0, CH_2Cl_2). IR (thin film, cm^{-1}): 3068, 3031, 2982, 2928, 1734, 1639, 1377, 1214, 1078, 1025, 739. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38-7.22 (m, 10 H), 6.02, (d, *J* = 3.8 Hz, 1 H), 5.69 (m, 1 H), 3.92 (m, 3 H), 4.68 (d, *J* = 11.4 Hz, 1 H),4.63 (d, *J* = 3.9 Hz, 1 H), 4.52 (d, *J* = 11.2 Hz, 1 H), 4.42 (d, *J* = 11.7 Hz, 1 H), 4.19 (dd, *J* = 3.2, 8.3 Hz, 1 H), 3.86 (d, *J* = 3.4 Hz, 1 H), 3.78 (m, 1 H),

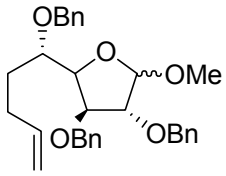
2.25 (m, 1H), 2.12 (m, 1 H), 1.49 (s, 3 H), 1.45 (m, 2 H), 1.33 (s, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.2, 138.3, 136.9, 12.8.5, 128.2, 128.1, 128.0, 127.3, 114.7, 111.5, 105.1, 84.3, 82.3, 81.3, 73.3, 71.6, 30.6, 29.6, 26.7, 26.3. HRMS (ESI): calcd. for $C_{26}H_{32}O_5$ $[M+H]^+$ 425.2328, found 425.2315.

(3R,4R)-4-(Benzyloxy)-5-((S)-1-(benzyloxy)pent-4-enyl)-2-methoxytetrahydrofuran-3-ol (40):



A procedure similar to that described for the synthesis of **7** was employed (4.50 mg, 98 % yield) $[\alpha]^{25}_D$ = - 2.90 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3428, 3064, 2924, 1640, 1496, 1453, 1358, 1208, 1109, 1052, 1027, 736, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.40-7.24 (m, 10 H), 5.72 (m, 1 H), 4.98-4.87 (m, 3 H), 4.69 (d, *J* = 11.7 Hz, 1 H), 5.99 (d, *J* = 10.7, 1 H), 4.42 (d, *J* = 11.9 Hz, 1 H), 4.27 (d, *J* = 4.1 Hz, 1 H), 4.19 (dd, *J* = 4.6, 8.3 Hz, 1 H), 3.82 (t, *J* = 4.6 Hz, 1 H), 3.78 (d, *J* = 4.6 Hz, 1 H), 3.48 (s, 3 H), 2.20 (m, 1 H), 2.15 (m, 1 H), 1.82 (d, *J* = 4.3 Hz, 1 H), 1.45 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.2, 138.5, 137.2, 128.3, 127.9, 127.3, 114.6, 110.2, 84.9, 82.6, 78.3, 78.1, 73.8, 71.7, 56.2, 30.7, 29.7. HRMS (ESI): calcd. for $C_{24}H_{30}O_5$ $[M+H]^+$ 399.2179, found 399.2156.

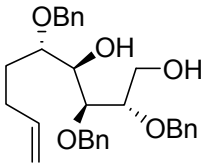
(3S,4R)-3,4-Bis(benzyloxy)-2-((S)-1-(benzyloxy)pent-4-enyl)-5-methoxytetrahydrofuran (41):



A procedure similar to that described for the synthesis of **8** was employed (4.00 mg, 95 % yield) $[\alpha]^{25}_D$ = - 1.2 (c = 0.2, CH_2Cl_2). IR (thin film, cm^{-1}): 3064, 3030, 2923, 1640, 1496, 1453, 1357, 1206, 1191, 1098, 1045, 735, 697. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35-7.25 (m, 15 H), 5.75 (m, 1 H), 4.98 (d, *J* = 17.1 Hz, 1 H), 4.93 (d, *J* = 10.2 Hz, 1 H), 4.87 (d, *J* = 3.8 Hz, 1 H), 4.71 (d, *J* = 10.6

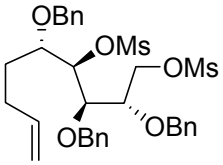
Hz, 1 H), 4.67 (dd, *J* = 2.4, 11.9 Hz, 2 H), 4.54 (d, *J* = 11.9 Hz, 1 H), 4.47 (dd, *J* = 6.6, 11.7 Hz, 2 H), 4.16 (m, 3 H), 3.63 (m, 1 H), 3.41 (s, 3 H), 2.13 (m, 2 H), 1.58 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.0, 138.4, 137.8, 128.4, 128.3, 128.1, 128.1, 127.9, 127.7, 127.3, 114.6, 100.8, 83.0, 82.0, 79.4, 73.1, 72.6, 72.2, 55.3, 30.7, 30.0. HRMS (ESI): calcd. for $C_{31}H_{36}O_5$ $[M+H]^+$ 489.2641, found 489.2635.

(2S,3S,4R,5S)-2,3,5-Tris(benzyloxy)non-8-ene-1,4-diol (42):



A procedure similar to that described for the synthesis of **9** was employed (3.8 mg, 88 % yield) $[\alpha]^{25}_D$ = - 2.90 (c = 0.2, CH_2Cl_2). IR (thin film, cm^{-1}): 3550, 3442, 3087, 3063, 3030, 2924, 2854, 1725, 1604, 1496, 1358, 1266, 1209, 1173, 1067, 1027, 959, 917, 819, 739, 699. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30-7.22 (m, 15 H), 5.73 (m, 1 H), 4.99-4.91 (m, 2 H), 4.69 (d, *J* = 11.4 Hz, 1 H), 4.65 (d, *J* = 11.4 Hz, 1 H), 4.57-4.58 (m, 4 H), 3.94 (s, 1 H), 3.81 (s, 1 H), 3.69 (s, 2 H), 3.49 (d, *J* = 4.1 Hz, 1 H), 2.91 (s, 1 H), 2.75 (s, 1 H), 2.14 (m, 1 H), 2.04 (m, 1 H), 1.62 (m, 1 H), 1.48 (m, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ138.2, 138.1, 138.0, 137.7, 128.4, 128.4, 128.3, 127.9, 127.9, 127.8, 127.7, 114.7, 79.4, 78.0, 73.3, 72.2, 72.1, 69.9, 60.4, 29.3, 29.2. HRMS (ESI): calcd. for $C_{30}H_{36}O_5$ $[M+H]^+$ 477.2641, found 477.2638.

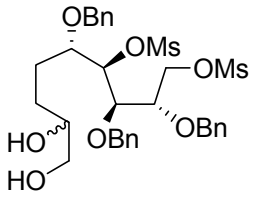
(2S,3R,4R,5S)-2,3,5-Tris(benzyloxy)non-8-ene-1,4-diyl dimethanesulfonate (43):



A procedure similar to that described for the synthesis of **10** was employed (3.50 mg, 96 % yield). $[\alpha]^{25}_D$ = + 2.40 (c = 0.3 CH_2Cl_2). IR (thin film, cm^{-1}): 3063, 3031, 2934, 2872, 1496, 1353, 1210,

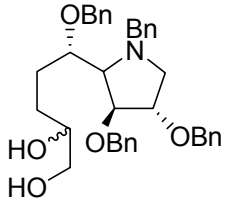
1067, 962, 921, 743, 700. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35-7.25 (m, 15 H), 5.73 (m, 1 H), 4.99-4.91 (m, 3 H), 4.69-4.62 (m, 3 H), 4.56 (d, J = 11.4 Hz, 1 H), 4.49 (d, J = 11.4 Hz, 1 H), 4.43 (d, J = 11.4 Hz, 1 H), 4.37 (d, J = 5.4 Hz, 1 H), 4.30 (dd, J = 3.8, 10.9 Hz, 1 H), 3.91 (t, J = 5.1 Hz, 1 H), 3.85 (dd, J = 5.1, 9.2 Hz, 1 H), 3.66 (m, 1 H), 2.94 (s, 3 H), 2.88 (s, 3 H), 2.07 (m, 2 H), 1.64 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 137.5, 137.4, 137.1, 137.0, 128.5, 128.4, 128.2, 128.0, 127.9, 115.3, 79.9, 76.2, 75.5, 74.4, 73.1, 71.8, 68.6, 38.6, 37.2, 29.1, 28.8.. HRMS (ESI): calcd. for $C_{39}H_{40}O_9S_2$ $[M+H]^+$ 633.2192, found 633.2180.

(2S,3R,4R,5S)-2,3,5-Tris(benzyloxy)-8,9-dihydroxynonane-1,4-diyl dimethanesulfonate (44):



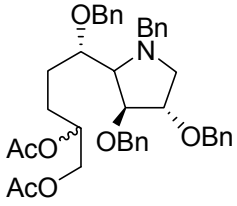
A procedure similar to that described for the synthesis of **23** was employed (2.50 g, 98% yield). $[\alpha]^{25}_{D}$ = + 2.52 (c = 0.4, CH_2Cl_2). IR (thin film, cm^{-1}): 3436, 3060, 2929, 2881, 1606, 1495, 1453, 1355, 1208, 1096, 1027, 912, 798. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36-7.25 (m, 15 H), 4.91 (m, 1 H), 4.68 (s, 2 H), 4.64 (d, J = 11.4 Hz, 1 H), 4.57 (dd, J = 5.8, 11.4 Hz, 1 H), 4.53 (d, J = 11.4 Hz, 1 H), 4.43-4.38 (m, 2 H), 4.30 (m, 1 H), 3.95 (dd, J = 4.8, 10 Hz, 1 H), 3.82 (m, 1 H), 3.67 (m, 1 H), 3.52 (m, 2 H), 3.36 (m, 1 H), 2.95 (s, 3 H), 2.91 (m, 3 H), 1.71 (m, 2 H), 1.38 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 137.4, 137.2, 128.5, 128.2, 128.0, 80.2, 76.6, 76.5, 75.7, 74.5, 73.1, 71.8, 71.7, 68.5, 66.4, 66.3, 38.6, 37.2, 28.2, 28.0, 25.2.. HRMS (ESI): calcd. for $C_{32}H_{42}O_{11}S_2$ $[M+H]^+$ 667.2247, found 667.2239.

(5S)-5-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-5-(benzyloxy)pentane-1,2-diol (45):



A procedure similar to that described for the synthesis of **14** was employed **(**3.00 g, 91% Yield). $[\alpha]^{25}_{D}$ = + 3.37 (c = 0.7, CH_2Cl_2). IR (thin film, cm^{-1}): 3429, 3087, 3062, 3030, 2926, 2868, 1954, 1811, 1667, 1495, 1207, 1094, 1056, 737, 698. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25-7.25 (m, 20 H), 4.91 (d, *J* = 11.4 Hz, 1 H), 4.60-4.52 (m, 4 H), 4.47 (t, *J* = 7.2 Hz, 1 H), 4.39 (d, *J* = 11.4 Hz, 1 H), 4.25 (dd, *J* = 4.8, 9.7 Hz, 1 H), 4.13 (d, *J* = 4.6 Hz, 1 H), 4.01 (dt, *J* = 3.6, 6.8 Hz, 1 H), 3.92 (br s, 1 H), 3.86 (d, *J* = 9.7 Hz, 1 H), 3.76 (t, *J* = 5.6 Hz, 1 H), 3.55-3.43 (m, 2 H), 3.31 (m, 2 H), 2.02 (m, 1 H), 1.56-1.45 (m, 4 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 138.9, 137.7, 137.4, 128.5, 128.2, 128.0, 127.6, 127.4, 84.4, 82.7, 81.2, 78.5, 78.0, 73.4, 71.7, 71.4, 66.7, 29.2, 28.7, 27.6, 27.2. HRMS (ESI): calcd. for $C_{37}H_{43}NO_5$ $[M+H]^+$ 582.3219, found 582.3215.

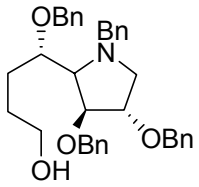
(5S)-5-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-5-(benzyloxy)pentane-1,2-diyl diacetate (46):



A procedure similar to that described for the synthesis of **15** was employed **(**50 mg, 98% Yield) $[\alpha]^{25}_{D}$ = + 5.20 (c = 0.7, CH_2Cl_2). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34-7.23 (m, 20 H), 5.06-5.00 (m, 1 H), 4.91 (t, *J* = 11.4 Hz, 1 H), 4.54 (d, *J* = 2.4 Hz, 1 H), 4.53 (s, 2 H), 4.49 (d, *J* = 3.1 Hz, 1 H), 4.46 (d, *J* = 3.2 Hz, 1 H), 4.29 (t, *J* = 13.4 Hz, 1 H), 4.18 (dt, *J* = 3.4, 11.9 Hz, 1 H), 4.11 (t, 1 H), 4.07 (d, *J* = 4.8 Hz, 1 H), 4.00-3.91 (m, 2 H), 3.67 (m, 1 H), 3.25 (d, *J* = 13.4 Hz, 1 H), 3.09 (d,

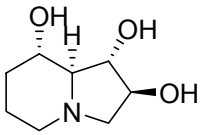
J = 10.9 Hz, 1 H), 2.77 (dd, *J* = 4.6, 7.3 Hz, 1 H), 2.43 (ddd, *J* = 3.2, 5.3, 8.5 Hz, 1 H), 2.02 (s, 3 H), 3.96 (s, 3 H), 1.80-1.75 (m, 2 H), 1.70-1.67 (m, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.0, 170.5, 139.1, 138.8, 138.2, 128.3, 128.0, 127.8, 127.8, 127.6, 127.5, 127.4, 126.8, 85.1, 84.9, 81.1, 77.7, 72.7, 72.4, 72.2, 71.7, 71.6, 71.0, 70.7, 65.2, 68.9, 59.6, 59.5, 57.5, 27.6, 27.4, 27.0, 26.9, 21.0, 20.9, 20.7.

(4S)-4-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-4-(benzyloxy)butan-1-ol (47):



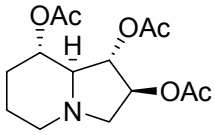
A procedure similar to that described for the synthesis of **14** was employed **(**2.50, 95% Yield) $[\alpha]^{25}_{D}$ = + 9.30 (c = 0.3, CH_2Cl_2). IR (thin film, cm^{-1}): 3395, 3062, 3029, 2924, 1604, 1495, 1449, 1369, 1209, 1091, 1027, 736, 700. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35-7.21 (m, 20 H), 4.94 (d, *J* = 11.4 Hz, 1 H), 4.68 (s, 2 H), 4.53 (d, *J* = 11.4 Hz, 1 H), 4.47 (d, *J* = 12.2 Hz, 1 H), 4.44 (d, *J* = 13.1 Hz, 1 H),4.40 (d, *J* = 12.2 Hz, 1 H), 4.30 (d, *J* = 13.4 Hz, 1 H), 4.09 (d, *J* = 4.8 Hz, 1 H), 3.93 (d, *J* = 5.3 Hz, 1 H), 3.66 (t, *J* = 4.8 Hz, 1 H), 3.55 (t, *J* = 6.3 Hz, 1 H), 3.25 (d, *J* = 13.4 Hz, 1 H), 3.10 (d, *J* = 11.0 Hz, 1 H), 2.81 (dd, *J* = 2.6, 5.1 Hz, 1 H), 2.43 (dd, *J* = 5.3, 10.9 Hz, 1 H), 1.78 (br s, 1 H), 1.72-1.66 (m, 2 H), 1.61 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.2, 138.8, 138.1, 128.3,127.6, 126.8, 85.2, 81.4, 78.2, 72.4, 71.7, 70.8, 62.8, 59.7, 59.5, 29.6, 28.1. HRMS (ESI): calcd. for $C_{36}H_{41}NO_4$ [M+H$^+$] 552.3114, found 552.3108.

Octahydro-indolizine-1,2,8-triol (48):



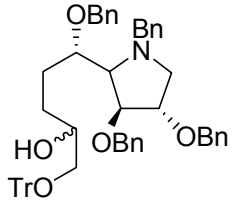
A procedure similar to that described for the synthesis of **2** was employed (149 mg, 78%) yield. $[\alpha]^{25}_{D}$ = + 20.35 (c = 0.8, MeOH). ^{1}H NMR (500 MHz, 50% d_6DMSO in $CDCl_3$): δ 3.84-3.75 (m, 3 H), 2.85 (d, *J* = 7.3 Hz, 1 H), 2.75 (d, *J* = 7.7 Hz, 1 H), 2.38 (t, *J* = 7.8 Hz, 1 H), 1.92-1.88 (m, 1 H), 1.83-1.75 (m, 3 H), 1.37-1.24 (m, 2 H). HRMS cald for $C_8H_{15}NO_3$ $[M+H]^+$ 174.1130, found 174.1122.

(1S,2S,8S,8aS)-Octahydroindolizine-1,2,8-triyl triacetate (49):



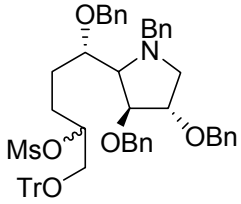
A procedure similar to that described for the synthesis of **15** was employed (84.68 mg, 98%): $[\alpha]^{25}_{D}$ = + 28 (c = 0.25, CH_2Cl_2). IR (thin film, cm^{-1}): 3086, 3062, 2927, 2864, 1337, 1644, 1495, 1359, 1174, 1095, 968, 738, 699. ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.18 (dd, *J* = 2.2, 7.5 Hz, 1 H), 4.99 (ddd, *J* = 0.7, 2.4, 3.2 Hz, 1 H), 4.78 (ddd, *J* = 4.6, 9.5, 14.1 Hz, 1 H), 3.02 (d, *J* = 11.0 Hz, 1 H), 2.95 (dt, *J* = 2.9, 10.7 Hz, 1 H), 2.72 (dd, *J* = 6.3, 11.0 Hz, 1 H), 2.17-2.09 (m, 1 H), 2.07-1.99 (m, 2 H), 2.08 (s, 3 H), 2.06 (s, 3 H), 1.97 (s, 3 H), 1.71 (m, 2 H), 1.27-1.19 (m, 2 H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.7, 169.9, 169.2, 80.5, 72.9, 69.7, 59.0, 51.5, 30.1, 23.3, 21.0, 20.8. HRMS (ESI): calcd. for $C_{14}H_{21}NO_6$ $[M+H]^+$ 300.1147, found 300.1138.

(5S)-5-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-5-(benzyloxy)-1-(trityloxy) pentan-2-ol (50):



A procedure similar to that described for the synthesis of **28** was employed (1.60 g, 80 % yield). $[\alpha]^{25}_{D}$ = + 1.40 (c = 0.2, CH_2Cl_2). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 1.4 Hz, 3 H), 7.41 (s, 3 H), 7.29-7.19 (m, 29 H), 4.89 (d, *J* = 11.4 Hz, 1 H), 4.51 (s, 1 H), 4.48 (d, *J* = 4.3 Hz, 2 H), 4.43 (d, *J* = 8.0 Hz, 2 H), 4.27 (d, *J* = 13.4 Hz, 1 Hz), 4.09 (d, *J* = 4.8 Hz, 1 Hz), 3.91 (d, *J* = 5.3 Hz, 1 Hz), 3.64 (m, 2 H), 3.23 (d, *J* = 15.2 Hz, 1 H), 3.09 (m, 2 H), 3.00 (m, 1 H), 2.75 (dd, *J* = 2.4, 4.8 Hz, 1 H), 2.41 (dd, *J* = 5.6, 11.4 Hz, 2 H), 1.78 (m, 1 H), 1.65 (m, 1 H), 1.54 (m, 1 H), .88 (m, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.0, 138.8, 138.2, 138.0, 128.6, 128.3, 128.2, 128.1, 128.0, 127.8, 127.7, 127.6, 127.3, 126.9, 88.4, 86.6, 82.1, 78.4, 72.8, 71.8, 71.0, 70.5, 66.6, 62.1, 55.7, 30.2, 27.9. HRMS (ESI): calcd. for $C_{56}H_{57}NO_5$ $[M+H]^+$ 824.4315, found 824.4309.

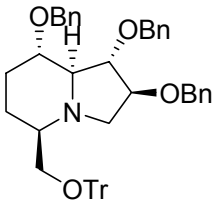
(5S)-5-((3S,4S)-1-Benzyl-3,4-bis(benzyloxy)pyrrolidin-2-yl)-5-(benzyloxy)-1-(trityloxy) pentan-2-yl methanesulfonate (51):



A procedure similar to that described for the synthesis of **29** was employed (1.50 g, 92% yield). $[\alpha]^{25}_{D}$ = + 3.62 (c = 0.5 CH_2Cl_2). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42-7.38 (m, 6 H), 7.32-7.18 (m, 29 H), 4.89 (d, *J* = 11.4 Hz, 1 H), 4.72 (br s, 1 H), 4.50 (d, *J* = 11.6 Hz, 1 H), 4.48 (s, 2 H), 4.47-4.39 (m, 3 H), 4.29 (d, *J* = 13.6 Hz, 1 H), 4.08 (m, 1 H), 3.91 (t, *J* = 5.4 Hz, 1 H), 3.52 (m, 1 H), 3.24 (m,

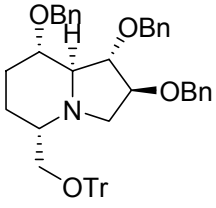
2 H), 3.08 (d, J = 11.0 Hz, 1 H), 2.88 (s, 3 H), 2.75 (dd, J = 2.4, 4.8 Hz, 1 H), 2.41 (q, J = 5.3, 10.9 Hz, 1 H), 1.85 (m, 1 H), 1.66 (m, 1 H), 1.27 (m, 1 H), 0.87 (m, 1 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 143.3, 143.3, 142.4, 139.2, 139.1, 138.8, 138.7, 138.3, 138.2, 138.1, 138.0, 128.6, 128.4, 128.3, 128.2, 128.0, 127.9, 127.7, 127.7, 127.6, 127.5, 127.4, 127.1, 126.8, 126.7, 87.0, 85.0, 83.1, 82.1, 81.2, 77.7, 76.8, 76.6, 72.6, 72.4, 71.6, 70.7, 70.6, 65.2, 59.4, 57.5, 38.5, 28.6, 28.3, 23.8, 26.7. HRMS (ESI): calcd. for $C_{56}H_{57}NO_7S$ $[M+H]^+$ 902.4090, found 902.4076.

(1S,2S,5R,8S,8aS)-1,2,8-Tris(benzyloxy)-5-(trityloxymethyl)octahydroindolizine (52):



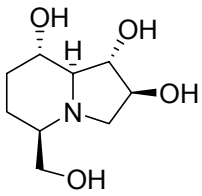
A procedure similar to that described for the synthesis of **30** was employed to synthesize **52** and **53** (0.48 g, 37% yield). $[\alpha]^{25}_D$ = + 8.35 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3086, 3061, 3030, 2924, 2855, 1747, 1599, 1493, 1451, 1369, 1223, 1075, 1028, 899, 737. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (s, 3 H), 7.41 (s, 3 H), 7.25 (m, 24 H), 4.59 (d, J = 11.7 Hz, 1 H), 4.51 (d, J = 11.7 Hz, 1 H), 4.48 (d, J = 10.5 Hz, 1 H), 4.39 (dd, J = 3.2, 12.2 Hz, 3 H), 3.92 (d, J = 1.9 Hz, 1 H), 3.81 (d, J = 1.4 Hz, 1 H), 3.34 (m, 2 H), 3.10 (m, 3 H), 2.95 (m, 1 H), 2.61 (m, 1 H), 2.09-1.78 (m, 2 H), 1.25 (m, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.0, 138.8, 138.2, 138.1, 128.6, 128.2, 128.0, 127.7, 127.3, 126.9, 88.5, 86.6, 82.1, 78.4, 72.8, 71.8, 71.0, 70.5, 66.6, 62.1, 55.7, 51.8, 30.3, 29.6, 27.9. HRMS (ESI): calcd. for $C_{49}H_{49}NO_4$ $[M+H]^+$ 716.3740, found 716.3729.

(1S,2S,5S,8S,8aS)-1,2,8-Tris(benzyloxy)-5-(trityloxymethyl)octahydroindolizine (53):



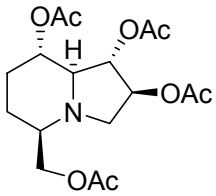
(0.50 g, 38% yield). $[\alpha]^{25}_D$ = + 5.80 (c = 1.0, CH_2Cl_2). IR (thin film, cm^{-1}): 2928, 2857, 1650, 1455, 1071, 868. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (d, *J* = 7.3 Hz, 6 H), 7.30-7.20 (m, 24 H), 4.62 (d, *J* = 11.7 Hz, 1 H), 4.51 (d, *J* = 11.2 Hz, 1 H), 4.48 (d, *J* = 10.9 Hz, 1 H), 4.42 (d, *J* = 12.2 Hz, 1 H), 4.32 (d, *J* = 12.4 Hz, 1 H), 3.83 (d, *J* = 5.8 Hz, 1 H), 3.37 (dt, *J* = 4.1, 10.0 Hz, 1 H), 3.18 (q, *J* = 5.6, 9.5 Hz, 1 H), 3.06 (m, 2 H), 2.43 (dd, *J* = 5.3, 10.4 Hz, 1 H), 2.32 (br d, *J* = 5.3, 10.4 Hz, 1 H), 2.18 (m, 2 H), 1.86 (d, *J* = 5.3 Hz, 1 H), 1.35-1.25 (m, 4H). HRMS (ESI): calcd. for $C_{49}H_{49}NO_4$ $[M+H]^+$ 716.3740, found 716.3728.

(1S,2S,5R,8S,8aS)-5-(Hydroxymethyl)octahydroindolizine-1,2,8-triol (54):



$[\alpha]^{25}_D$ = + 0.75 (c = 0.2 MeOH). IR (thin film, cm^{-1}): 3428, 2987, 2936, 1619, 1454, 1375, 1259, 1217, 1160, 1072, 872, 794. HRMS (ESI): calcd. for $C_9H_{17}NO_4$ $[M+H]^+$ 204.1236, found 204.1225.

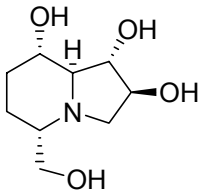
(1S,2S,5R,8S,8aS)-5-(Acetoxymethyl)octahydroindolizine-1,2,8-triyl triacetate (56):



A procedure similar to that described for the synthesis of **34** was employed (40 mg, 98 % yield). $[\alpha]^{25}_D$ = + 6.41 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 2924, 2853, 1745, 1454, 1372, 1248, 1040, 890, 716. ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.19 (dd, *J* = 2.4, 7.5 Hz, 1 H), 5.01 (dd, *J* = 2.4, 6.6 Hz, 1 H), 4.79 (dt, *J* = 4.6, 10.0 Hz, 1 H), 4.05 (dq, *J* = 4.6, 11.4, 15.8 Hz, 2 H), 3.15 (d, *J* = 11.2 Hz, 1 H), 2.74 (dd, *J* = 6.5, 10.9 Hz, 1 H), 2.35-2.32 (m, 1 H), 2.28 (t, *J* = 7.8 Hz, 1 H), 2.18 (m, 1 H),

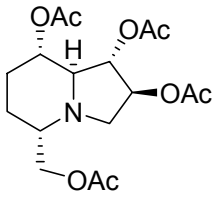
2.08 (s, 3 H), 2.07 (s, 3 H), 2.06 (s, 3 H), 1.97 (s, 3 H), 1.79-1.76 (m, 1 H), 1.45 (dd, J = 3.9, 11.1 Hz, 1 H), 1.34-1.35 (m, 2 H). ^{1}H NMR (100 MHz, $CDCl_3$): δ 171.3, 170.6, 169.8, 169.1, 79.9, 72.6, 69.4, 66.2, 60.4, 56.8, 29.6, 27.0, 20.8.. HRMS (ESI): calcd. for $C_{17}H_{25}NO_7$ $[M+H]^+$ 372.1658, found 372.1636.

(1S,2S,5S,8S,8aS)-5-(Hydroxymethyl)octahydroindolizine-1,2,8-triol (55):

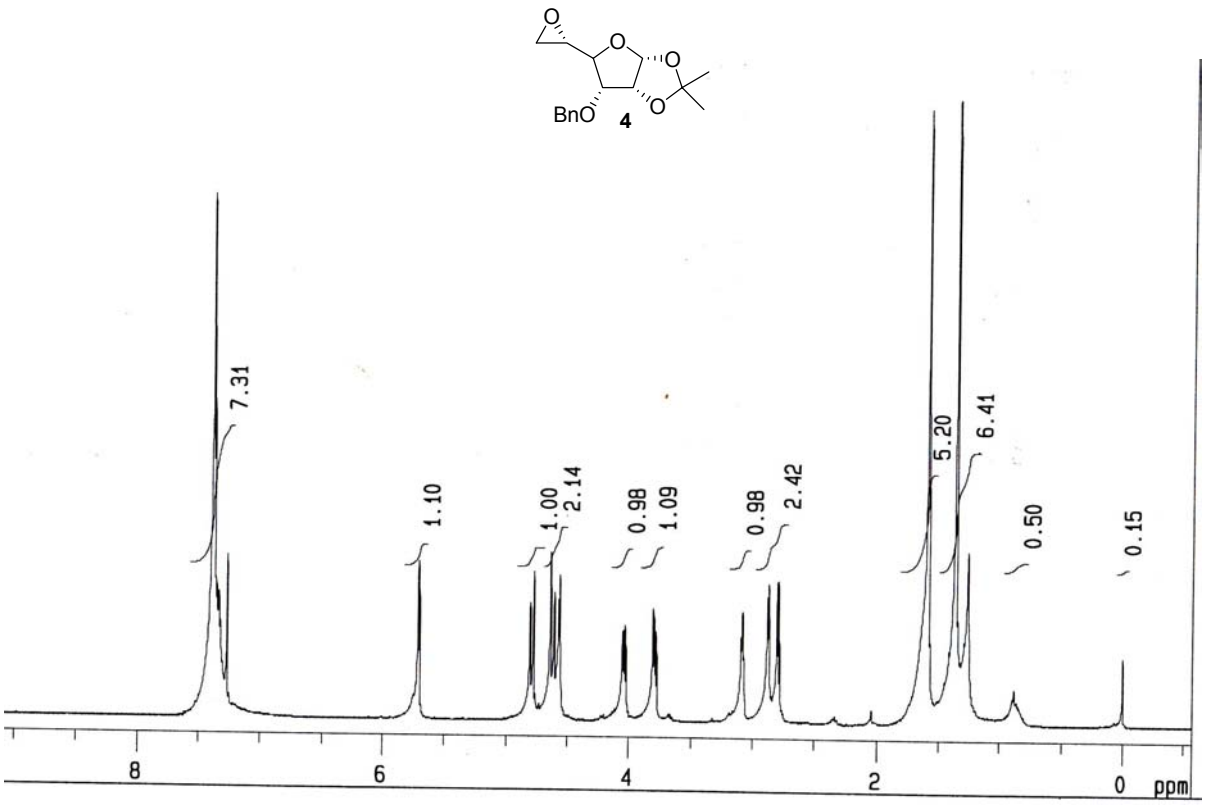


$[\alpha]^{25}_D$ = + 0.92 (c = 0.2 MeOH). IR (thin film, cm^{-1}): 3488, 2986, 2925, 1620, 1456, 1374, 1215, 1164, 1122, 1061, 1018, 852. HRMS (ESI): calcd. for $C_9H_{17}NO_4$ $[M+H]^+$ 204.1236, found 204.1228.

(1S,2S,5S,8S,8aS)-5-(Acetoxymethyl)octahydroindolizine-1,2,8-triyl triacetate (57):



A procedure similar to that described for the synthesis of **34** was employed (40 mg, 98 % yield). $[\alpha]^{25}_D$ = + 2.41 (c = 0.5, CH_2Cl_2). IR (thin film, cm^{-1}): 3062, 3030, 2926, 2858, 1739, 1495, 1453, 1366, 1230, 1097, 1028, 736, 697. ^{1}H NMR (500 MHz, $CDCl_3$): δ 5.09 (dd *J* = 2.0, 5.9 Hz, 1 H), 4.96 (dt, *J* = 1.8, 3.8 Hz, 1 H), 4.78 (dt, *J* = 4.6, 10.6 Hz, 1 Hz), 4.32 (dd, *J* = 6.6, 11.4 Hz, 1 H), 4.11 (dd, *J* = 4.0, 11.4 Hz, 1 H), 3.33 (dd, *J* = 6.3, 11.0 Hz, 1 H), 3.19 (m, 1 H), 2.98 (dd, *J* = 2.2, 11.0 Hz, 1 H), 2.80 (dd, *J* = 5.3, 9.5 Hz, 1 H), 2.08 (s, 3 H), 2.07 (s, 3 H), 2.06 (s, 3 H), 2.01 (s, 3 H), 1.98 (m, 1 H), 1.86 (m, 1 H), 1.73 (m, 1 H), 1.44 (m, 1 H). ^{1}H NMR (100 MHz, $CDCl_3$): δ 80.2, 71.4, 63.2, 61.0, 55.1, 52.5, 25.6, 24.0, 20.8. HRMS (ESI): calcd. for $C_{17}H_{25}NO_7$ $[M+H]^+$ 372.1658, found 372.1639.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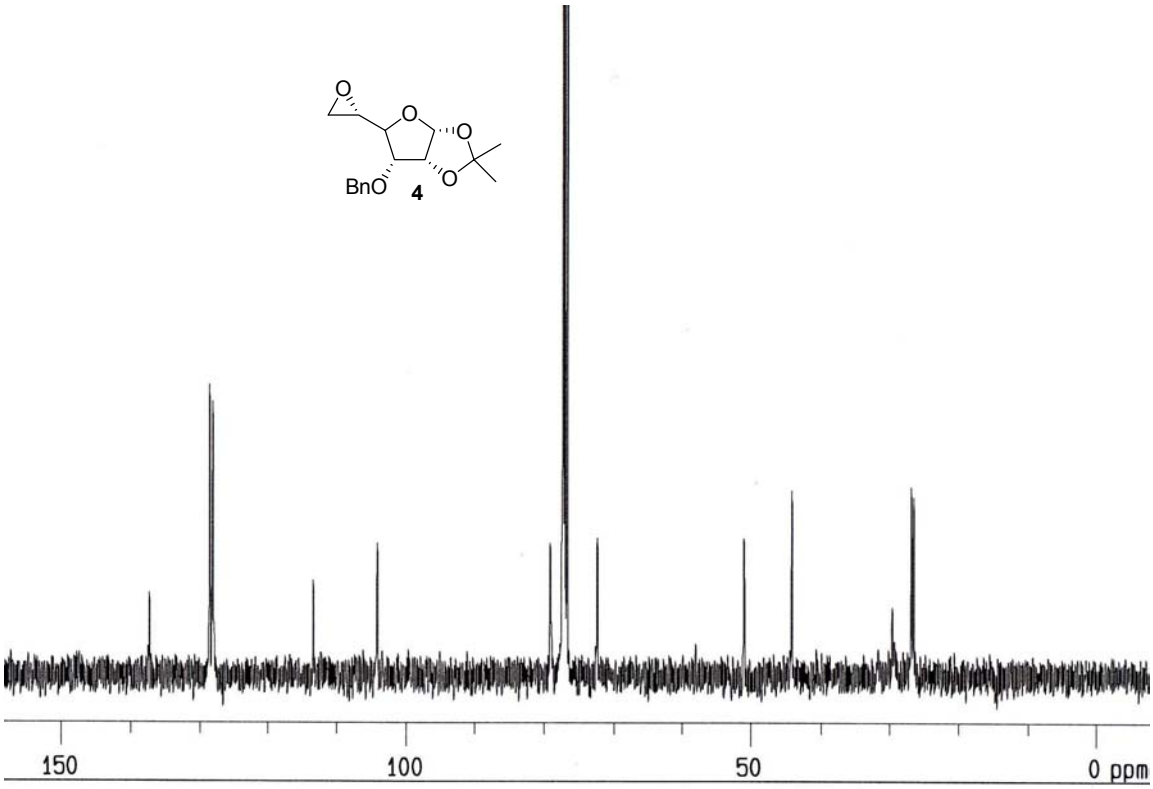
7.31
1.10
1.00
2.14
0.98
1.09
0.98
2.42
5.20
6.41
0.50
0.15
8
6
4
2
0
ppm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O
O
O
BnO
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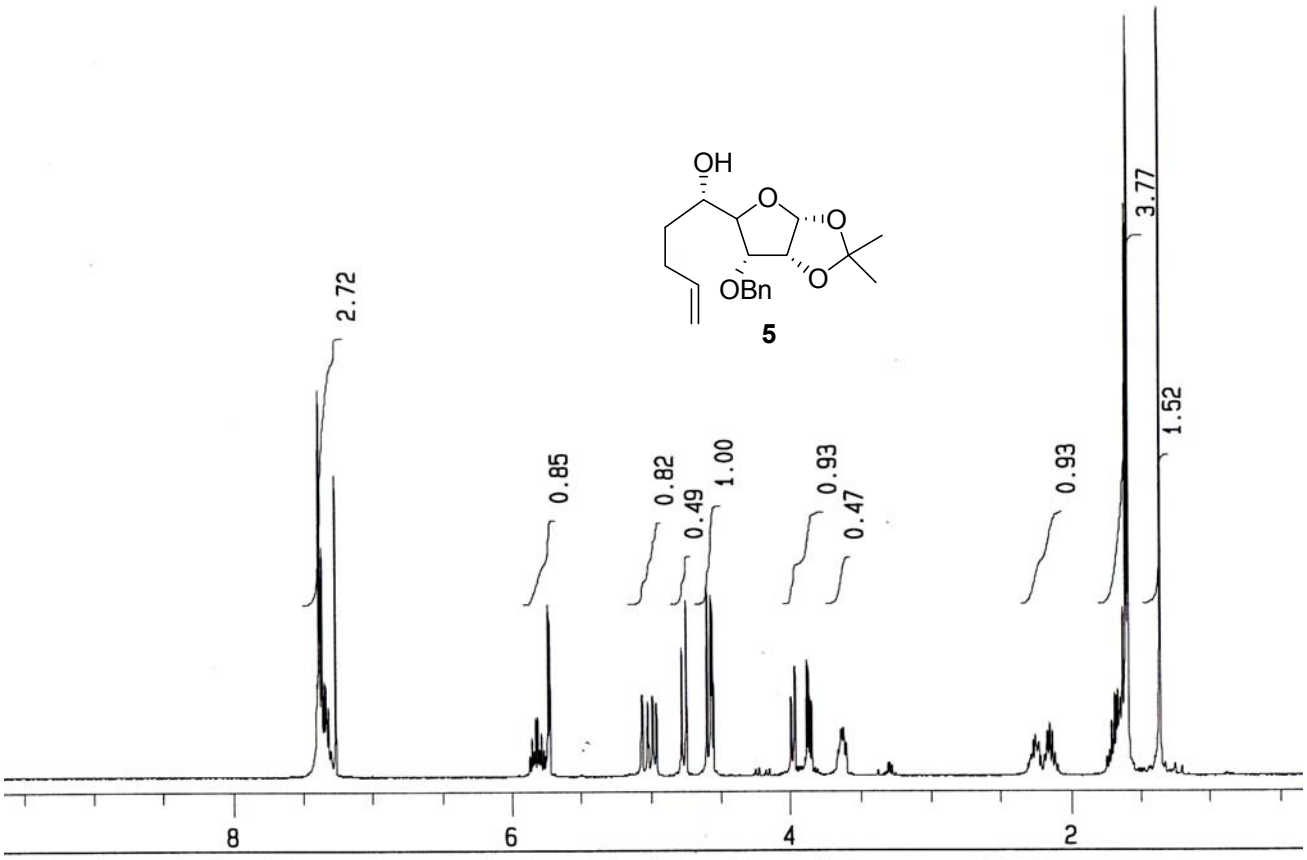
100
50
0 ppm


OH
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O
O
OBn
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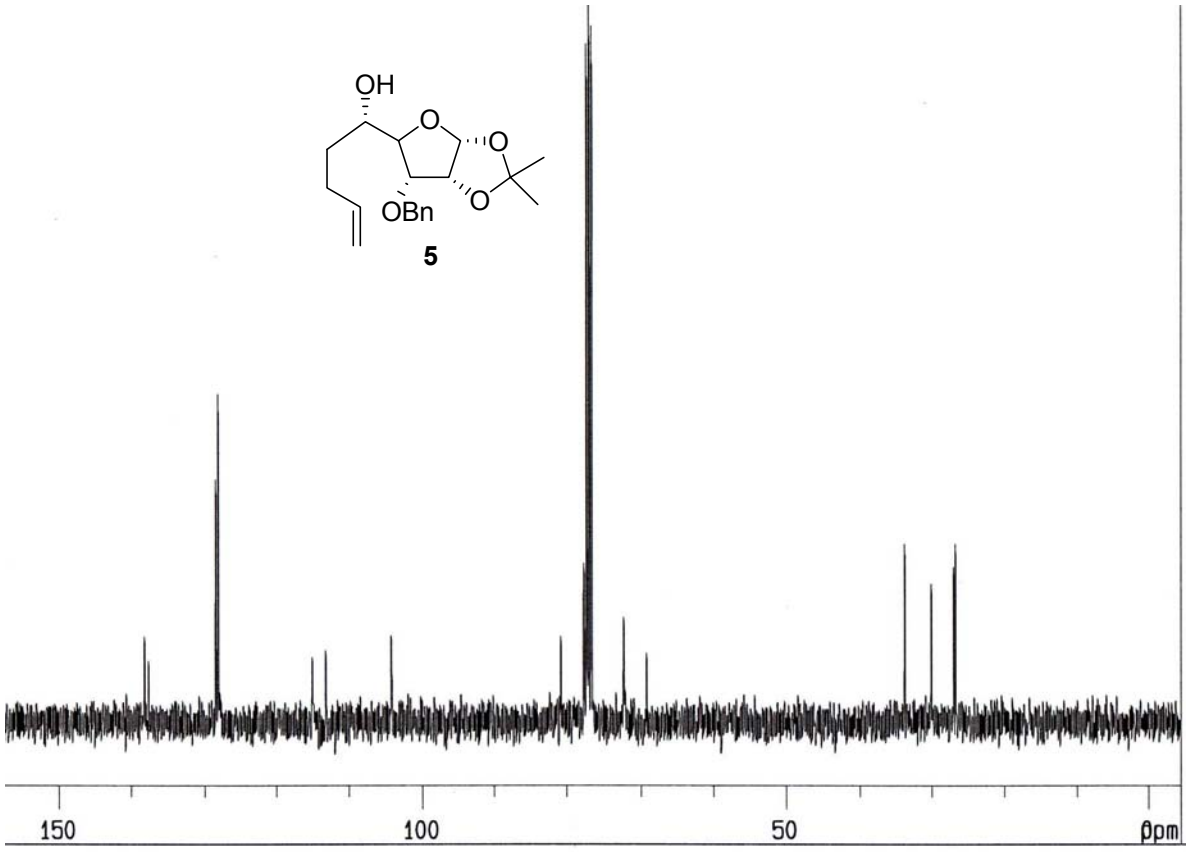
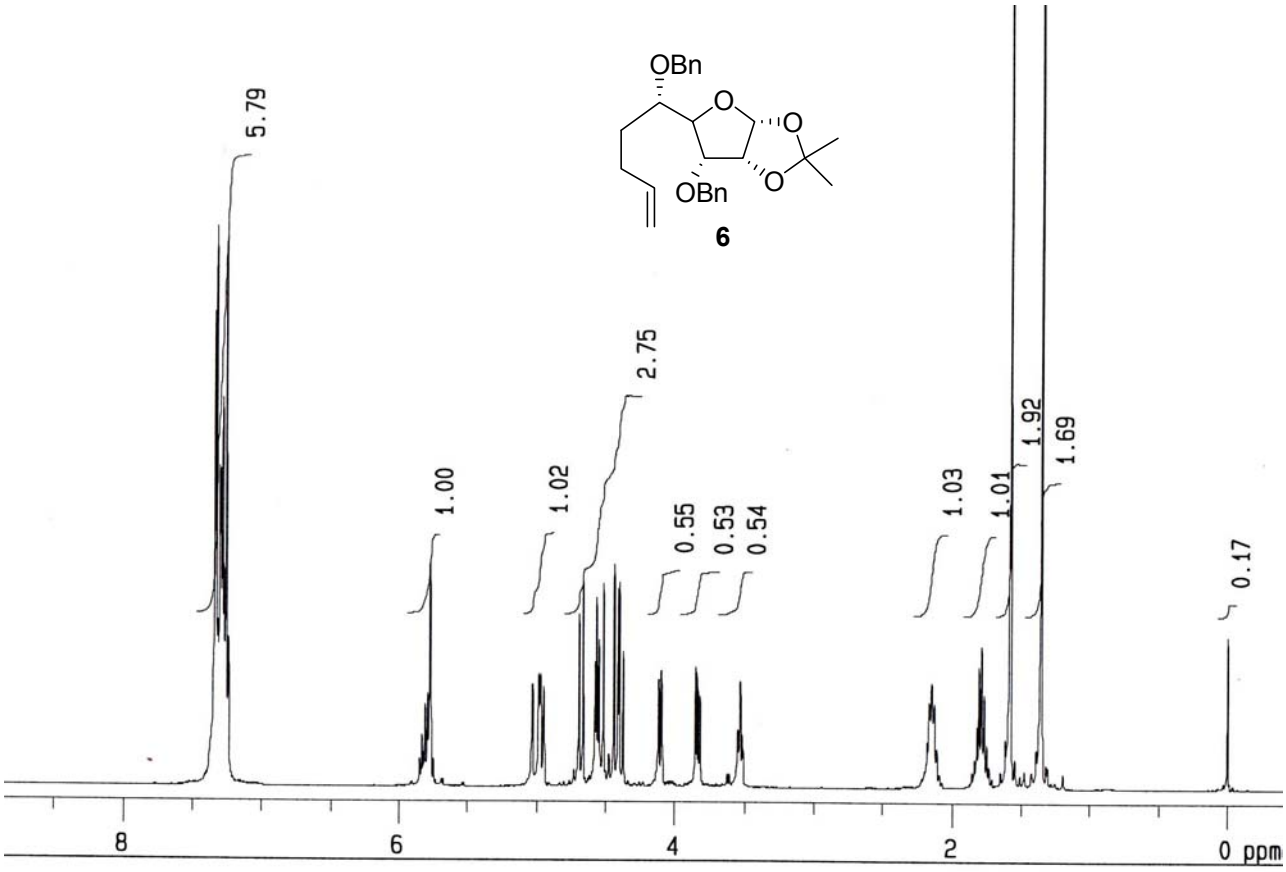
0.49
1.00
0.93
0.47
0.93
3.77
1.52
8
6
4
2



5


OBn
OBn
O
O
O
6
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1.00
1.02
2.75
0.55
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1.01
1.92
1.69
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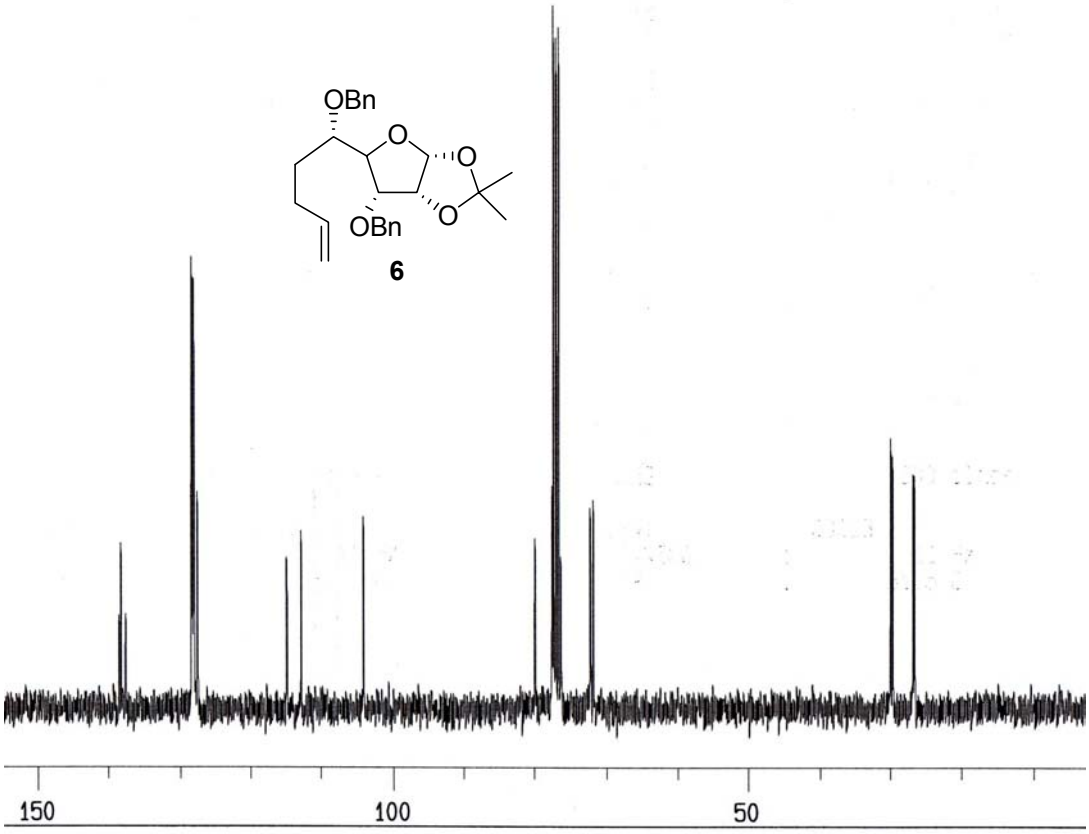
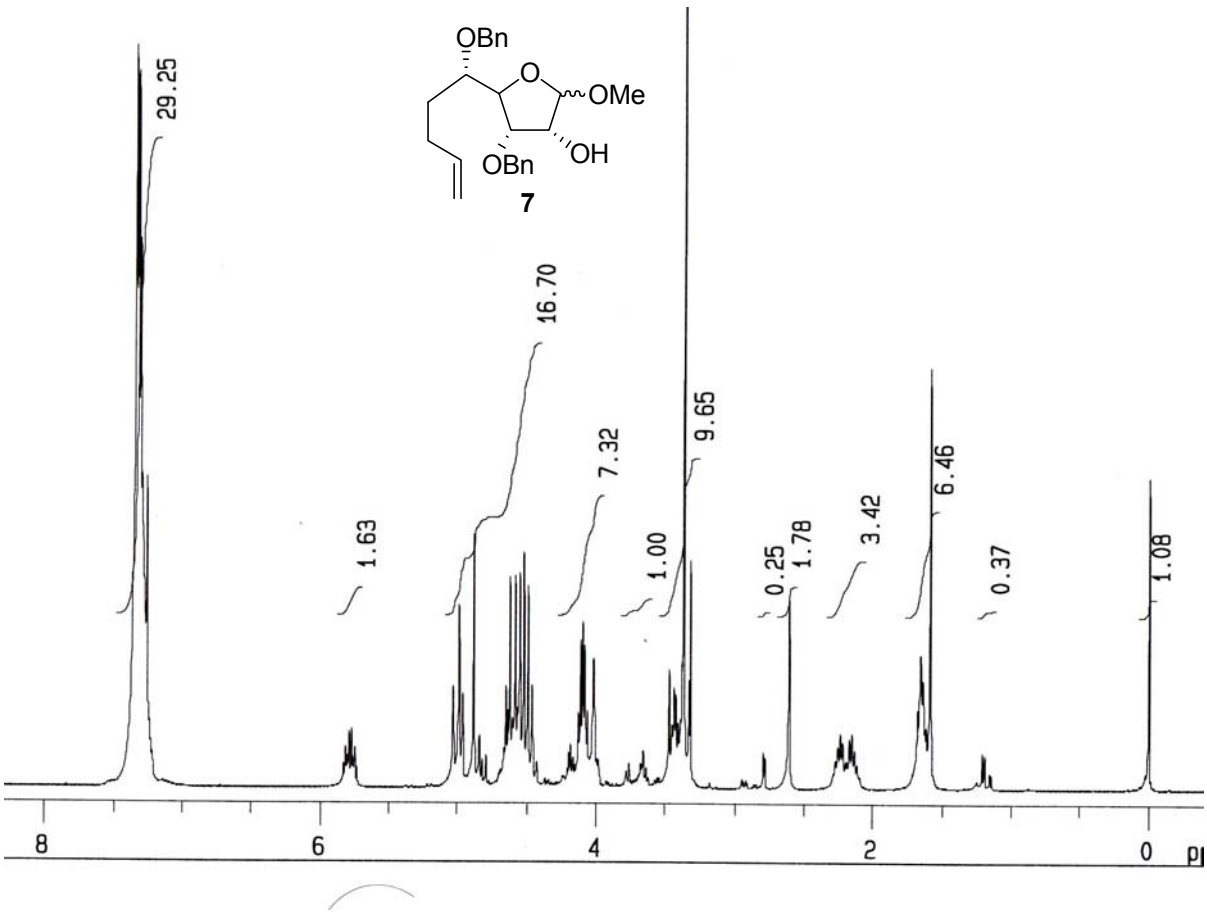
8
6
4
2
0 ppm



6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O
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7
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7.32
1.00
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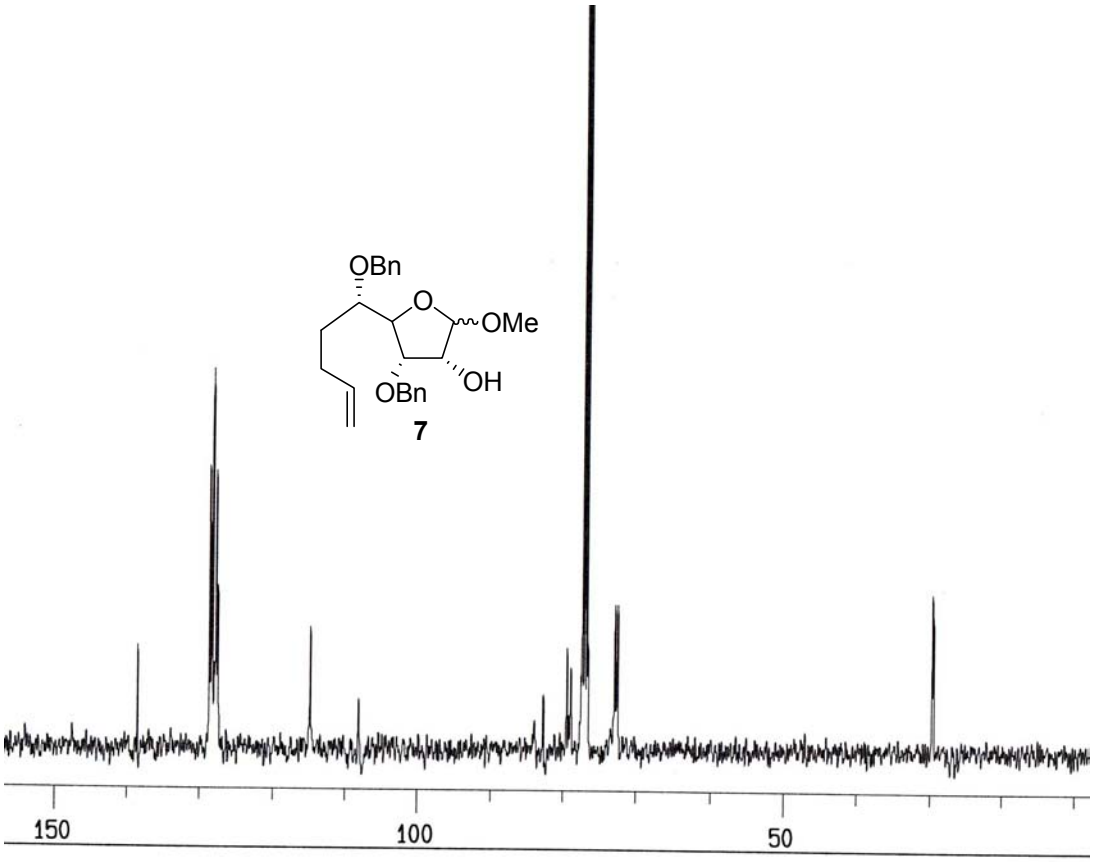
1.78
3.42
6.46
0.37
1.08
8
6
4
2
0
p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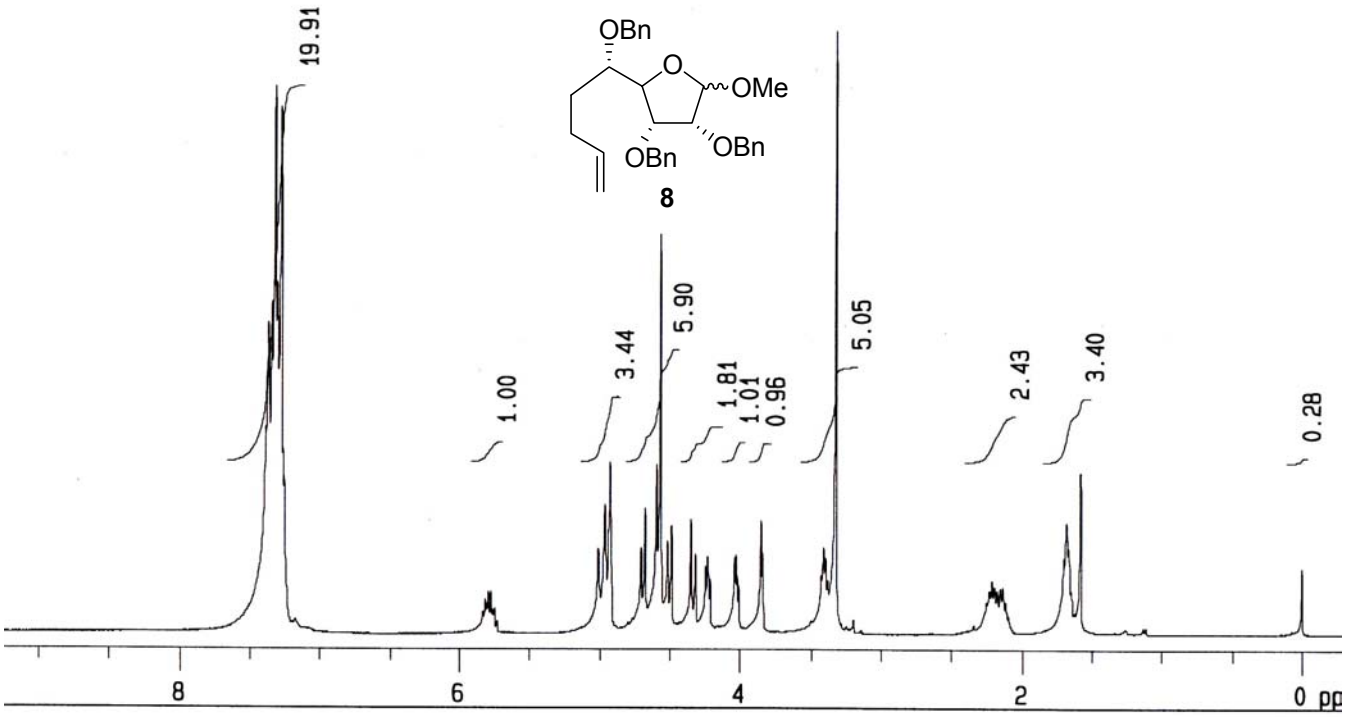
OMe
OH
OBn
7
150
100
50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O
OMe
OBn
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8
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1.01
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5.05
2.43
3.40
0.28
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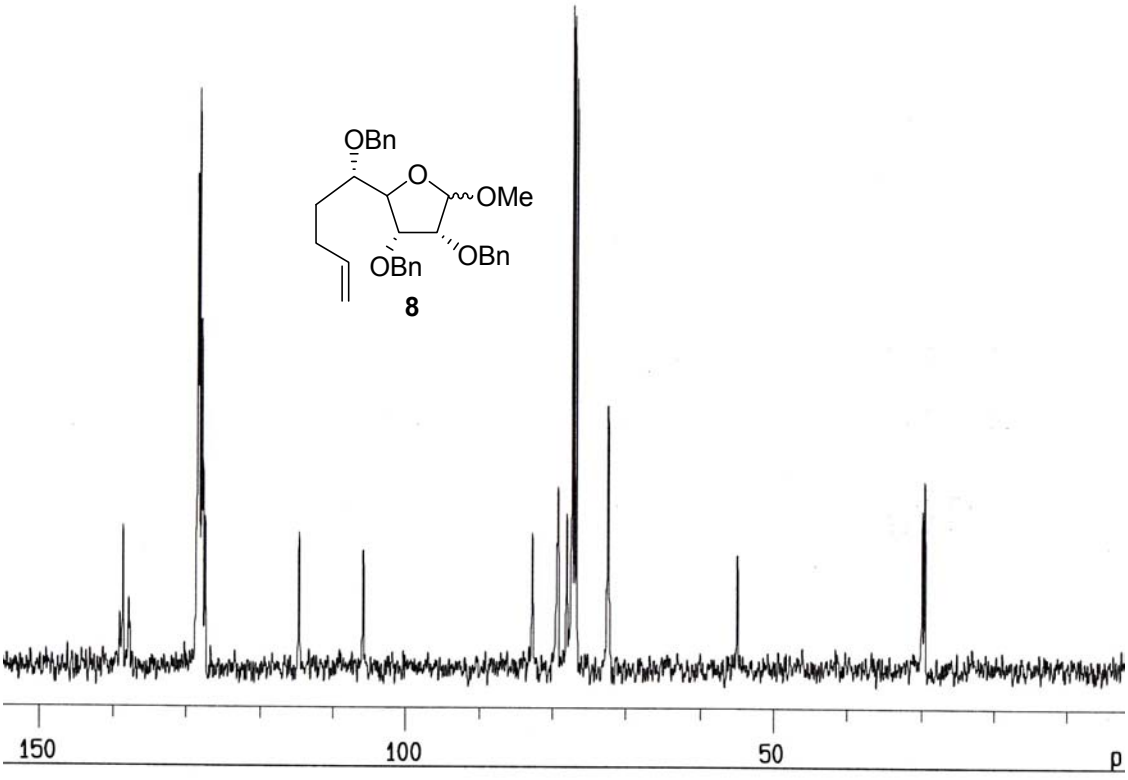
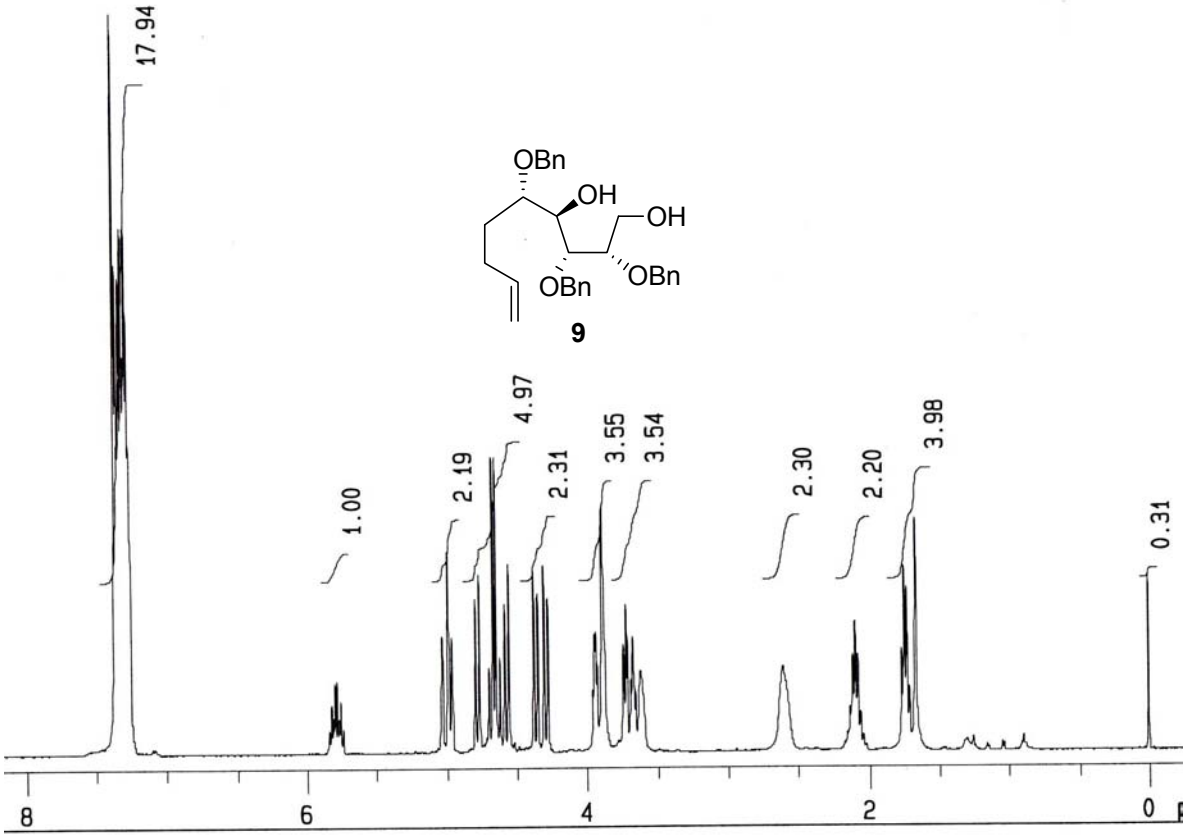
6
4
2
0 pp



8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0.31
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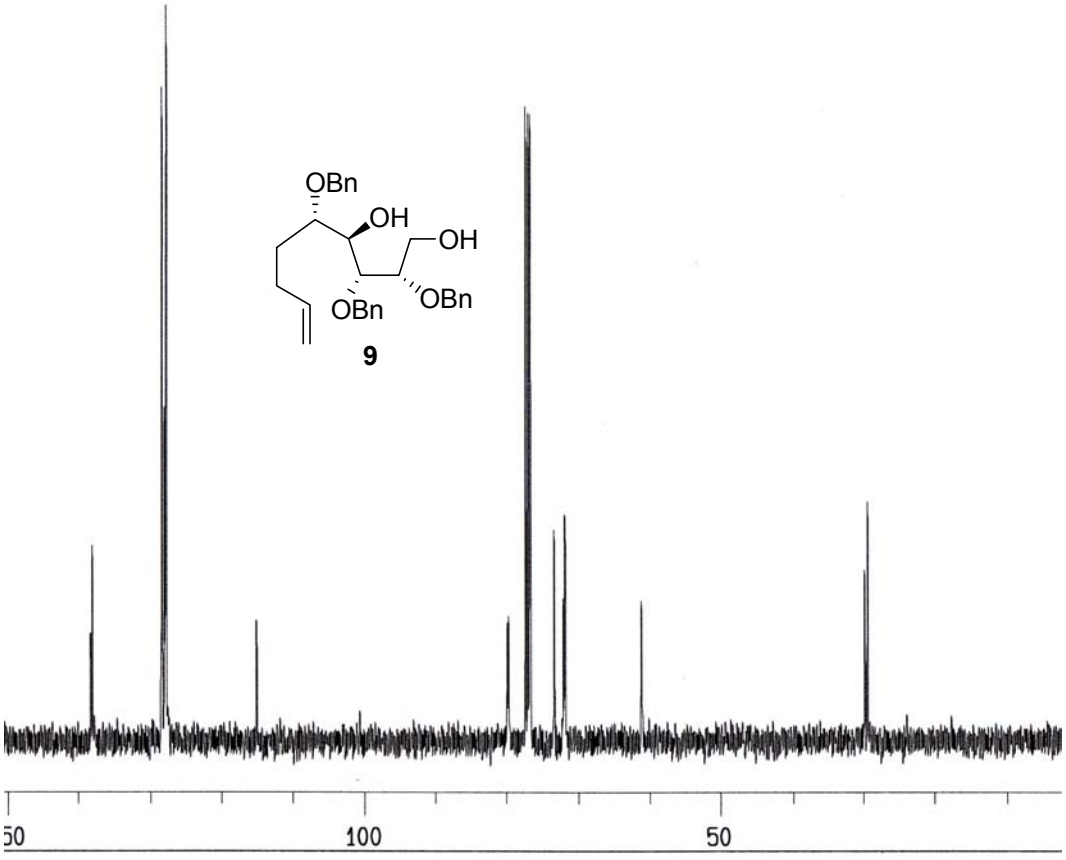
2
0
OBn
OH
OH
OBn
OBn

9


OBn
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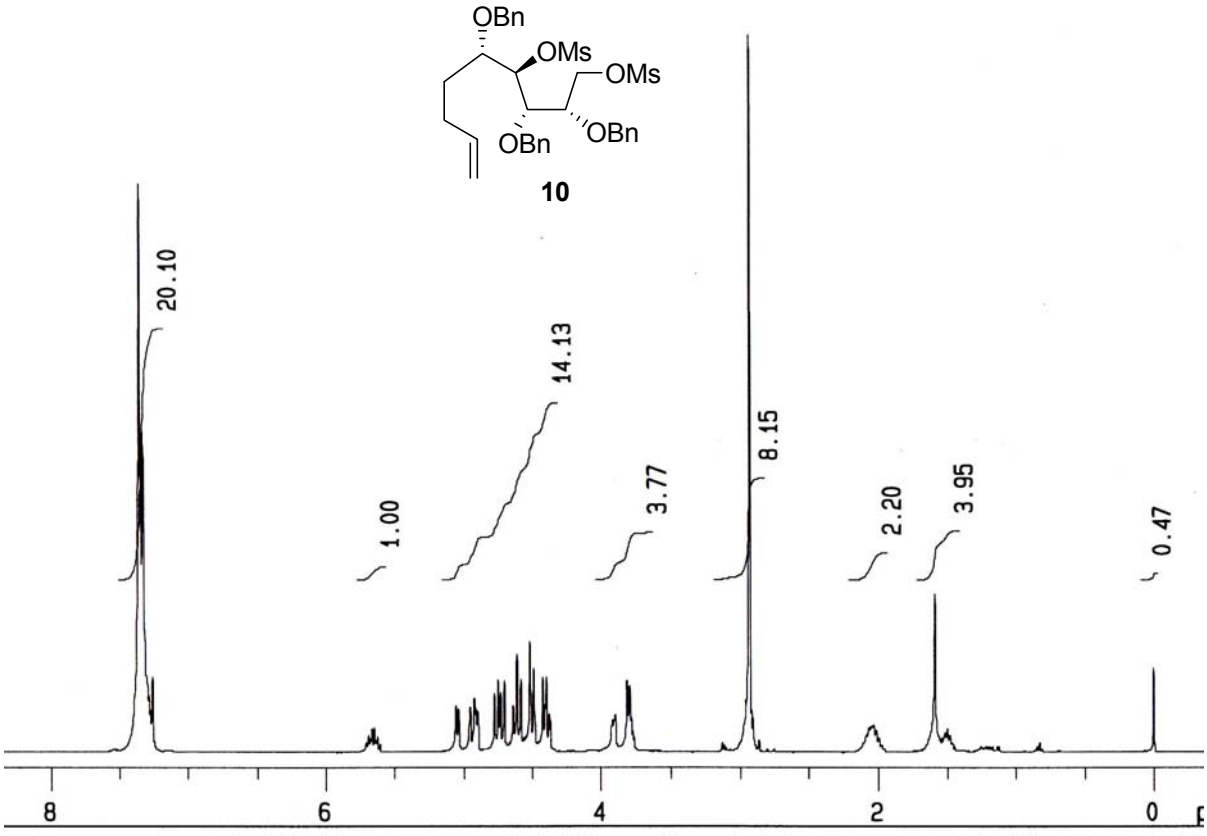
OBn
OBn
9
50
100
50


OBn
OMs
OMs
OBn
OBn
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8.15
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3.95
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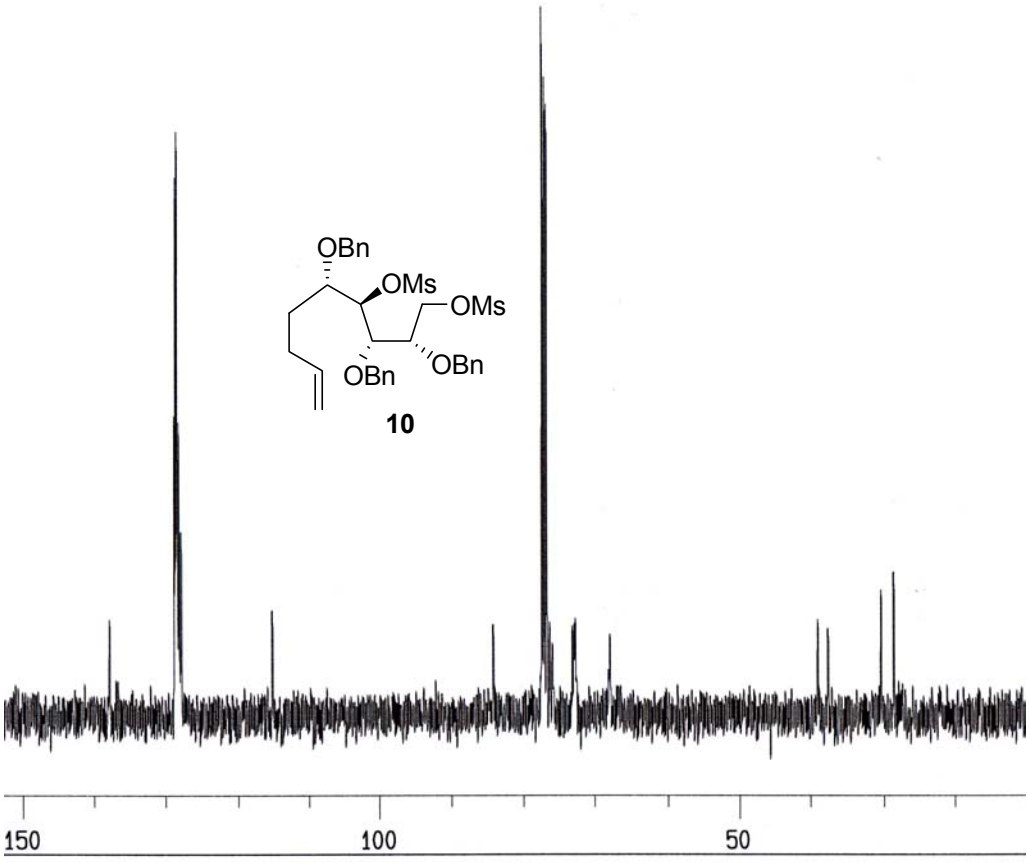
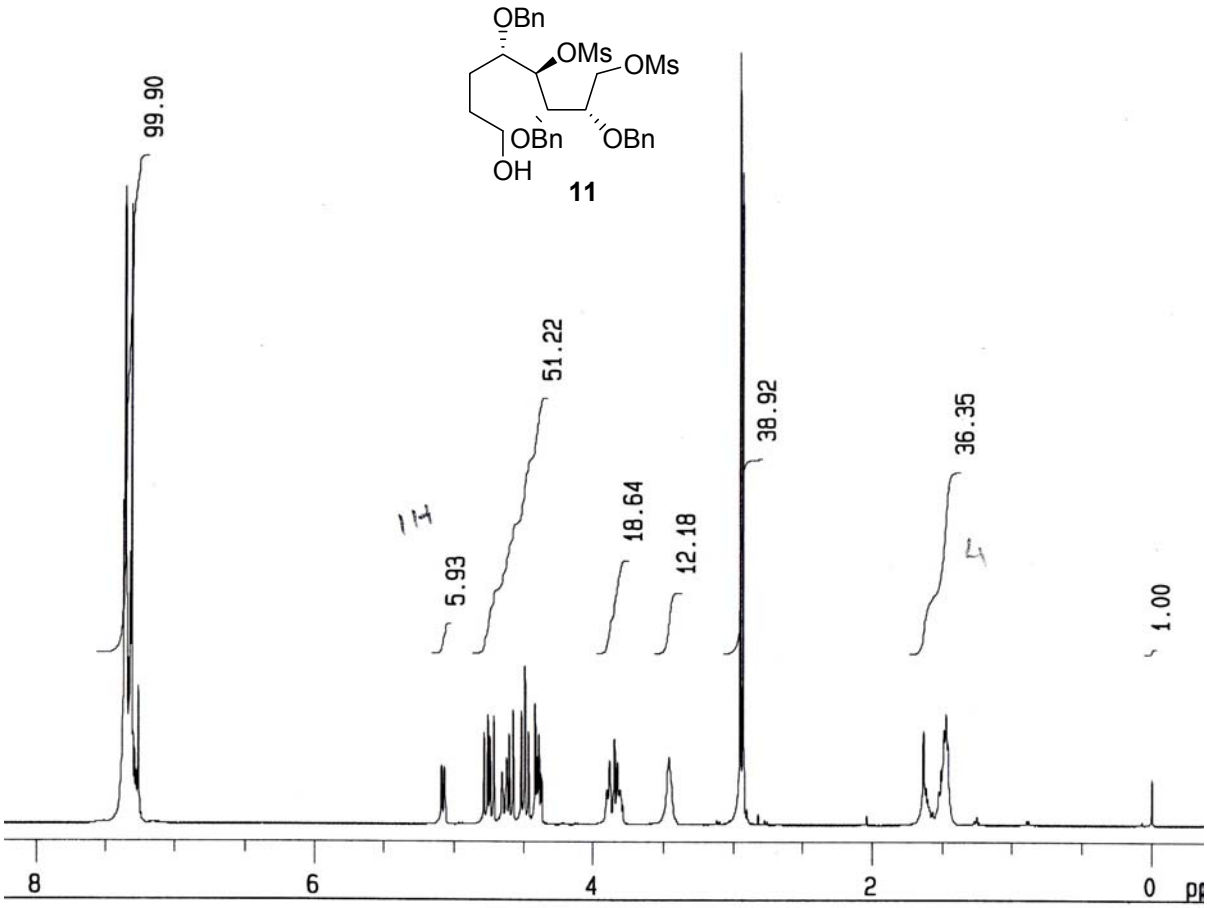
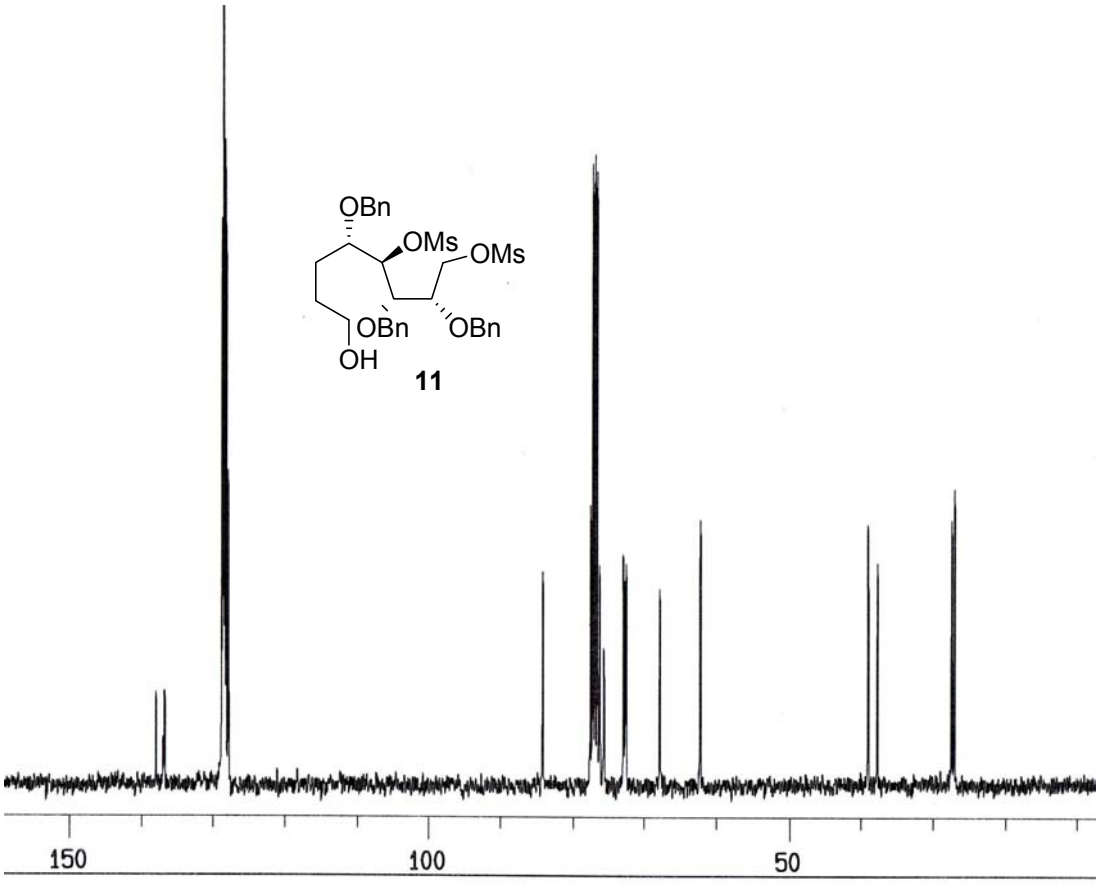
8
6
4
2
0

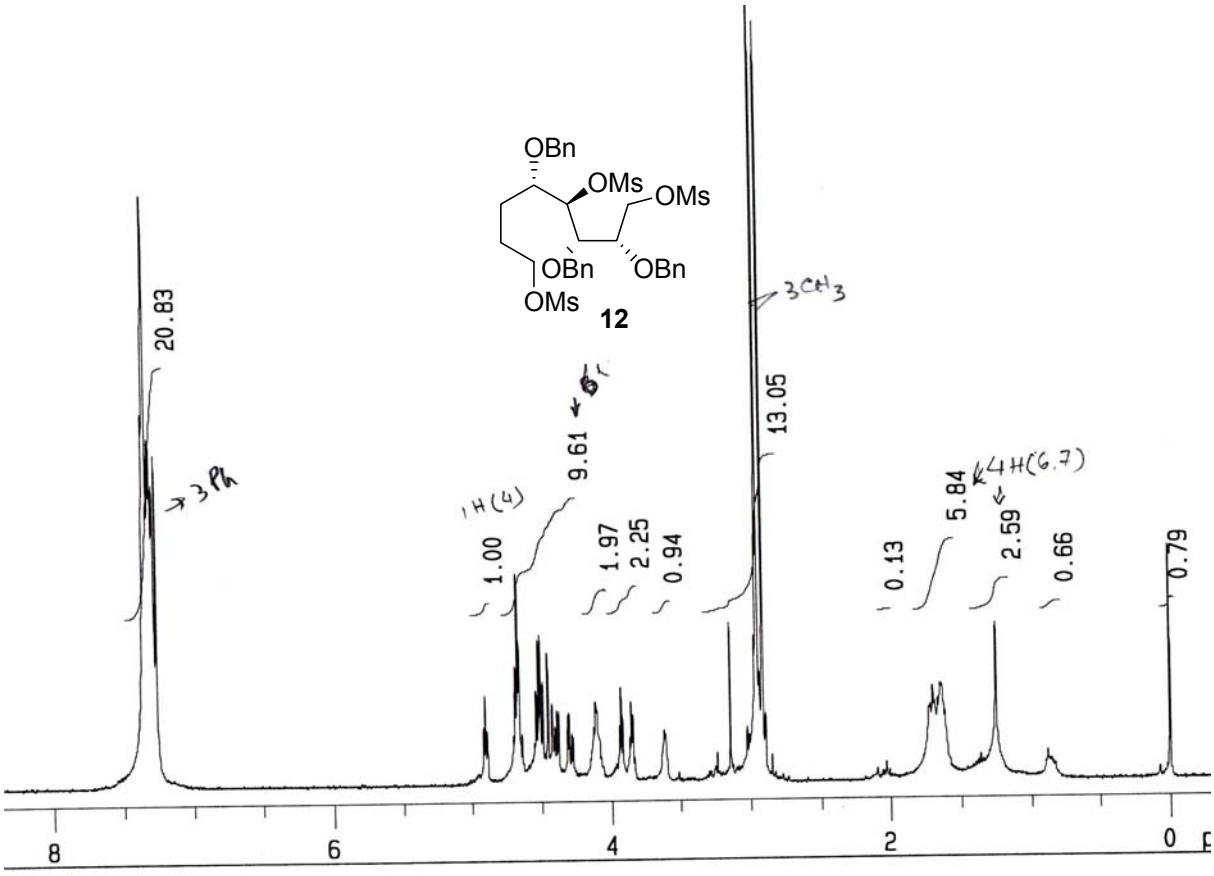


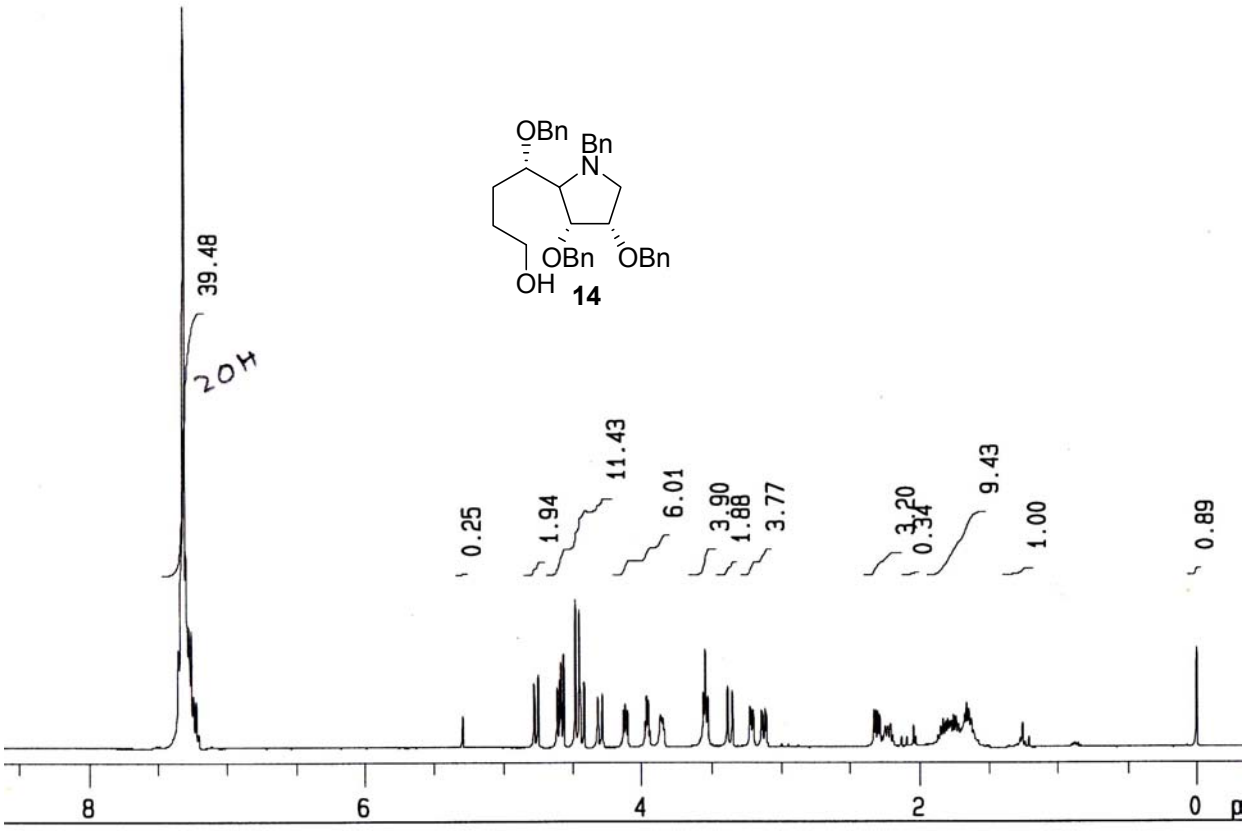
10

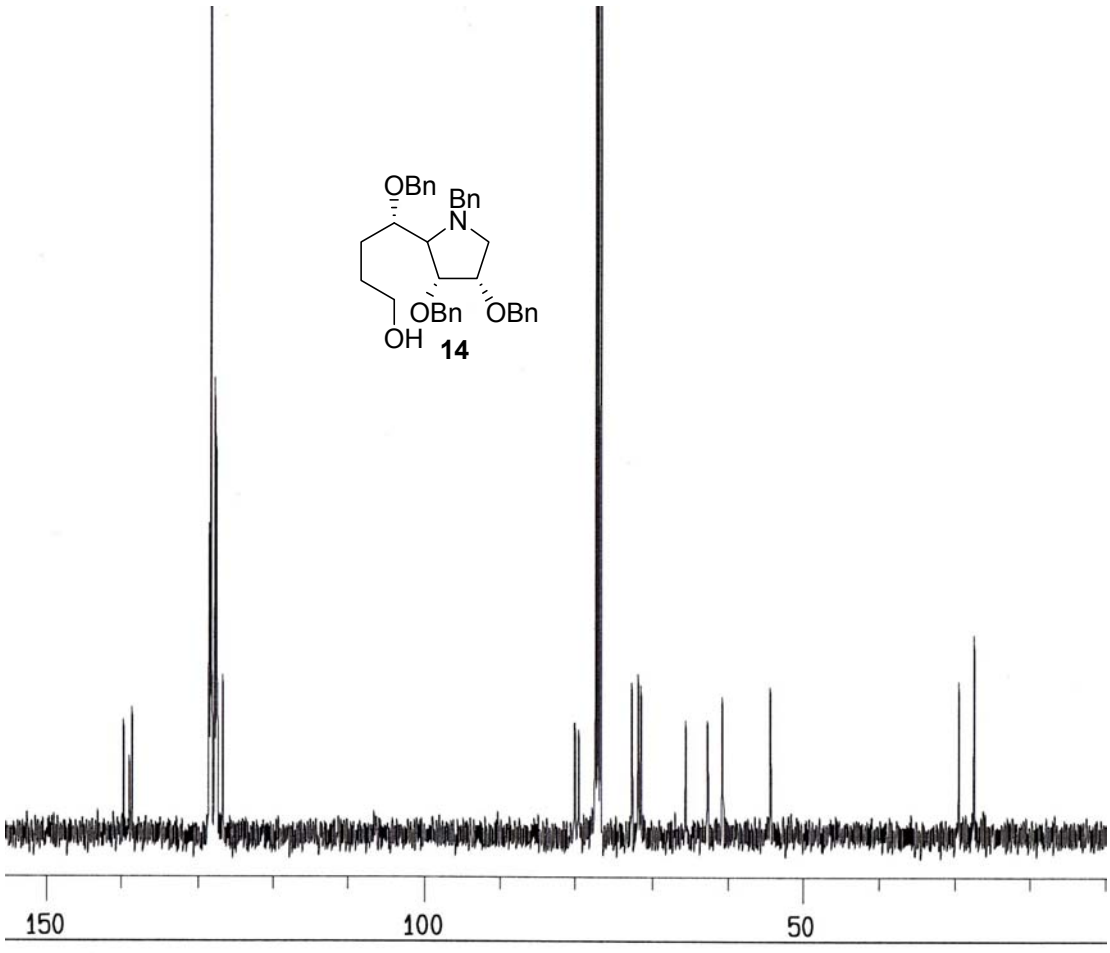

OBn
OMs
OMs
OBn
OBn
OH
11
99.90
51.22
38.92
36.35
18.64
12.18
5.93
1.00
8
6
4
2
0

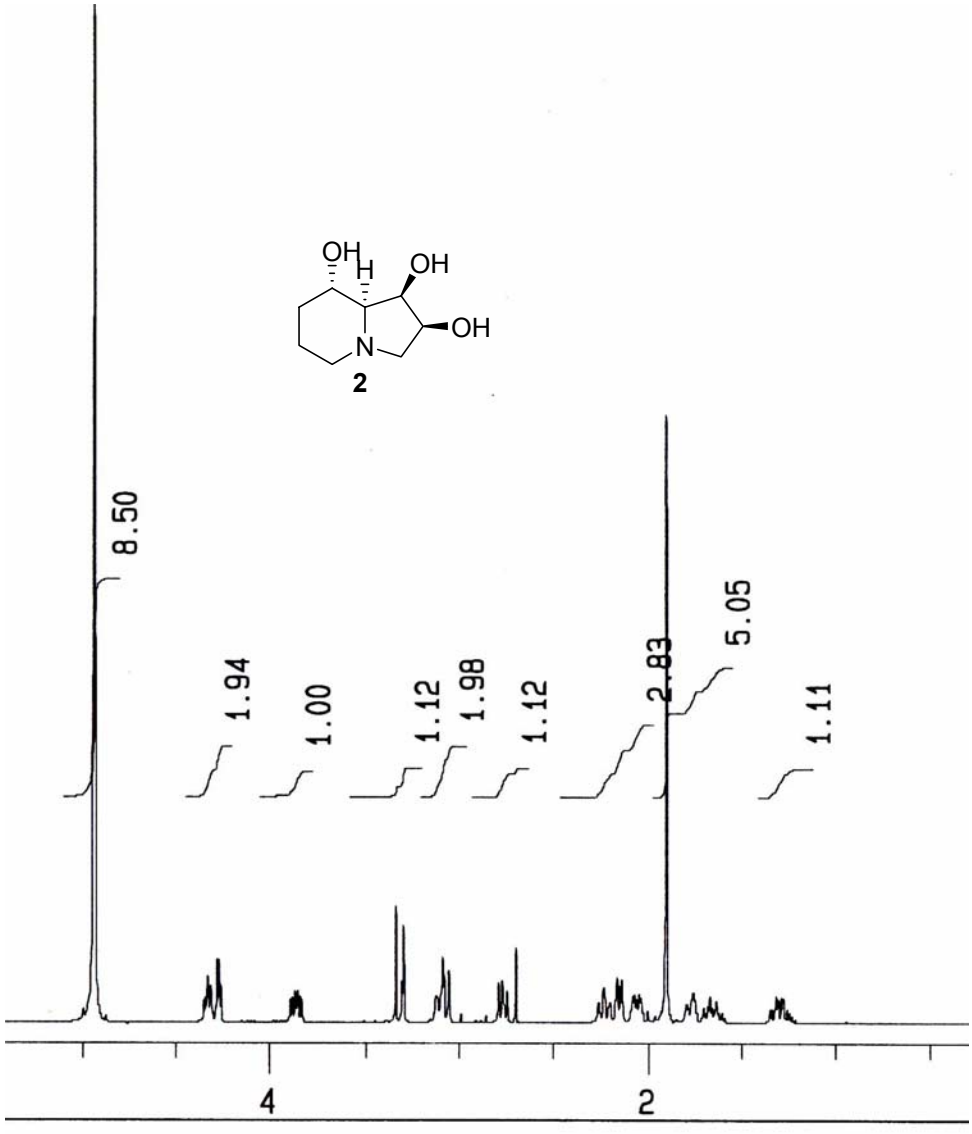


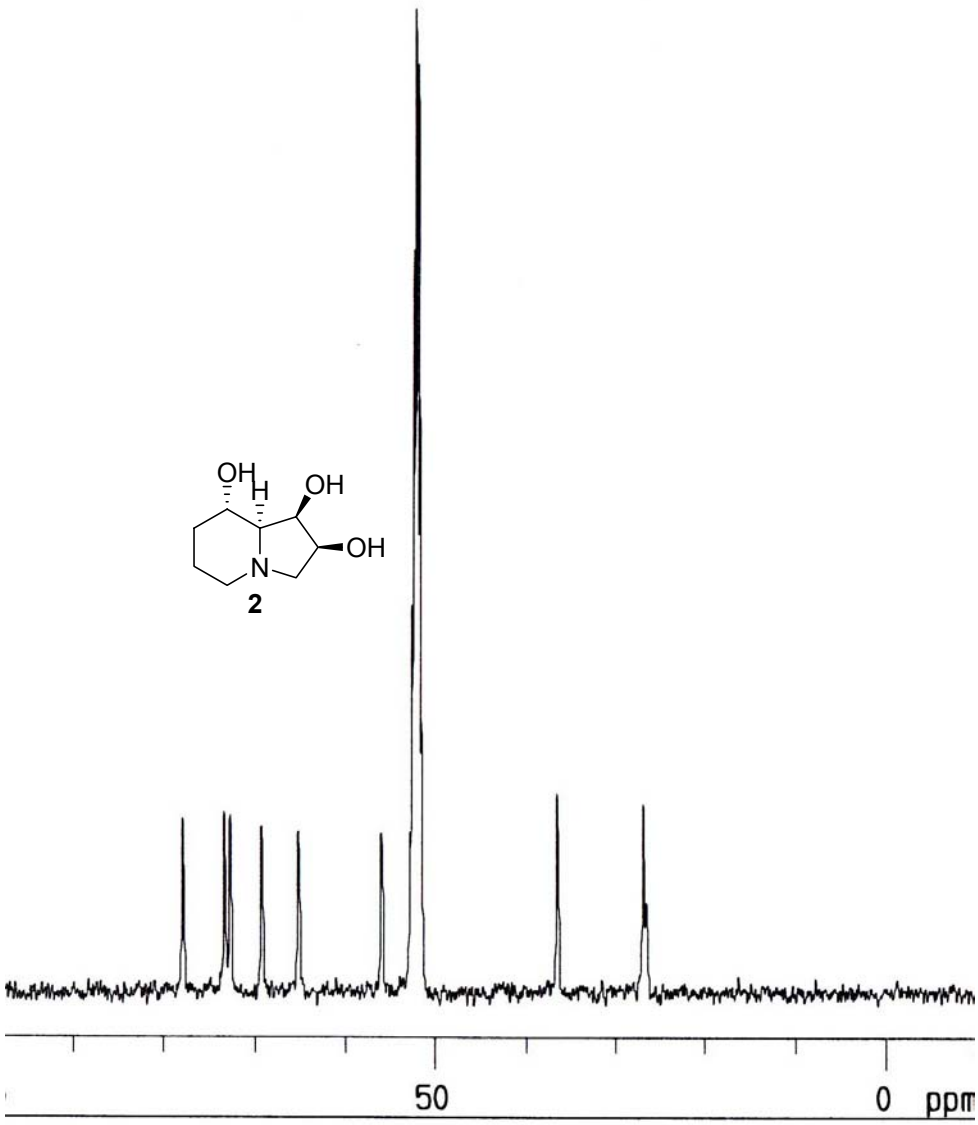
11


OBn
OMs
OMs
OBn
OBn
OMs
12
20.83
3Ph
1.00
1H(G)
9.61
6H
1.97
2.25
0.94
3CH3
13.05
0.13
5.84
4H(6.7)
2.59
0.66
0.79
8
6
4
2
0

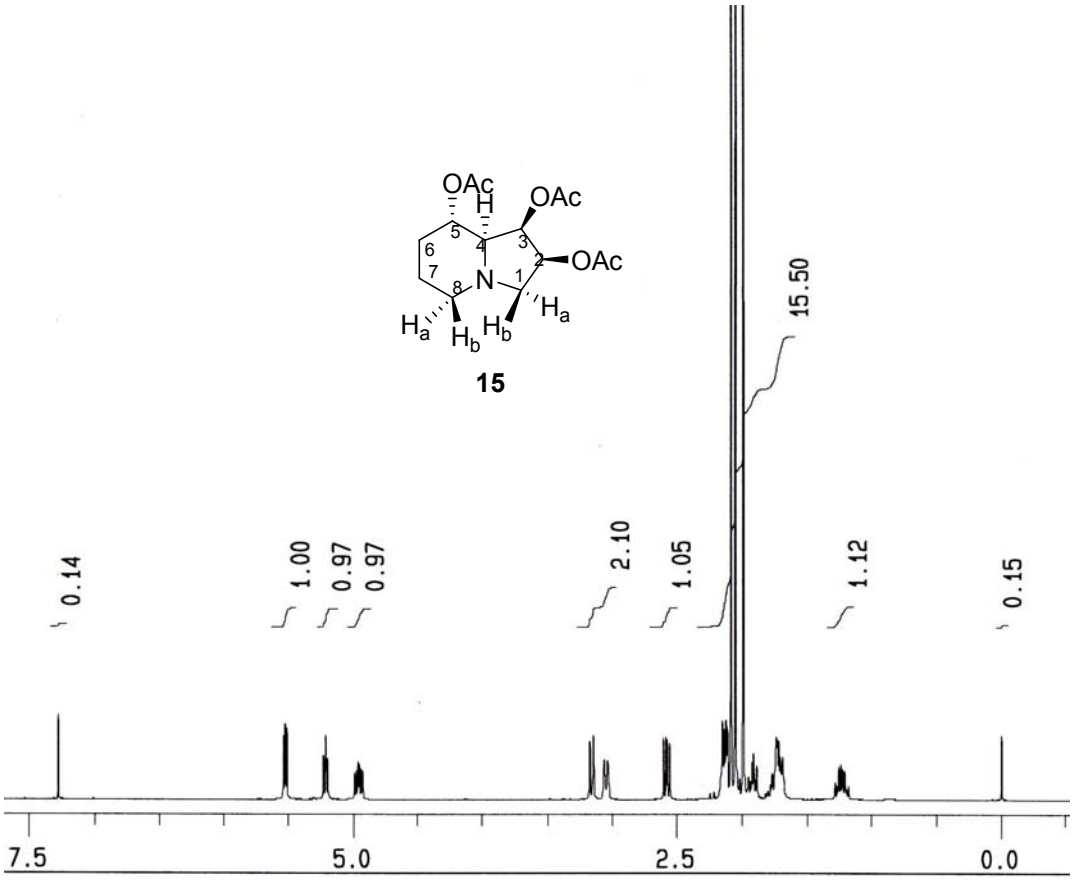

OBn
Bn
N
OBn
OBn
OH
14
39.48
20H
0.25
1.94
11.43
6.01
3.90
1.88
3.77
3.20
0.34
9.43
1.00
0.89
8
6
4
2
0

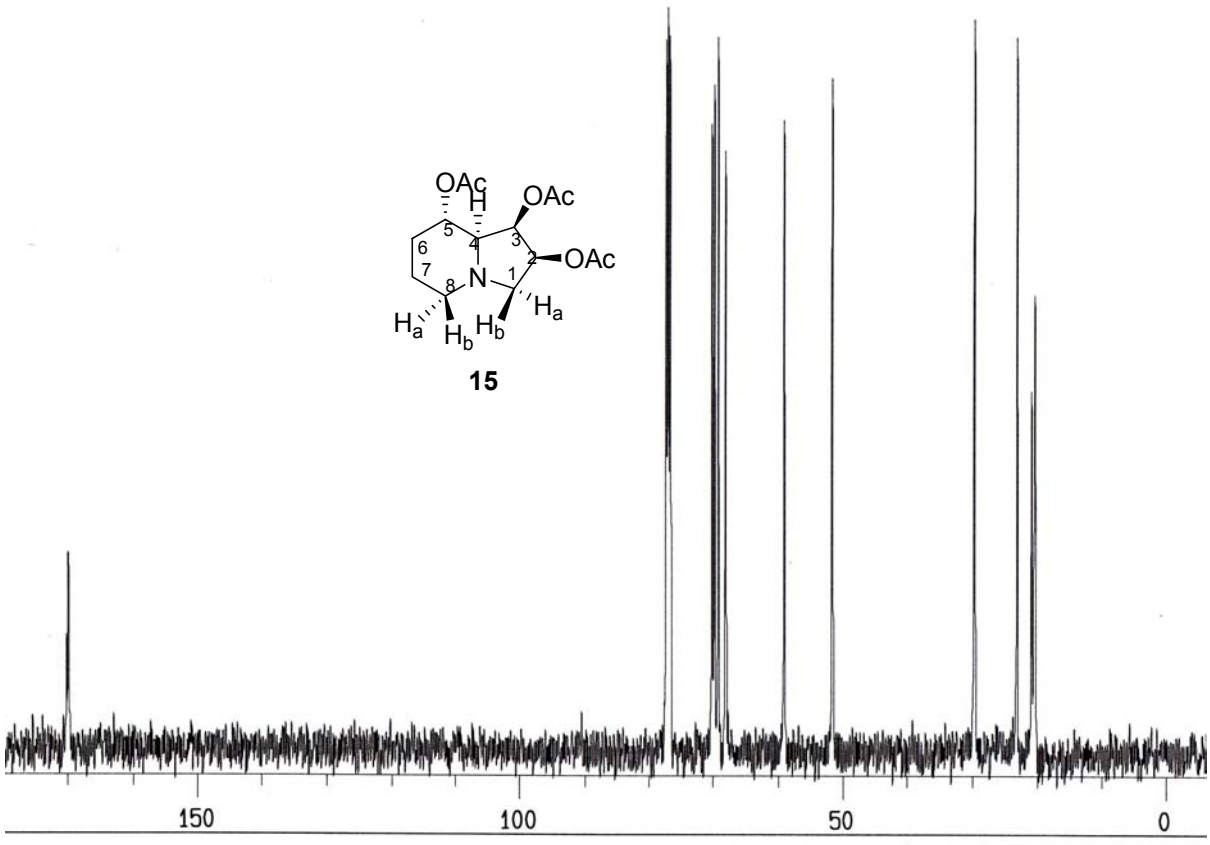

OBn
Bn
N
OBn
OBn
OH
14
150
100
50


OH
H
OH
OH
N
2
8.50
1.94
1.00
1.12
1.98
1.12
2.83
5.05
1.11
4
2



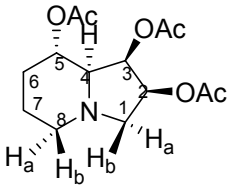
2


OAc
H
OAc
OAc
N
Ha
Hb Hb
Ha
15
15.50
0.14
1.00
0.97
0.97
2.10
1.05
1.12
0.15
7.5
5.0
2.5
0.0

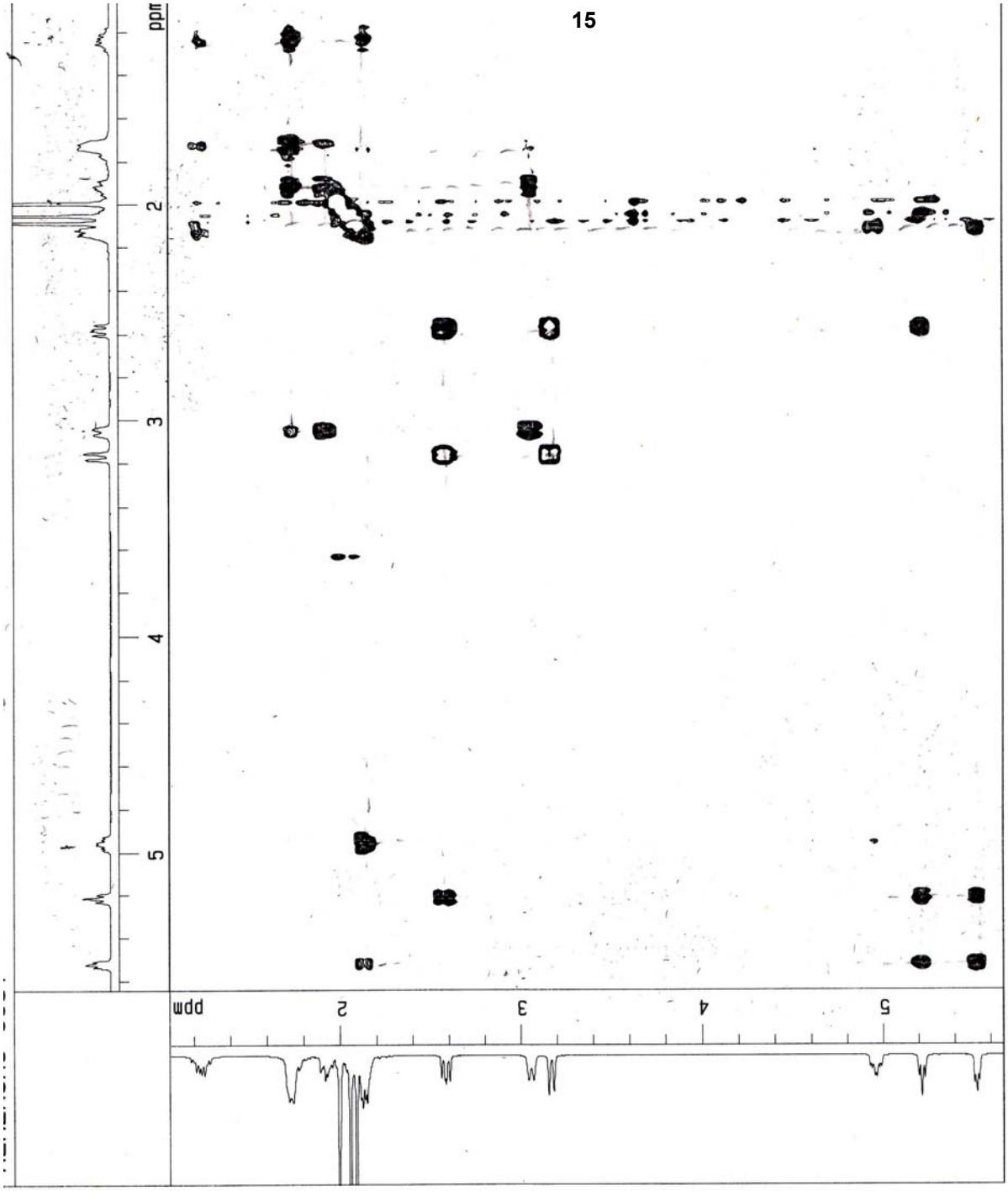


15

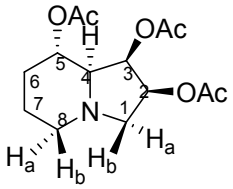
COSY spectrum of compound **15**



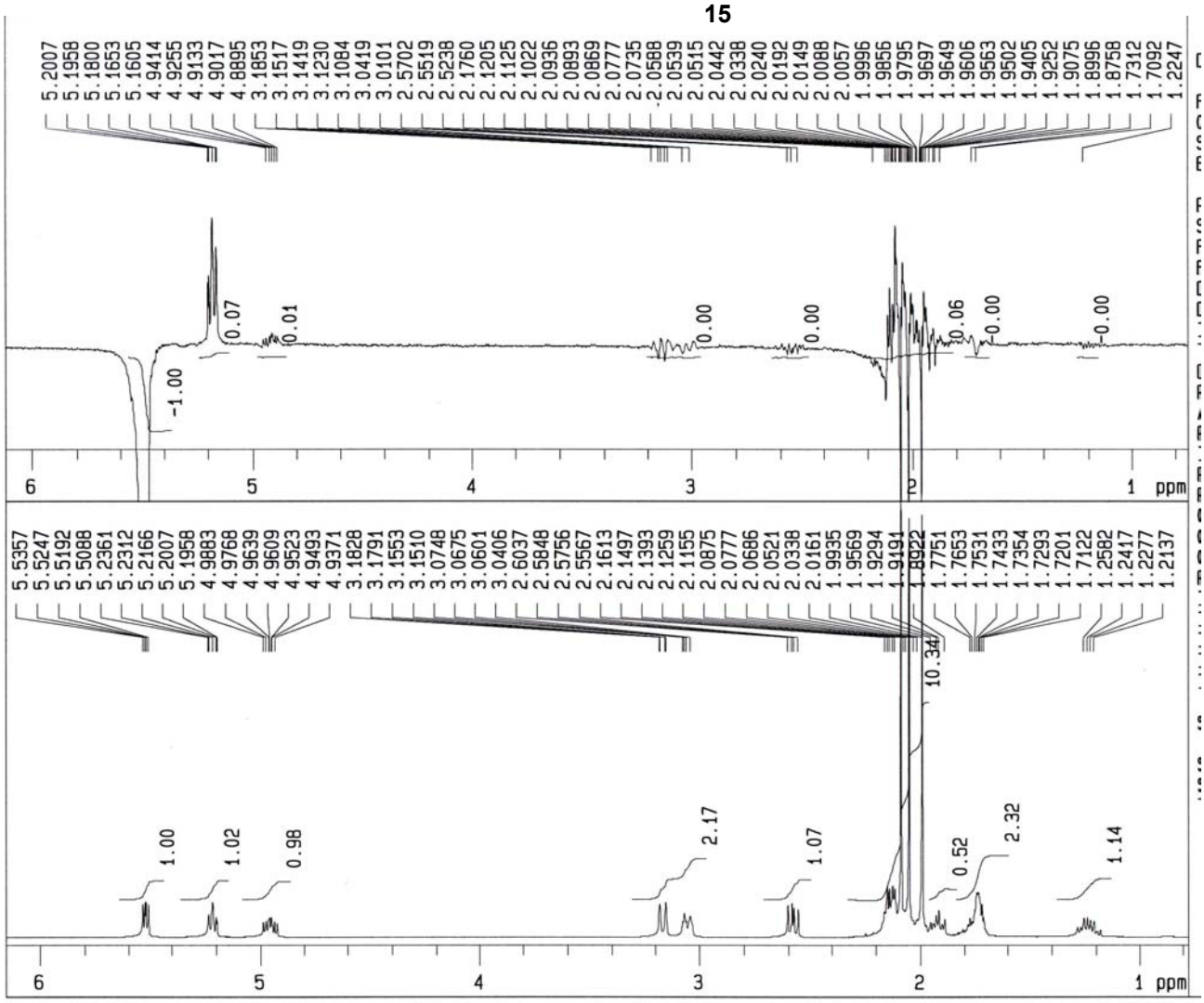
15



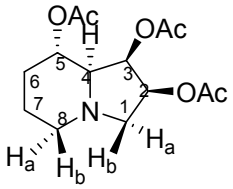
NOE spectrum of compound **15** (irradiation of H-3)



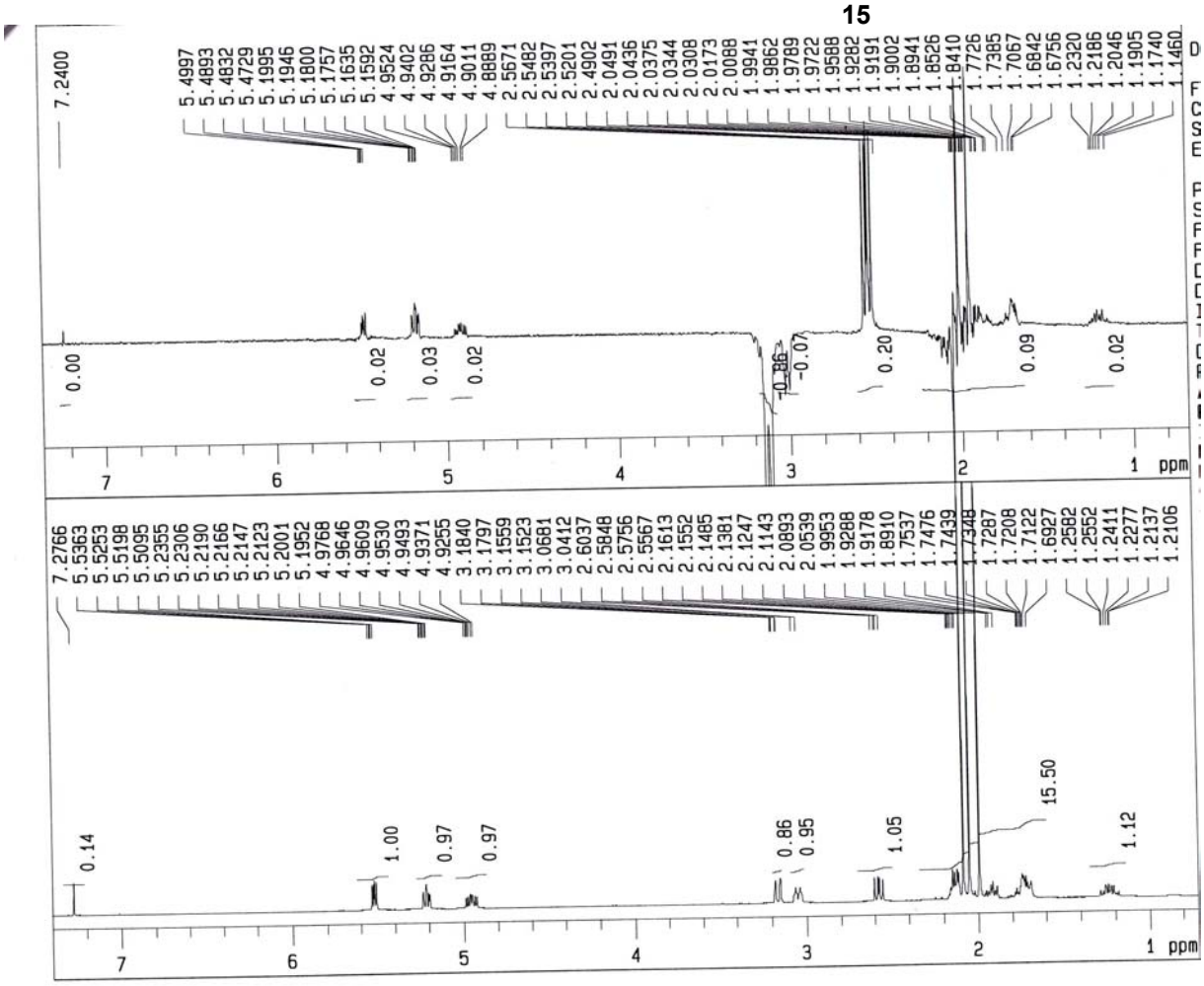
15



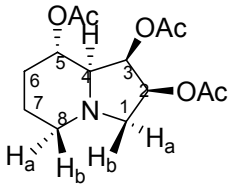
NOE spectrum of compound **15** (irradiation of H-1_a)



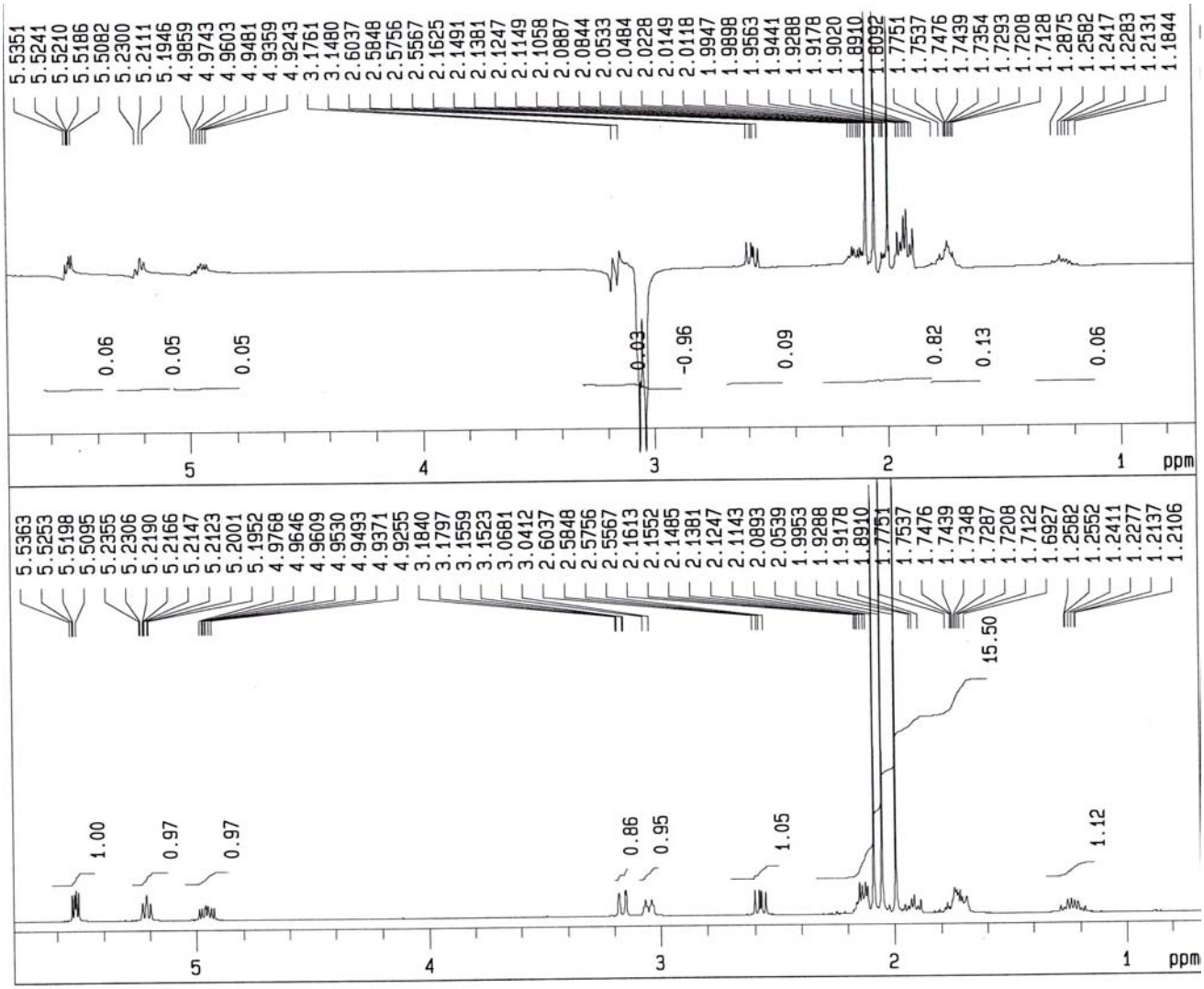
15



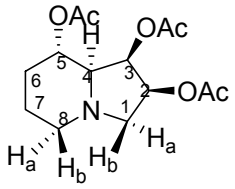
NOE spectrum of compound **15** (irradiation of H-8_b)



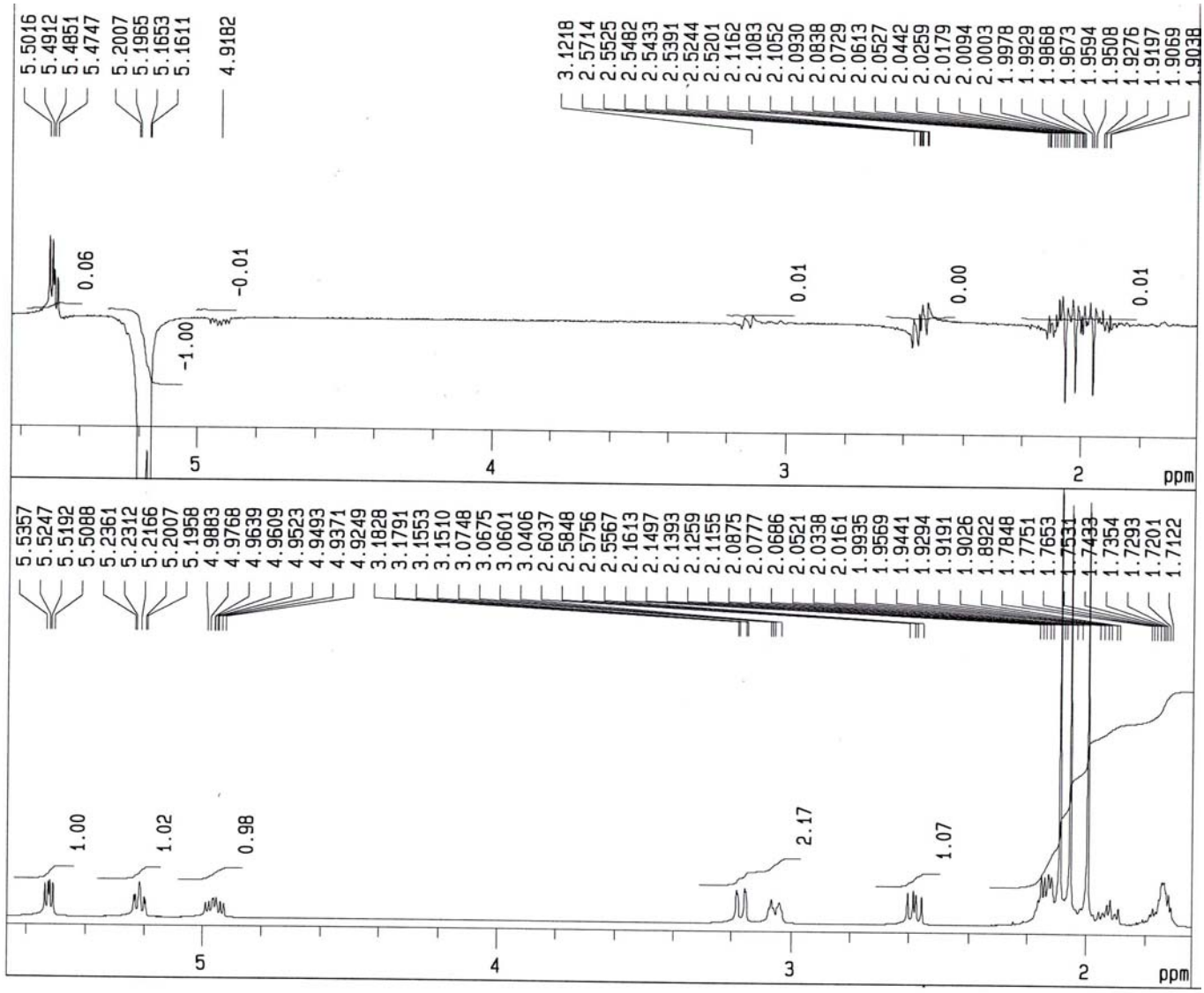
15



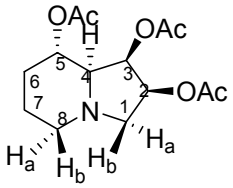
NOE spectrum of compound **15** (irradiation of H-2)



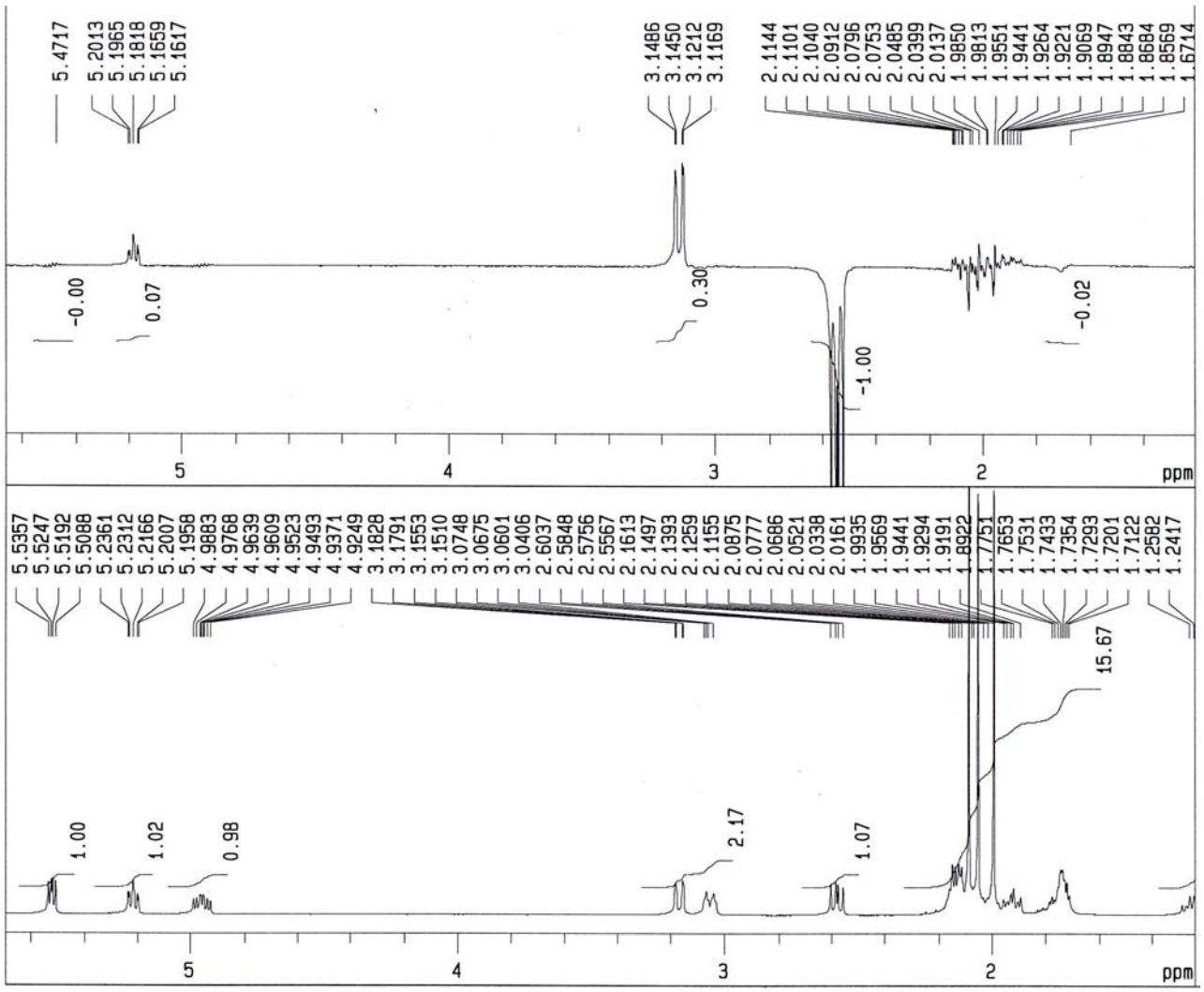
15

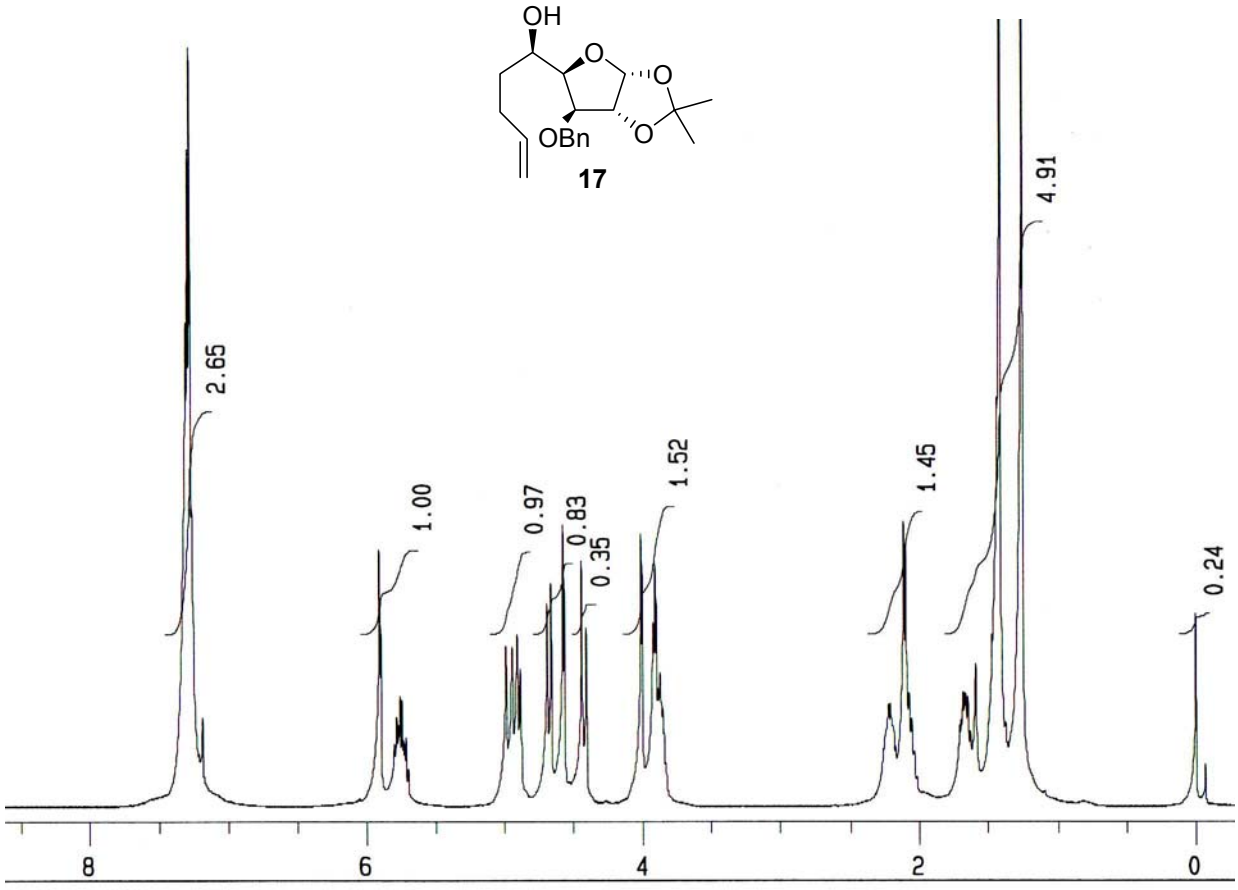


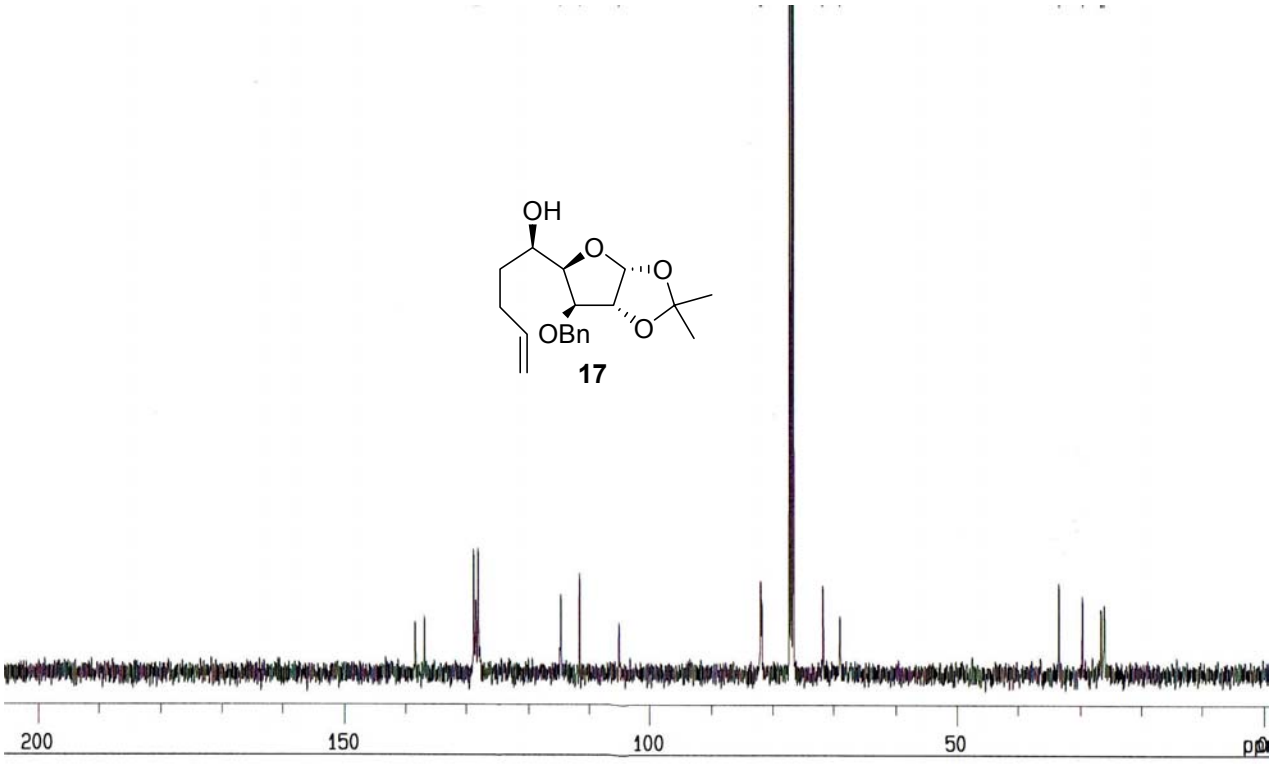
NOE spectrum of compound **15** (irradiation of H-1_b)



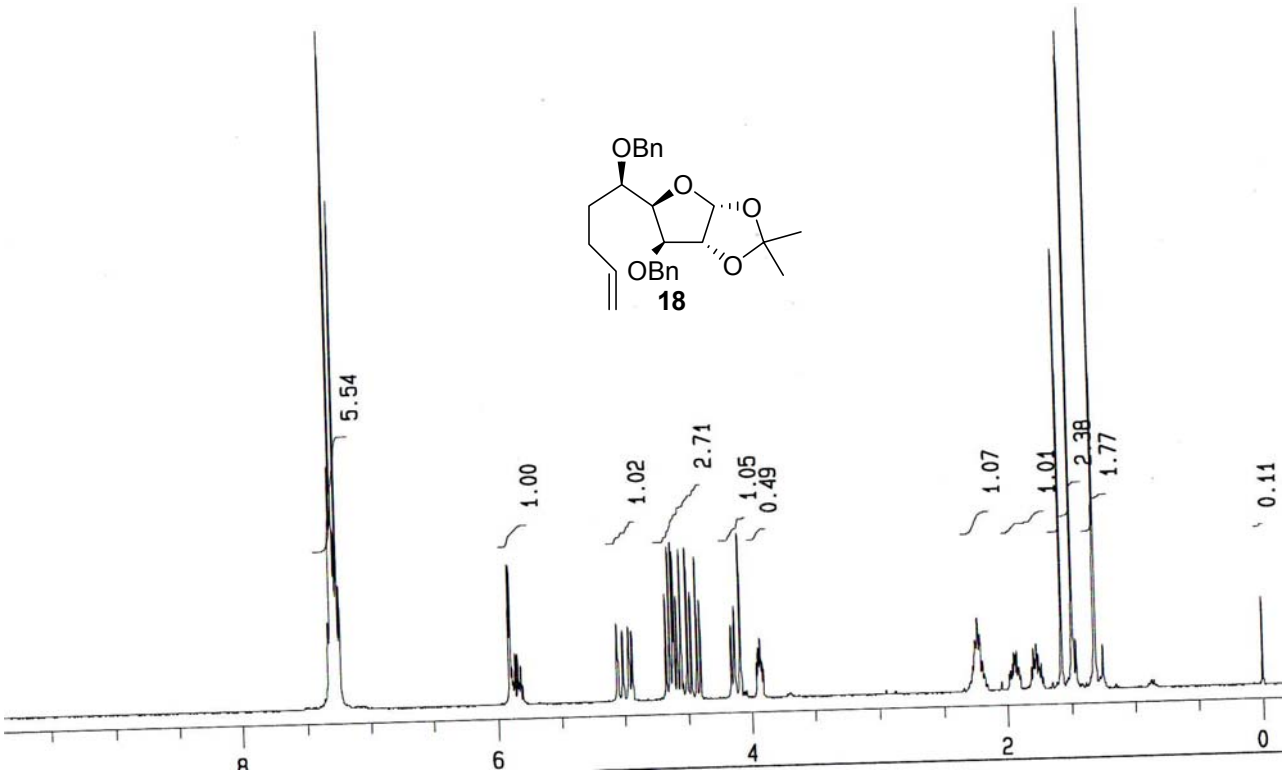
15

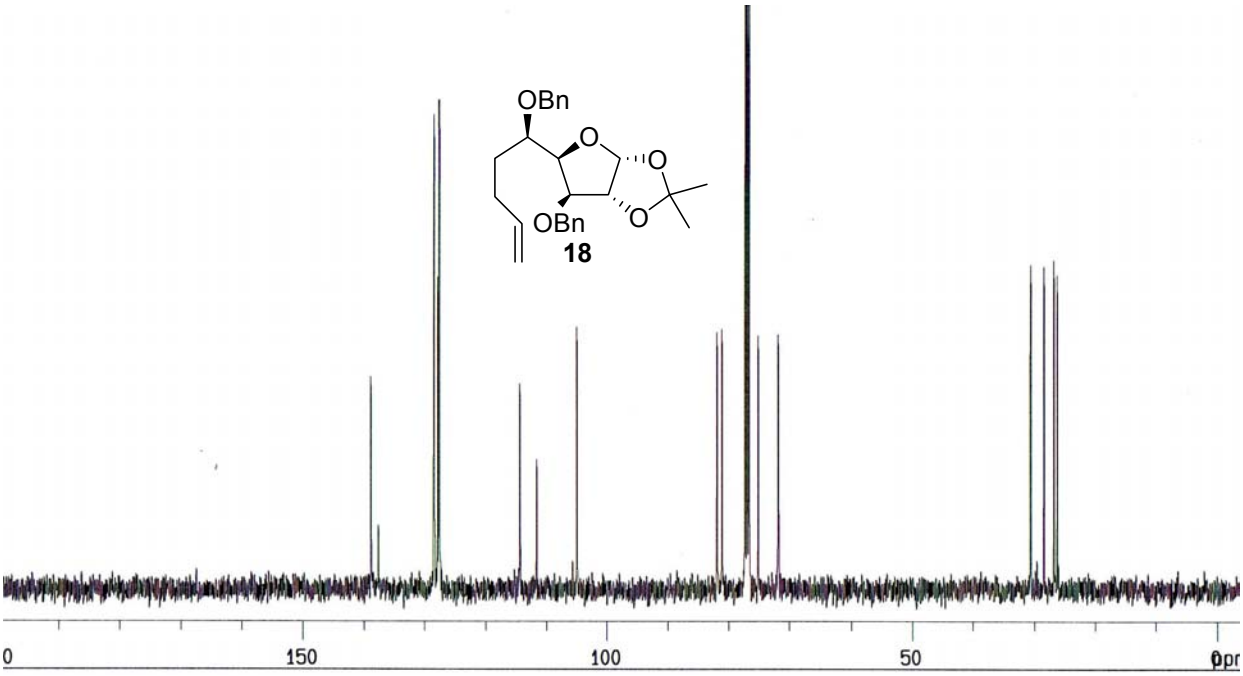


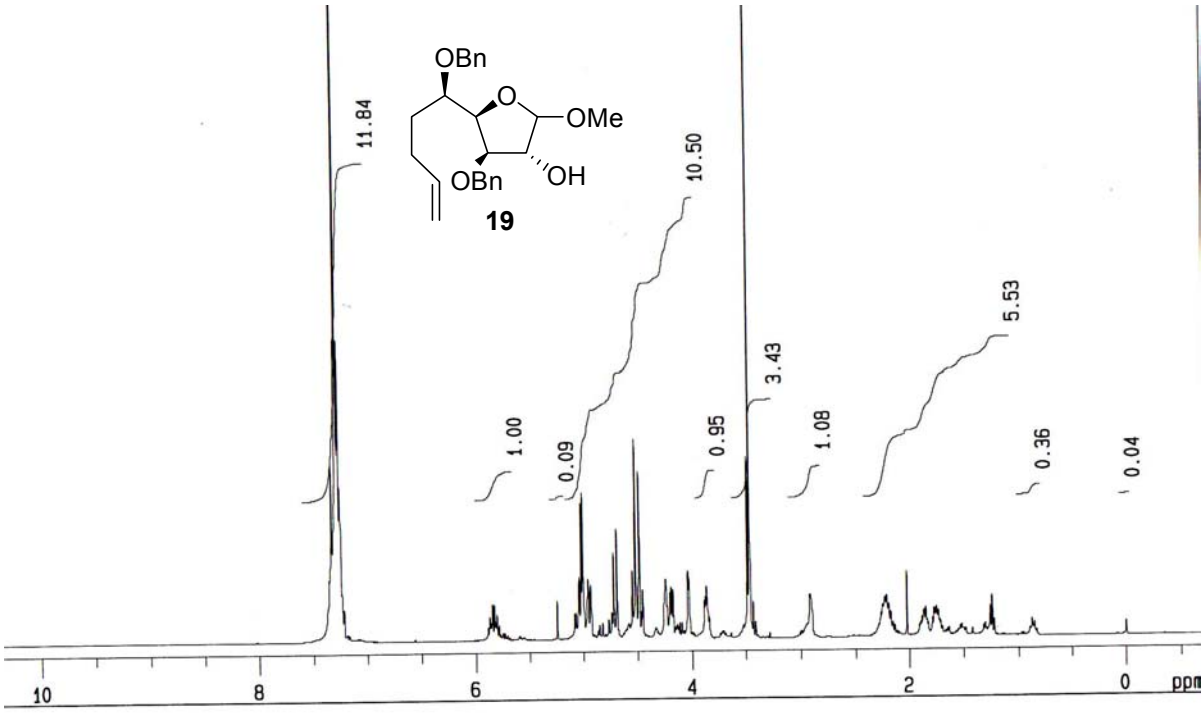

OH
O
O
O
OBn
17
2.65
1.00
0.97
0.83
0.35
1.52
1.45
4.91
0.24
8
6
4
2
0

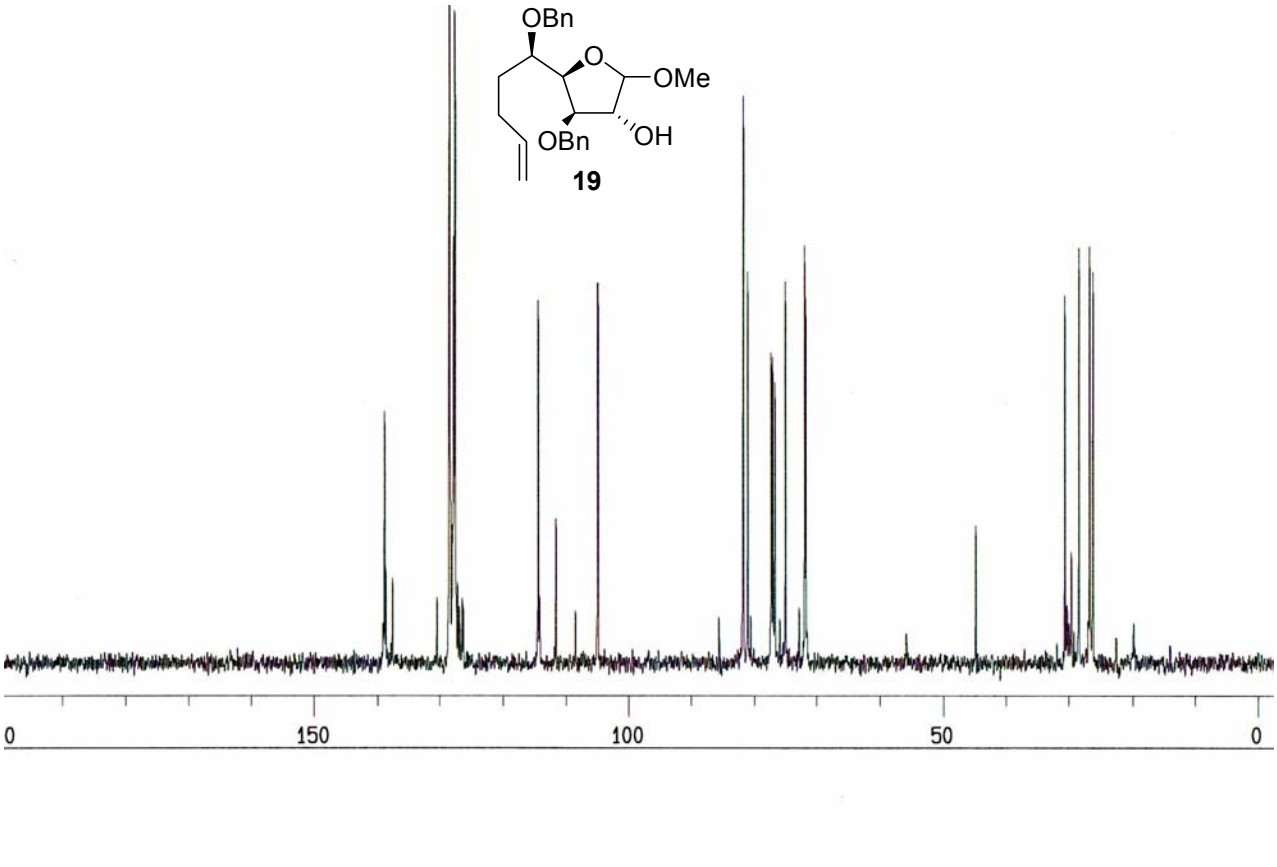


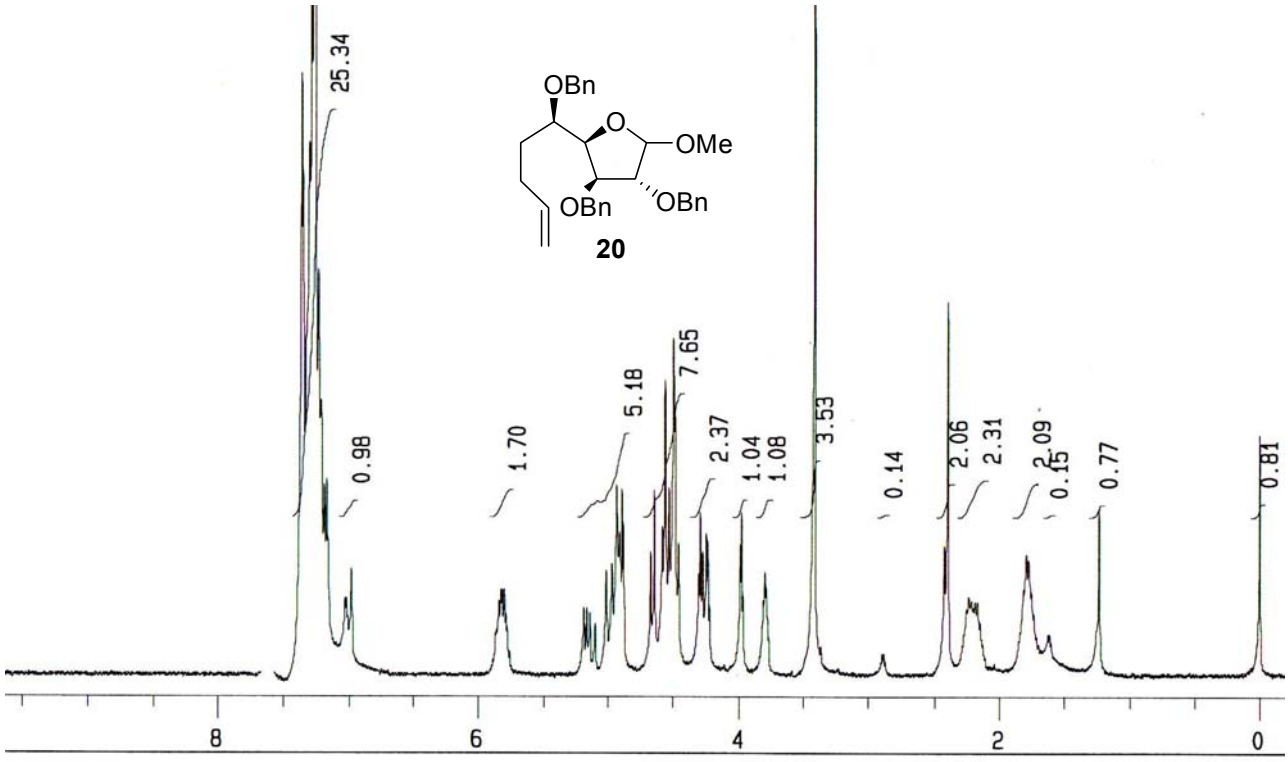
17

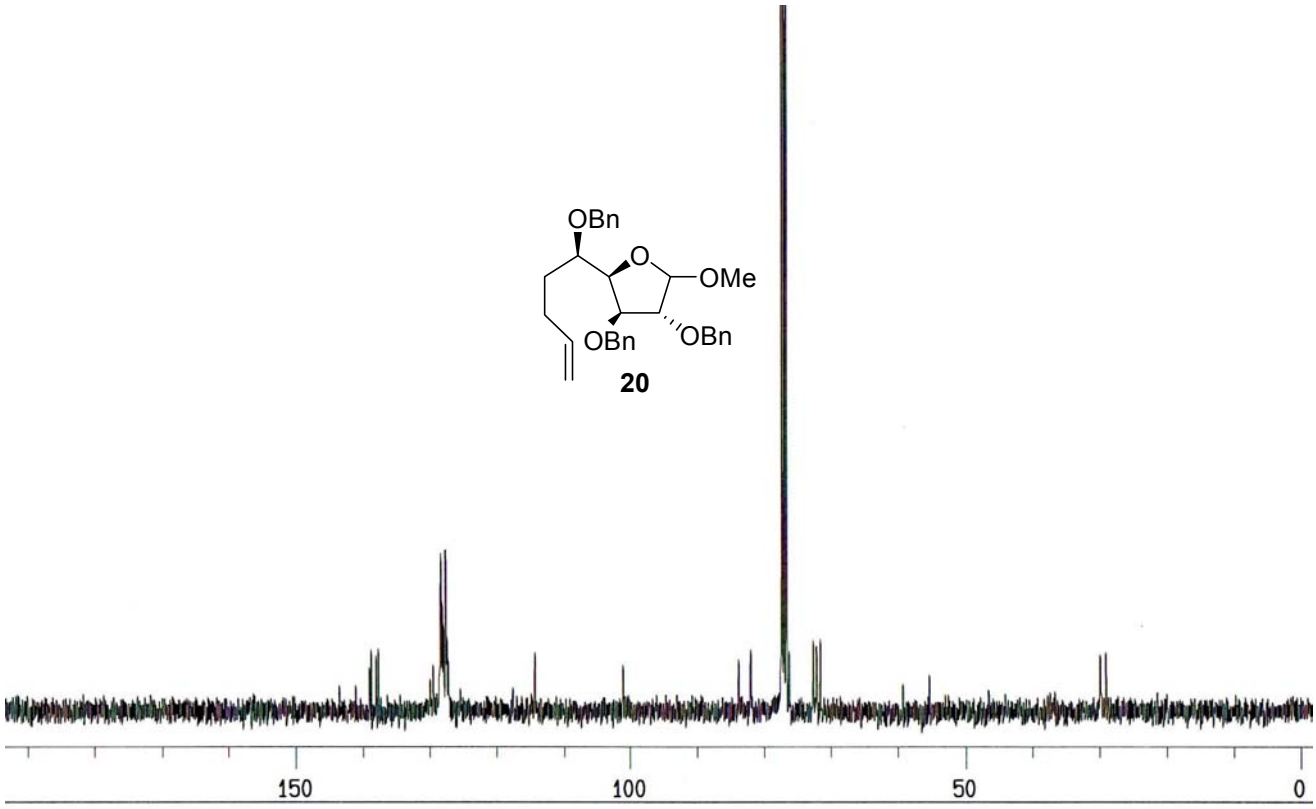

OBn
O
O
O
OBn
18
5.54
1.00
1.02
2.71
1.05
0.49
1.07
1.01
2.38
1.77
0.11
8
6
4
2
0


OBn
O
O
OBn
O
18
0
150
100
50
0ppr

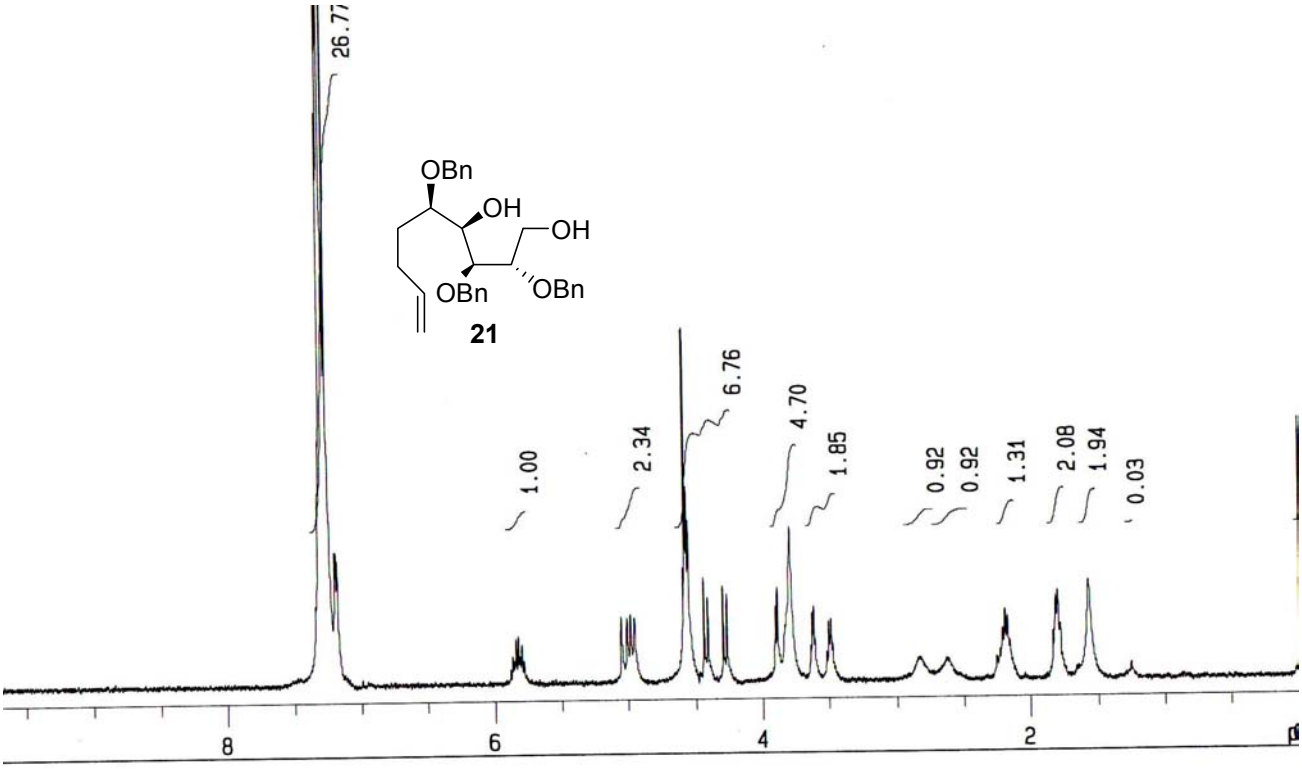

OBn
O
OMe
OBn
OH
19
11.84
1.00
0.09
10.50
0.95
3.43
1.08
5.53
0.36
0.04
10
8
6
4
2
0
ppm

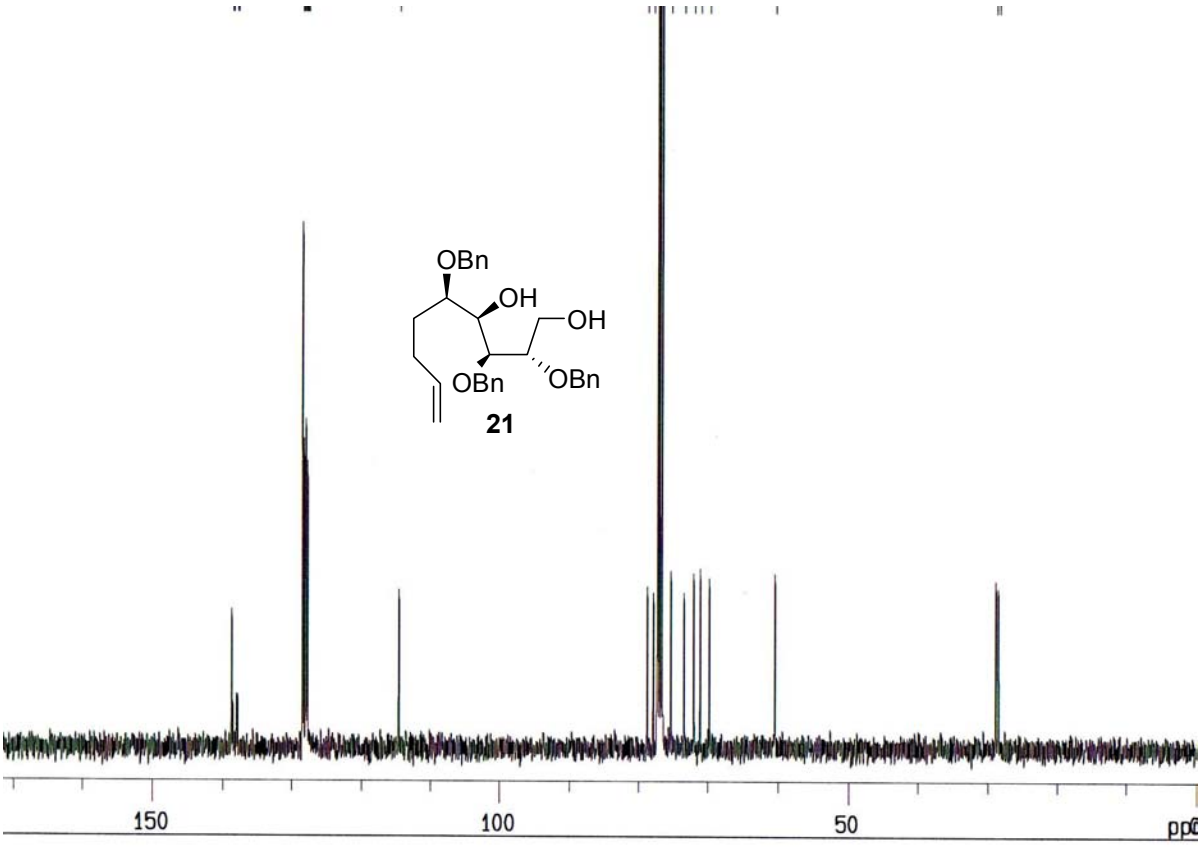

OBn
O
OMe
OBn
OH
19
0
150
100
50
0

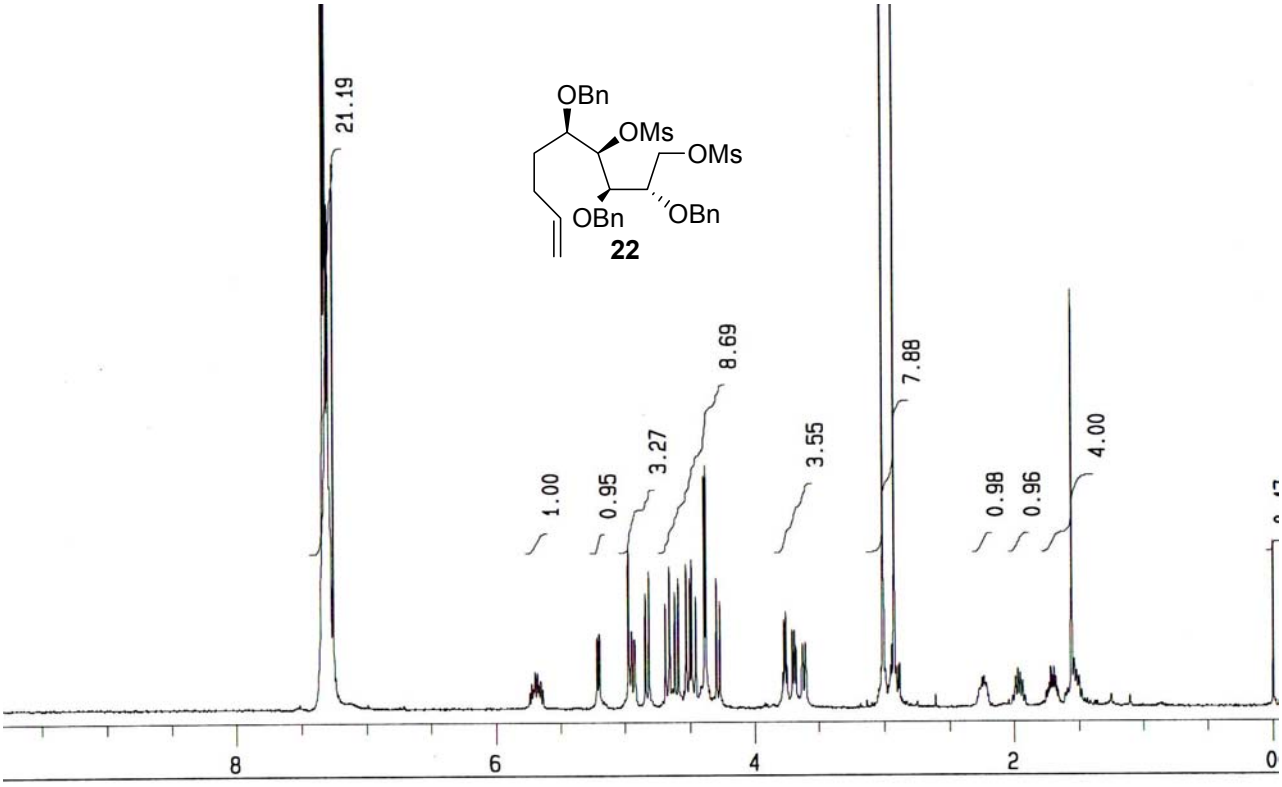

OBn
O
OMe
OBn
OBn
20
25.34
0.98
1.70
5.18
7.65
2.37
1.04
1.08
3.53
0.14
2.06
2.31
2.09
0.15
0.77
0.81
8
6
4
2
0

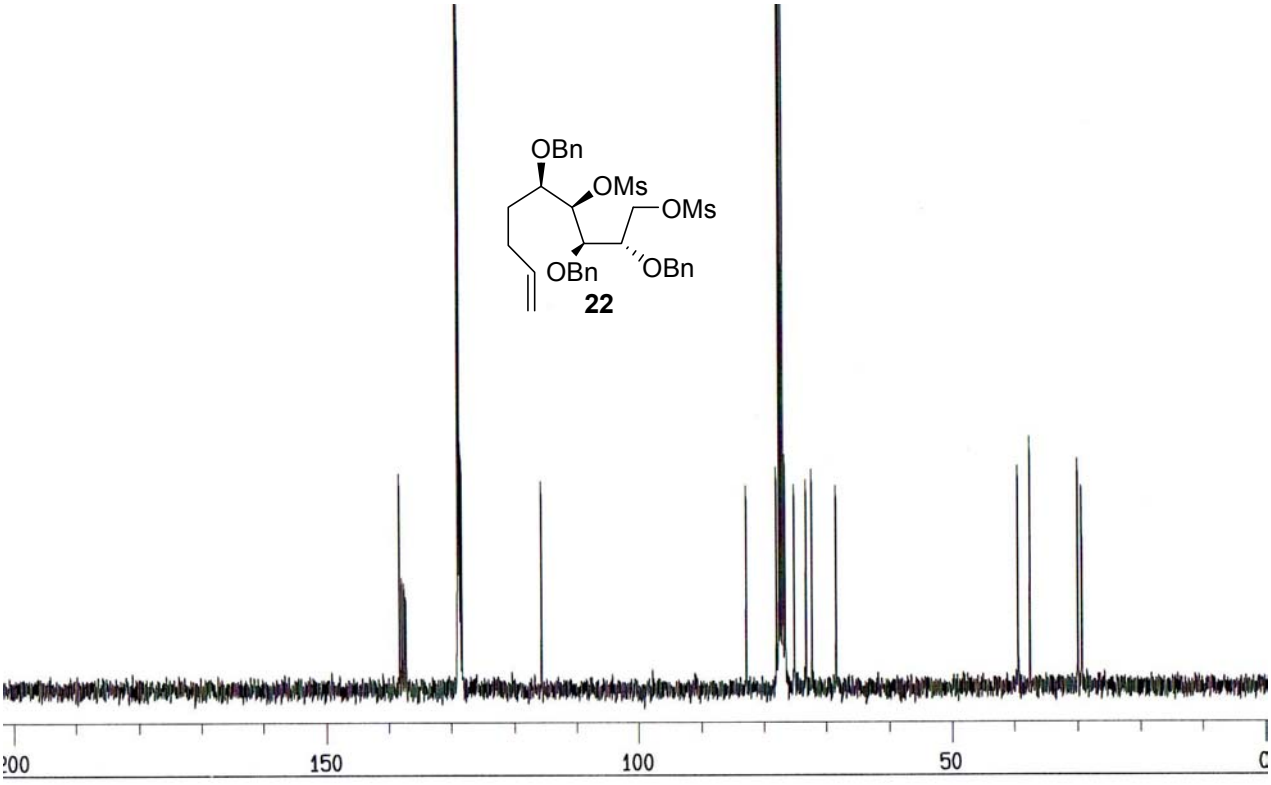


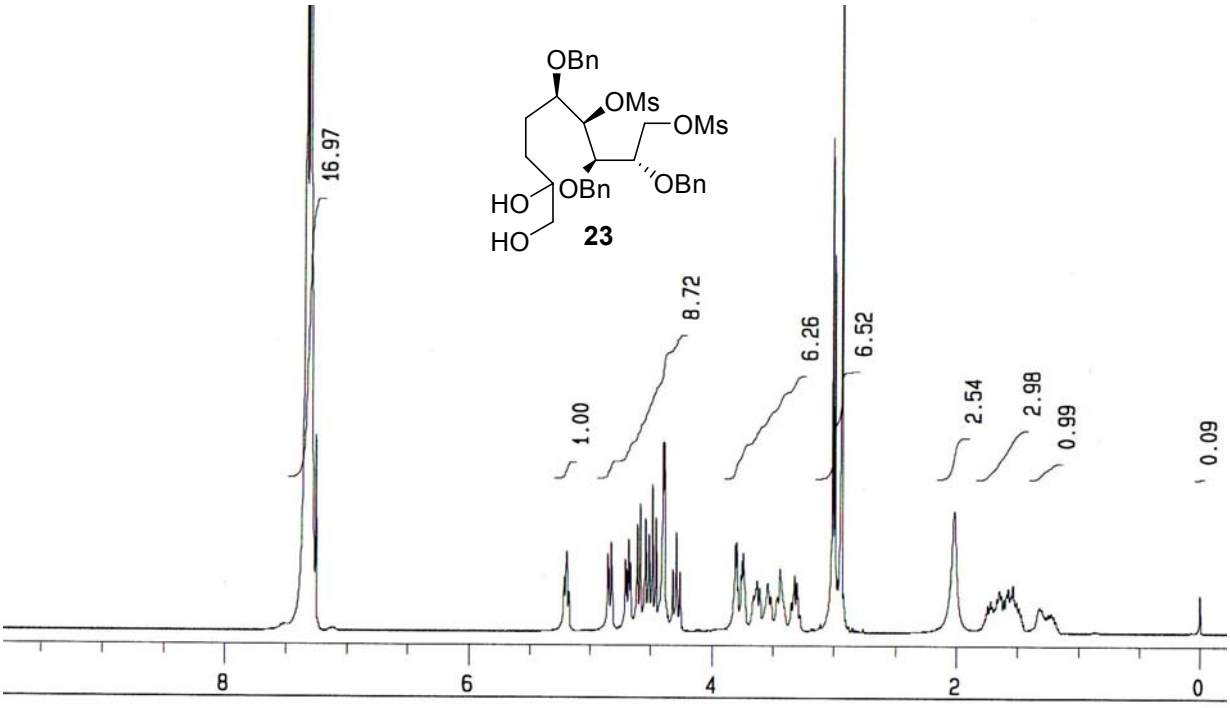
20

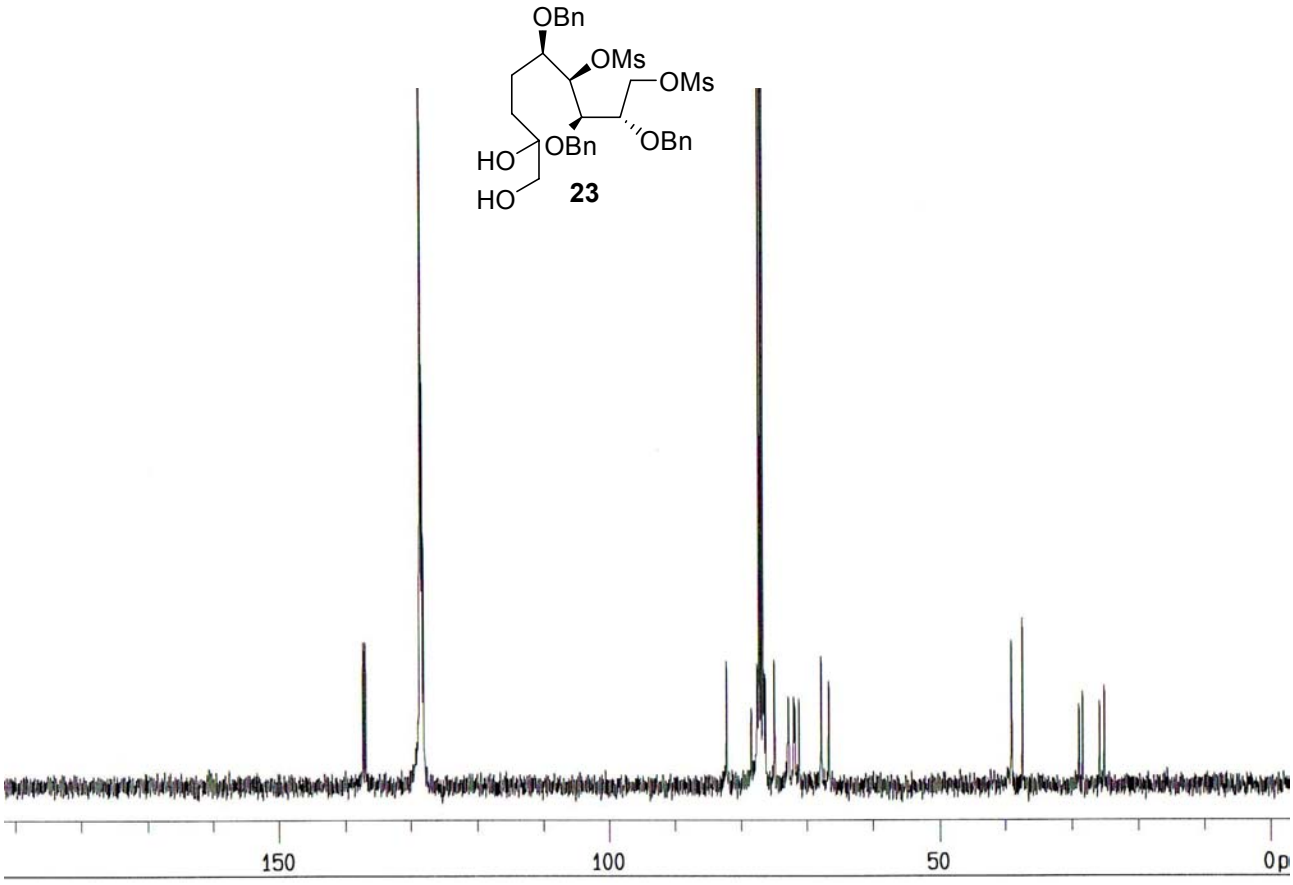

OBn
OH
OH
OBn
OBn
21
26.77
1.00
2.34
6.76
4.70
1.85
0.92
0.92
1.31
2.08
1.94
0.03
8
6
4
2

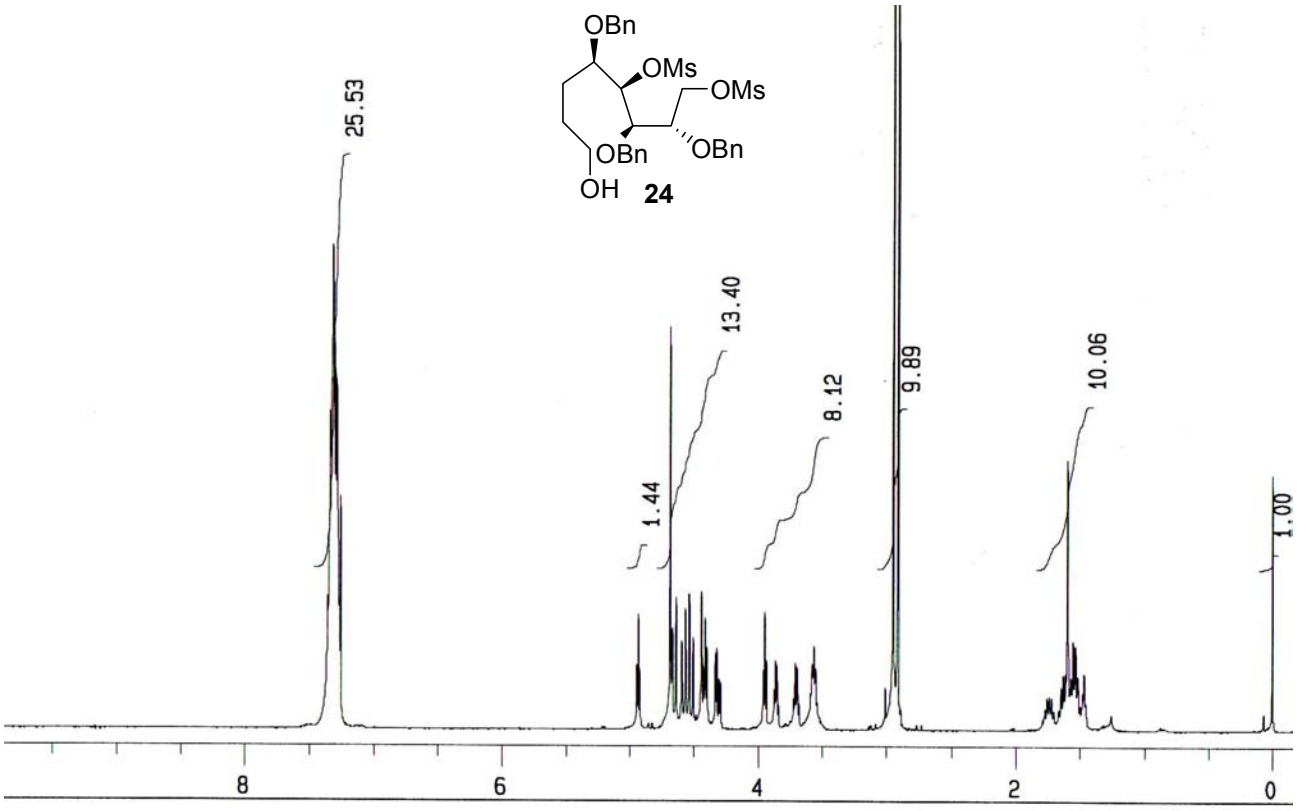

OBn
OH
OH
OBn
OBn
21
150
100
50
ppm

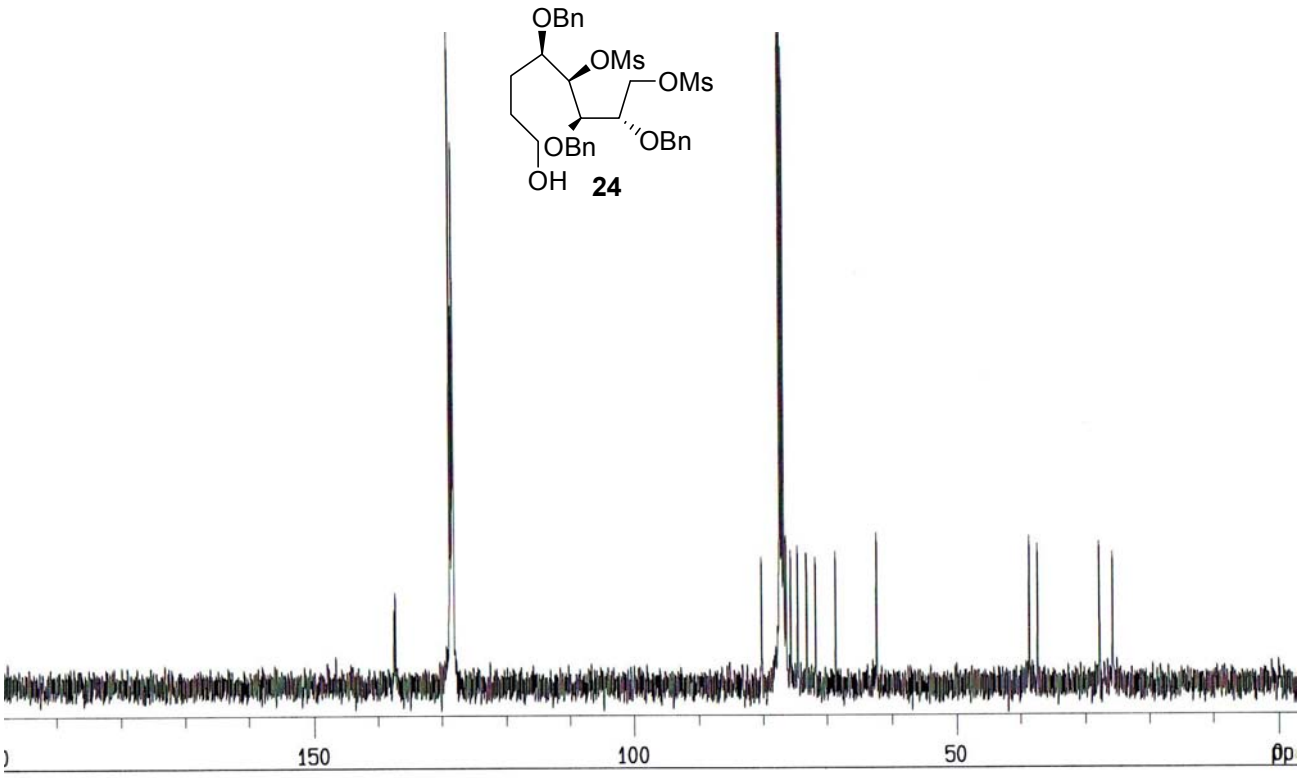

OBn
OMs
OMs
OBn
OBn
22
21.19
1.00
0.95
3.27
8.69
3.55
7.88
0.98
0.96
4.00
8
6
4
2
0

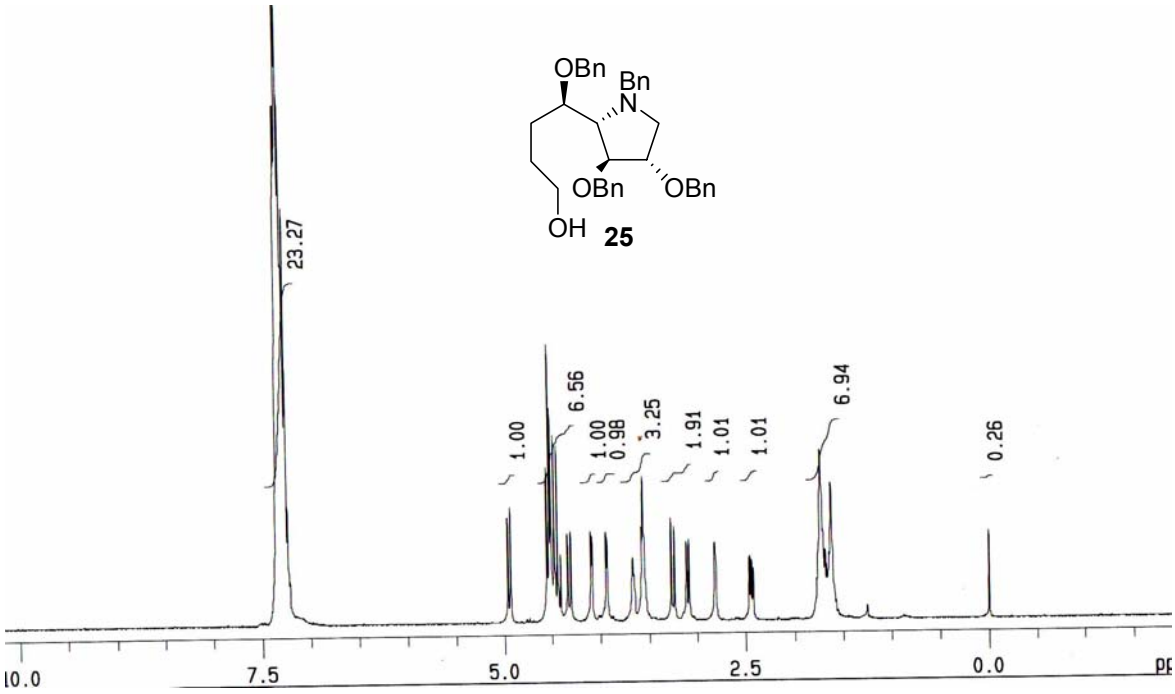

OBn
OMs
OMs
OBn
OBn
22
200
150
100
50

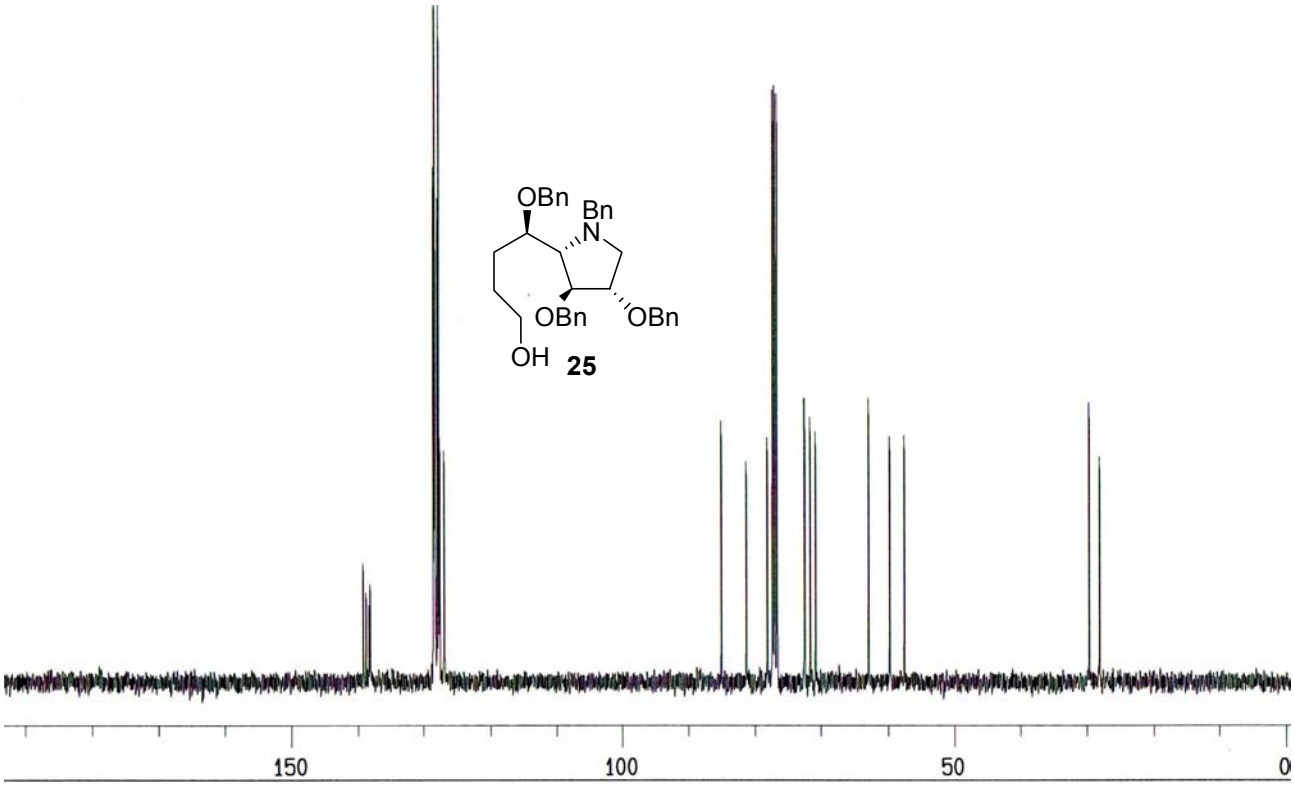

OBn
OMs
OMs
OBn
OBn
HO
HO
23
16.97
1.00
8.72
6.26
6.52
2.54
2.98
0.99
0.09
8
6
4
2
0


OBn
OMs
OMs
OBn
OBn
HO
HO
23
150
100
50
0p


OBn
OMs
OMs
OBn
OBn
OH
24
25.53
13.40
8.12
9.89
10.06
1.44
1.00
8
6
4
2
0

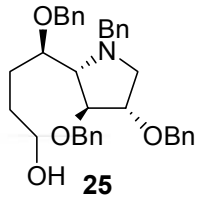

OBn
OMs
OMs
OBn
OBn
OH
24
150
100
50


OBn
Bn
N
OBn
OBn
OH
25
23.27
1.00
6.56
1.00
0.98
3.25
1.91
1.01
1.01
6.94
0.26
10.0
7.5
5.0
2.5
0.0

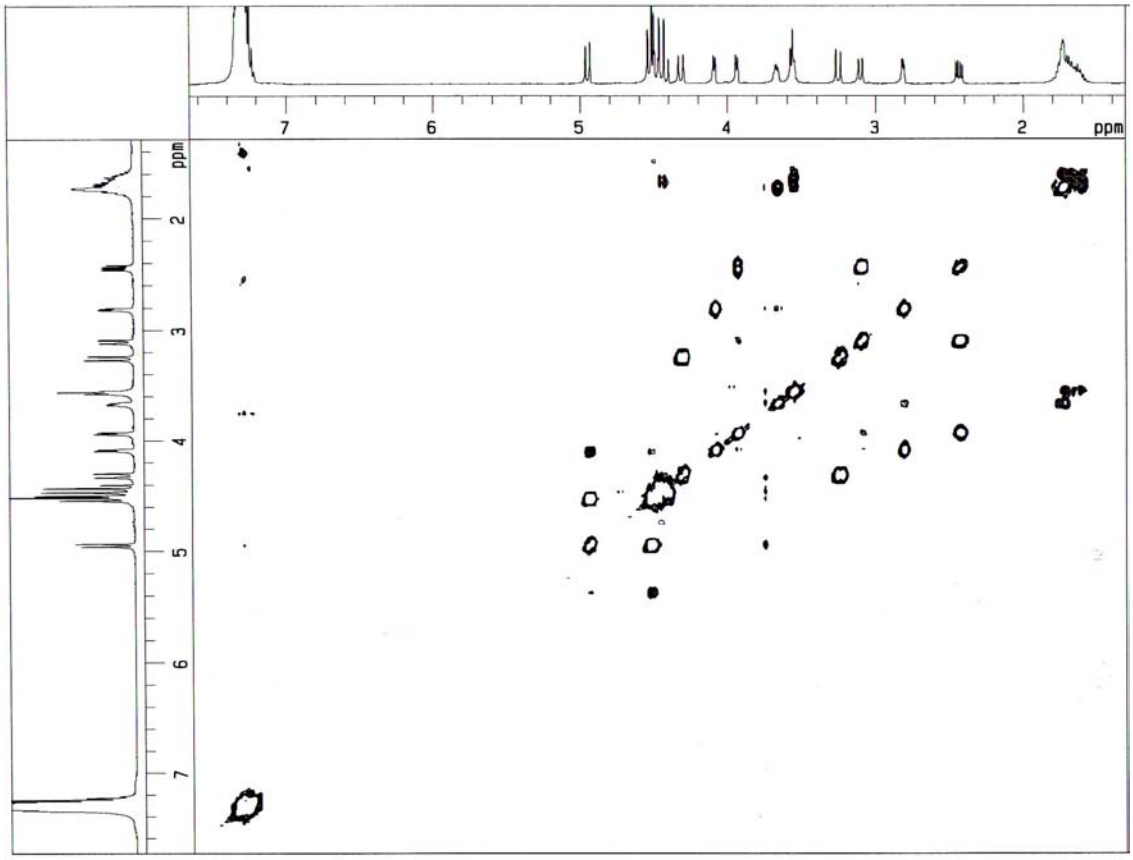


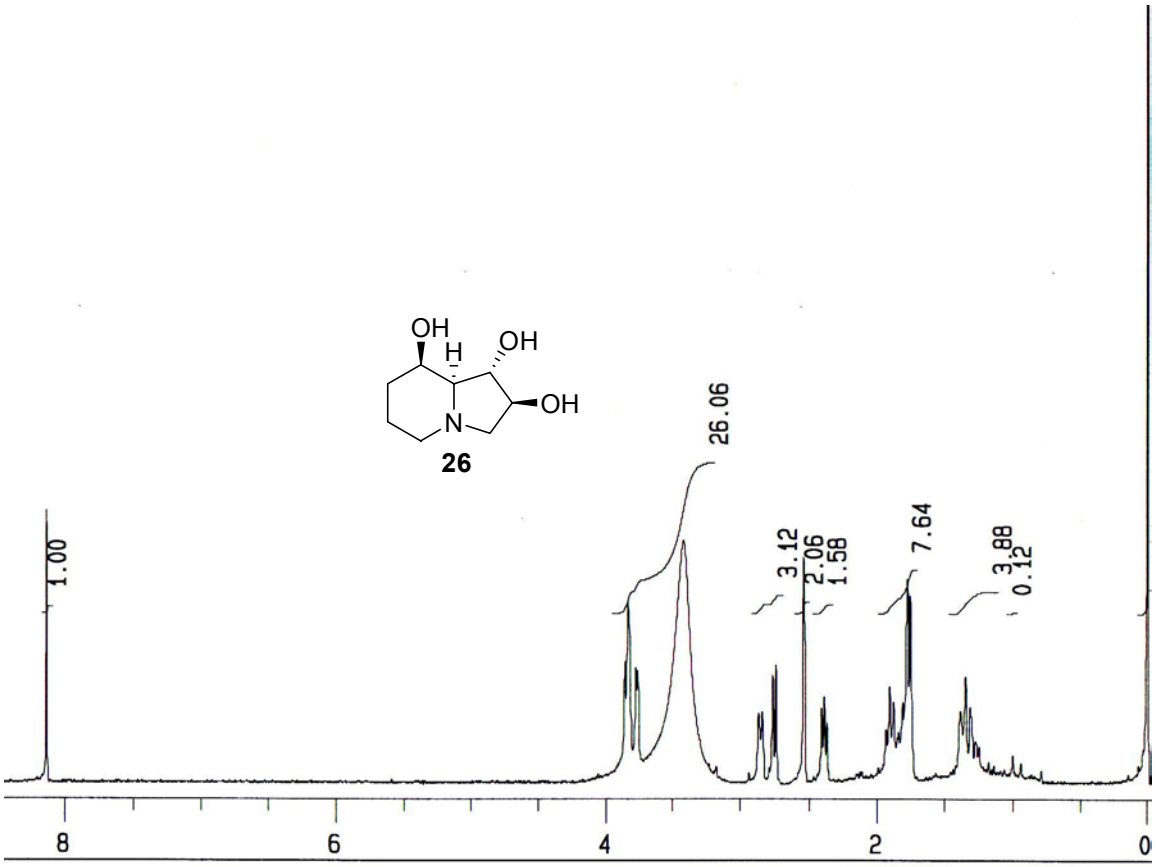
25

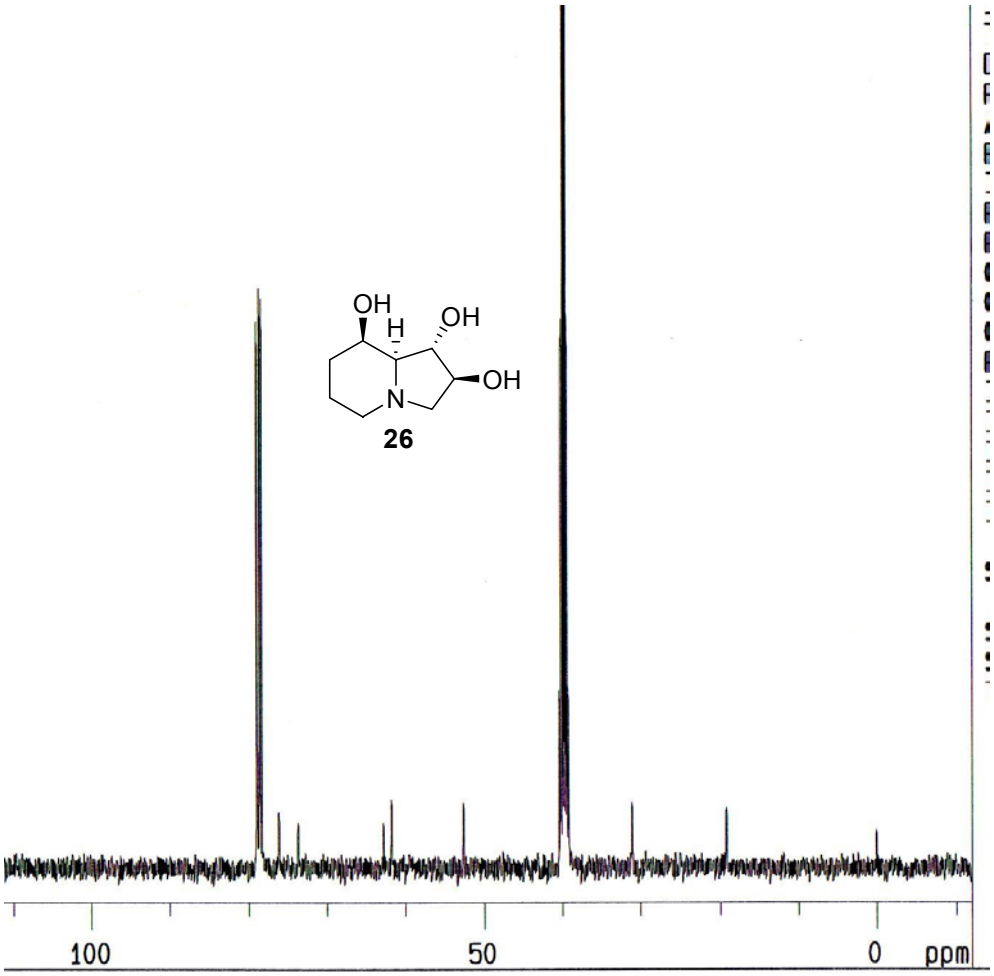
COSY spectrum of compound **25**



25

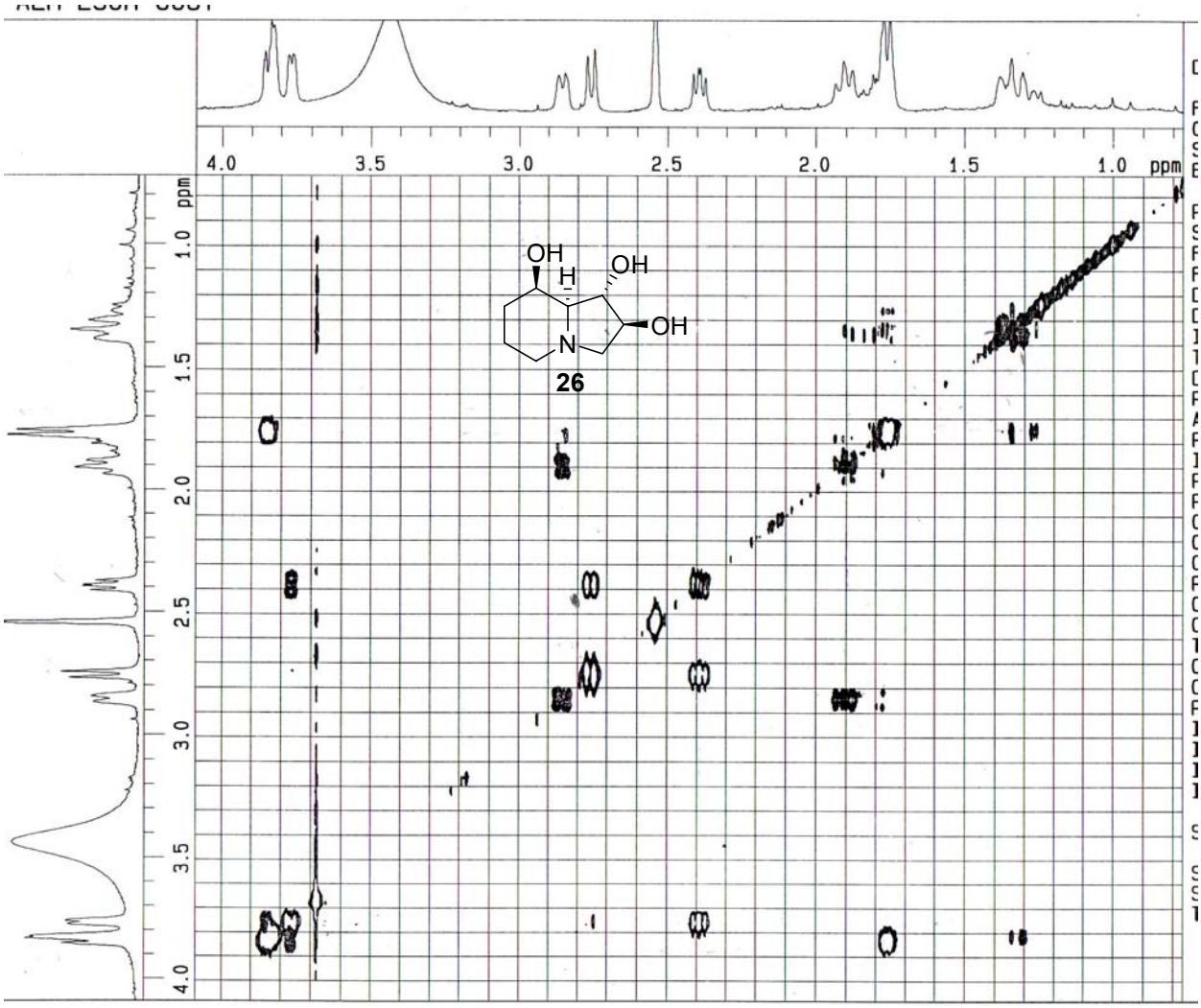



OH
H
OH
OH
N
26
26.06
1.00
3.12
2.06
1.58
7.64
3.88
0.12
8
6
4
2
0

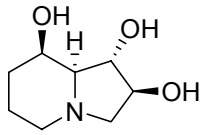


26

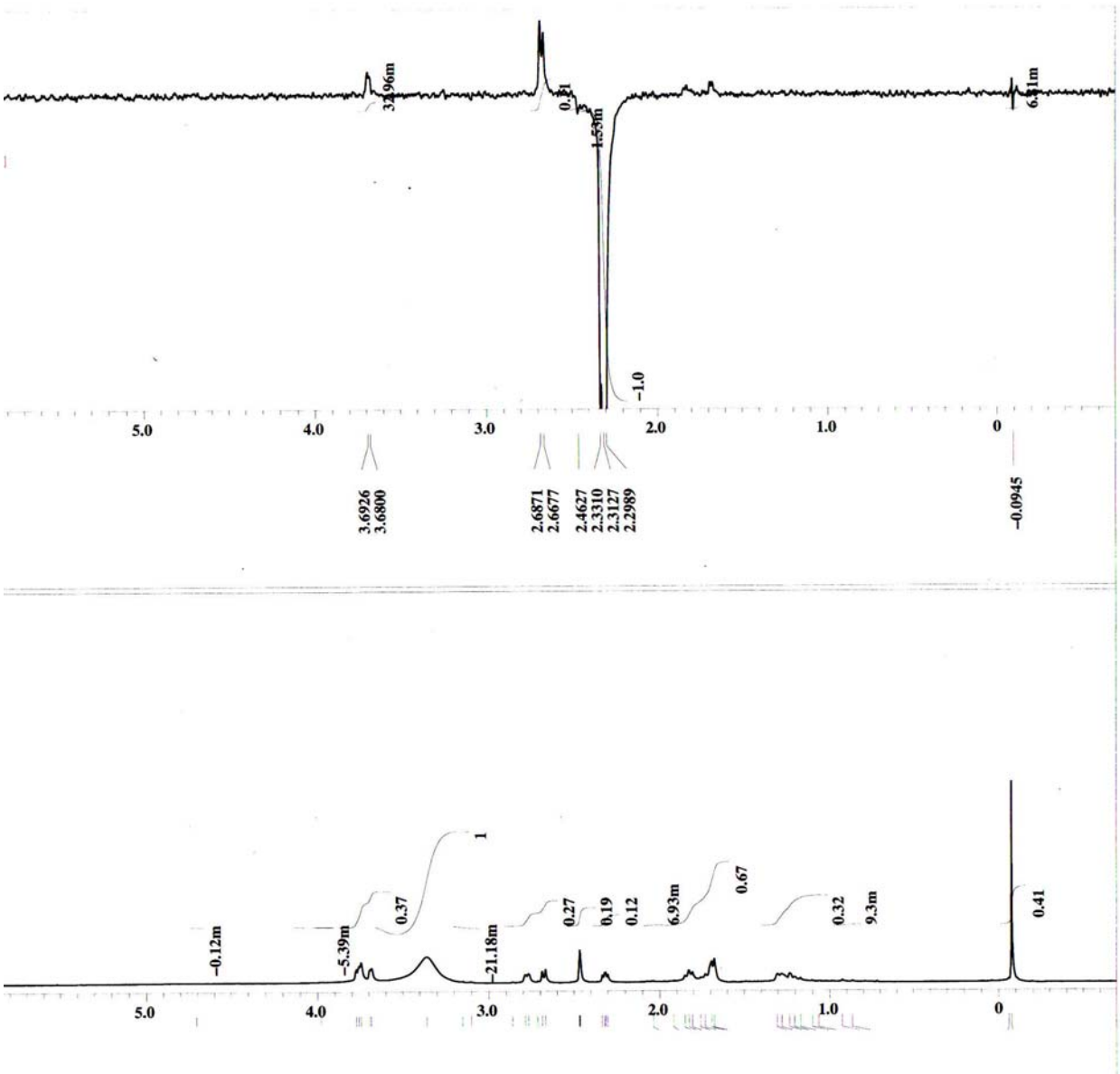
COSY spectrum of compound **26**



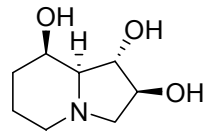
NOE spectrum of compound **26**



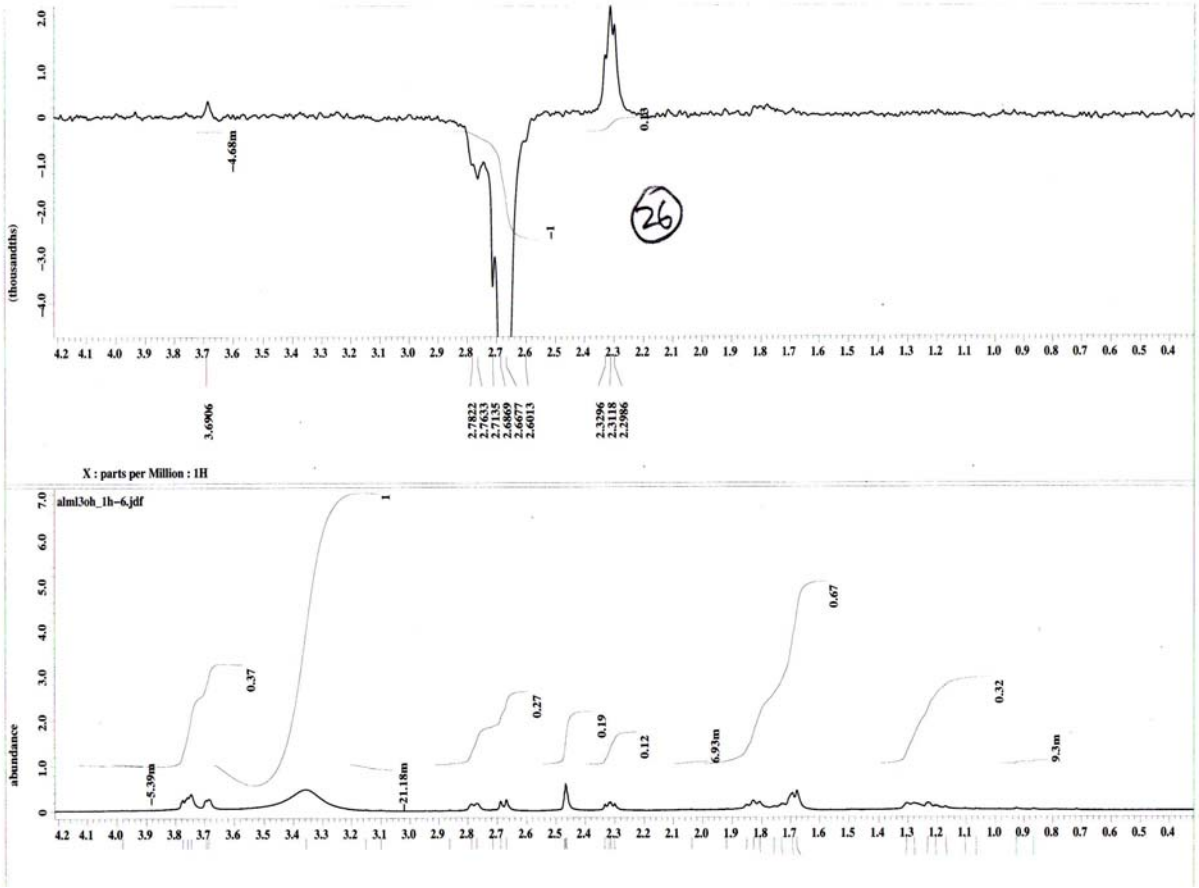
26



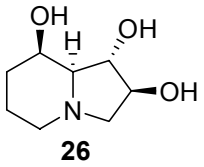
NOE spectrum of compound **26**



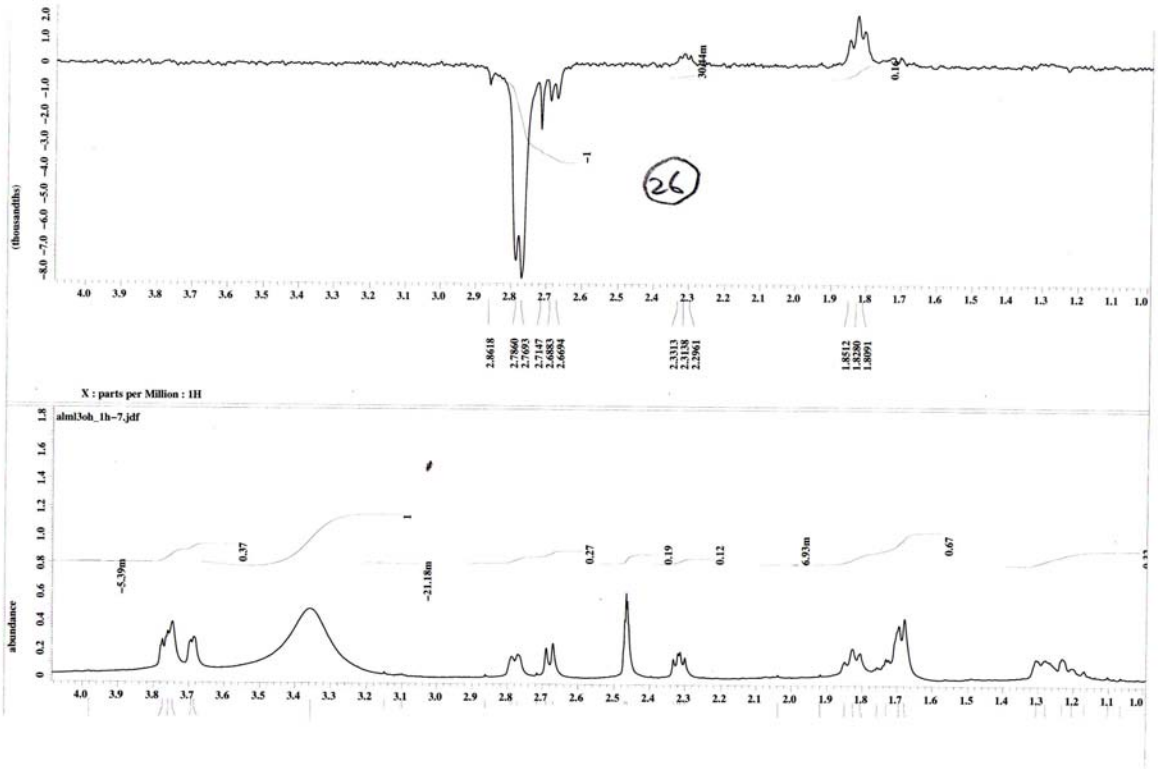
26

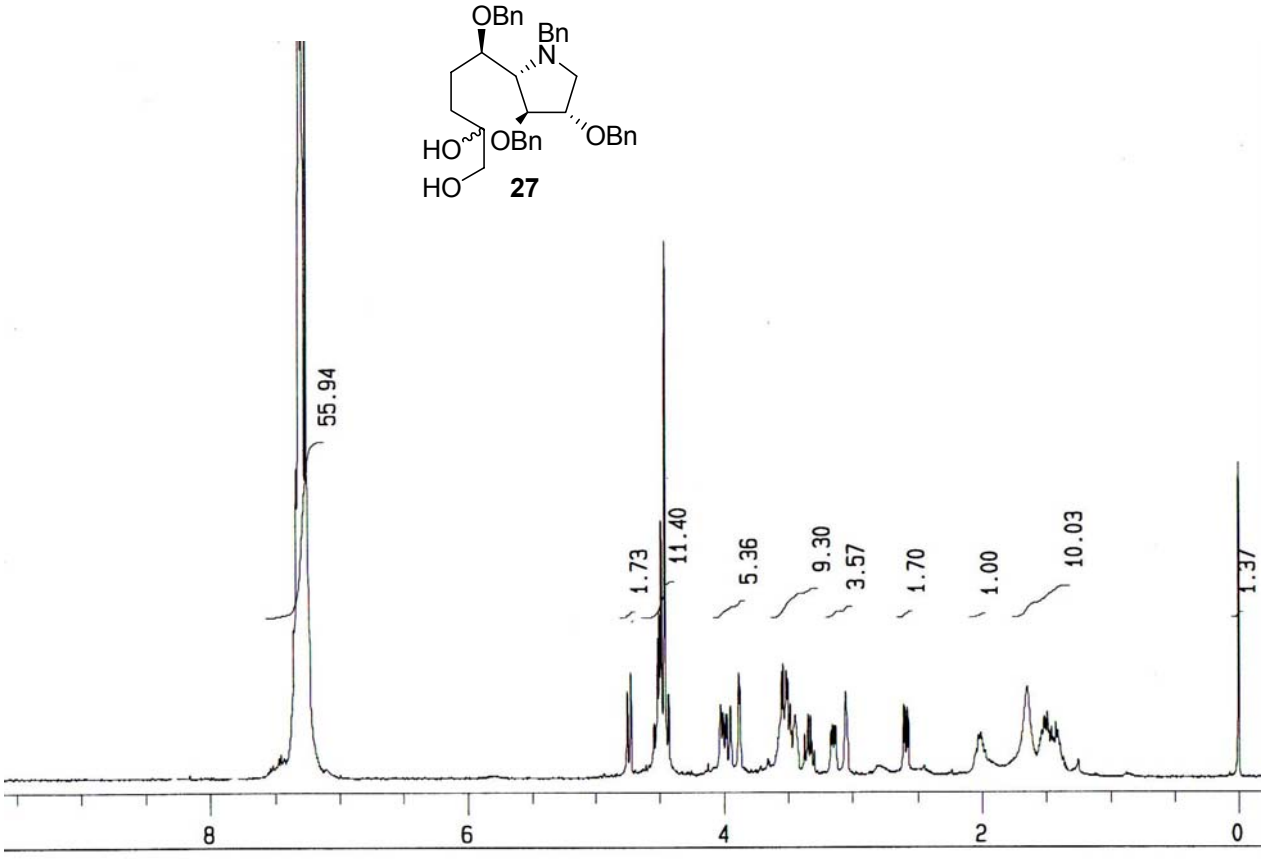


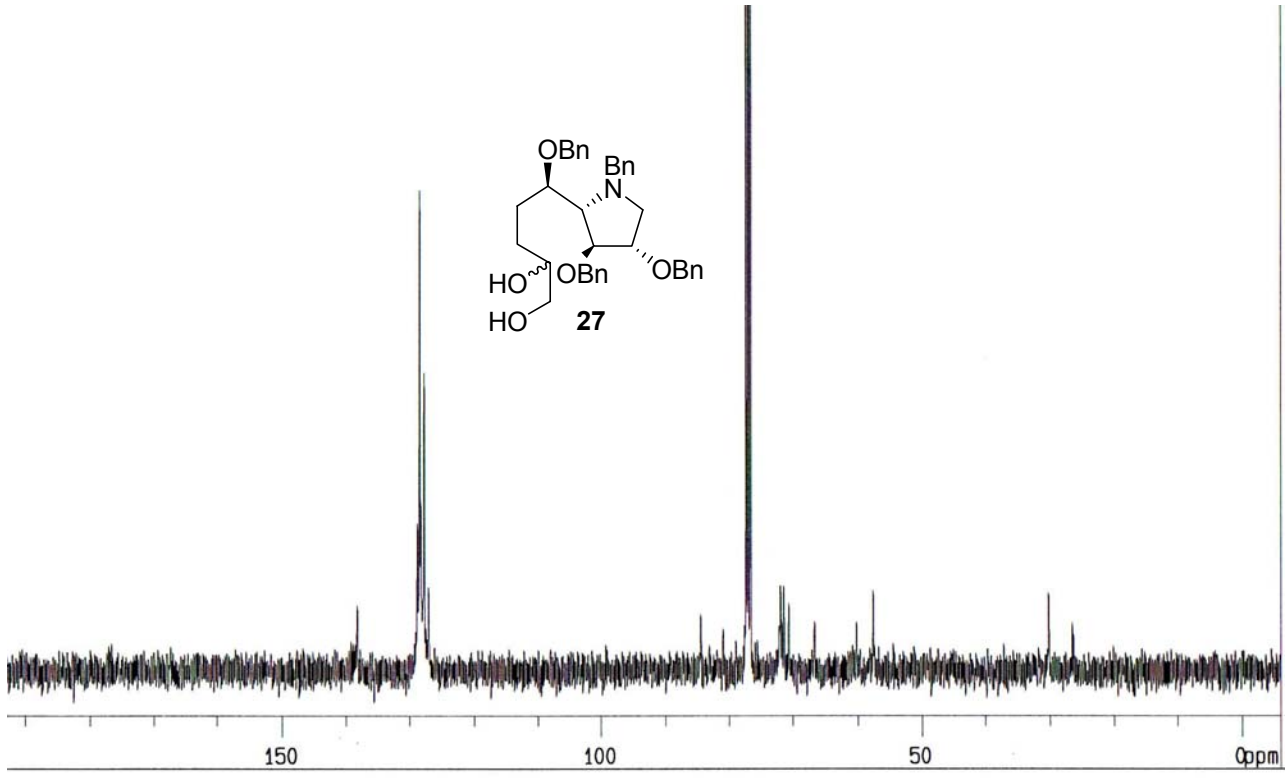
NOE spectrum of compound **26**

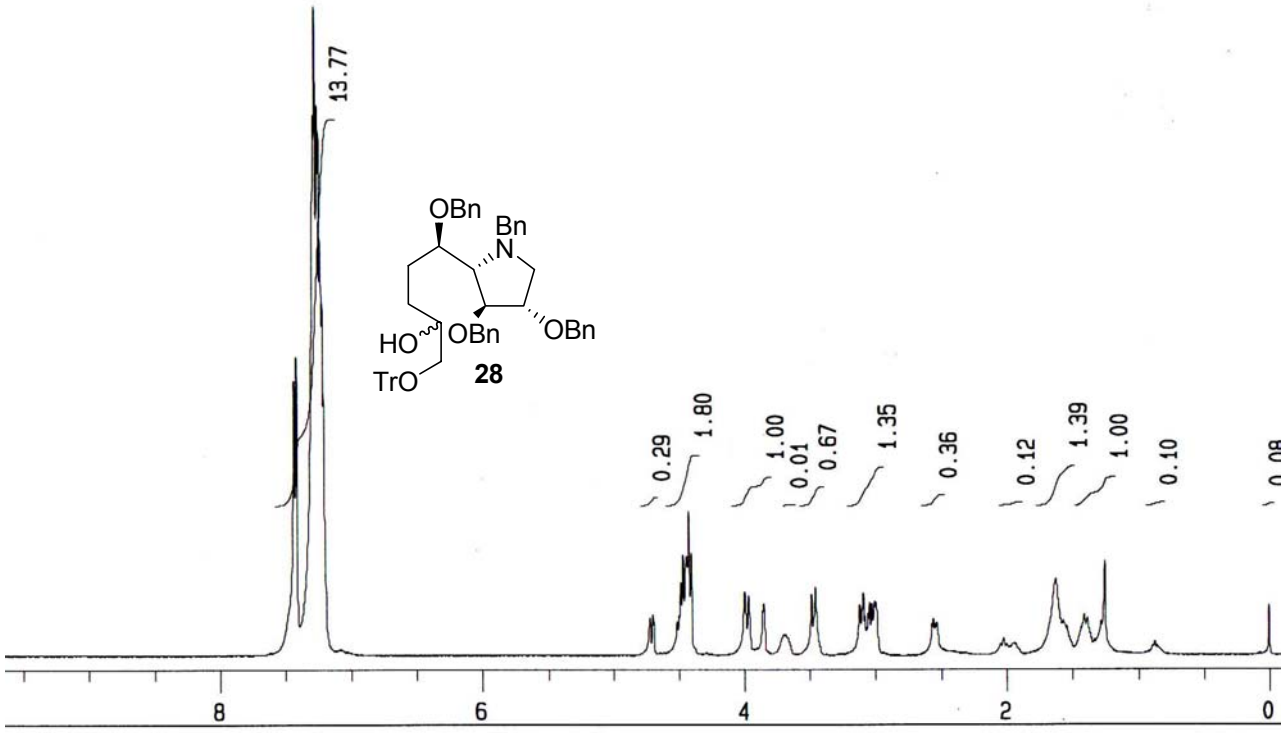


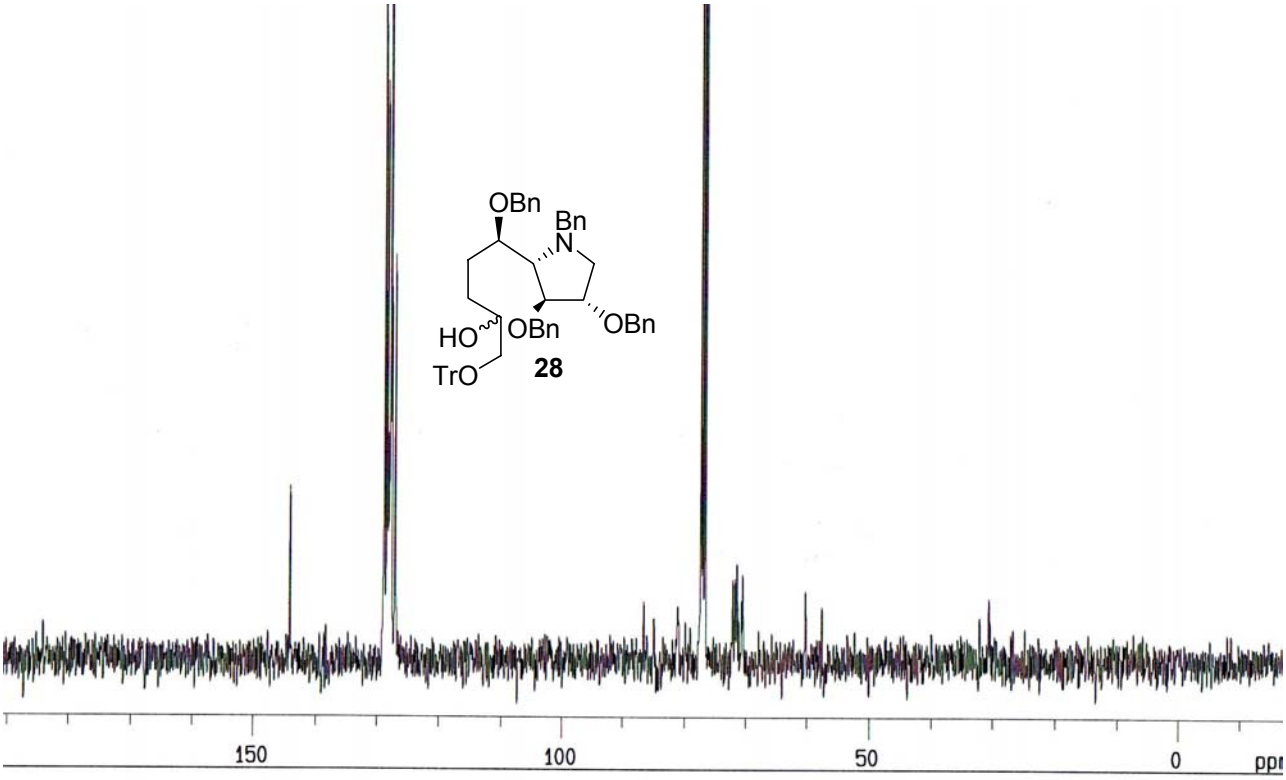
26

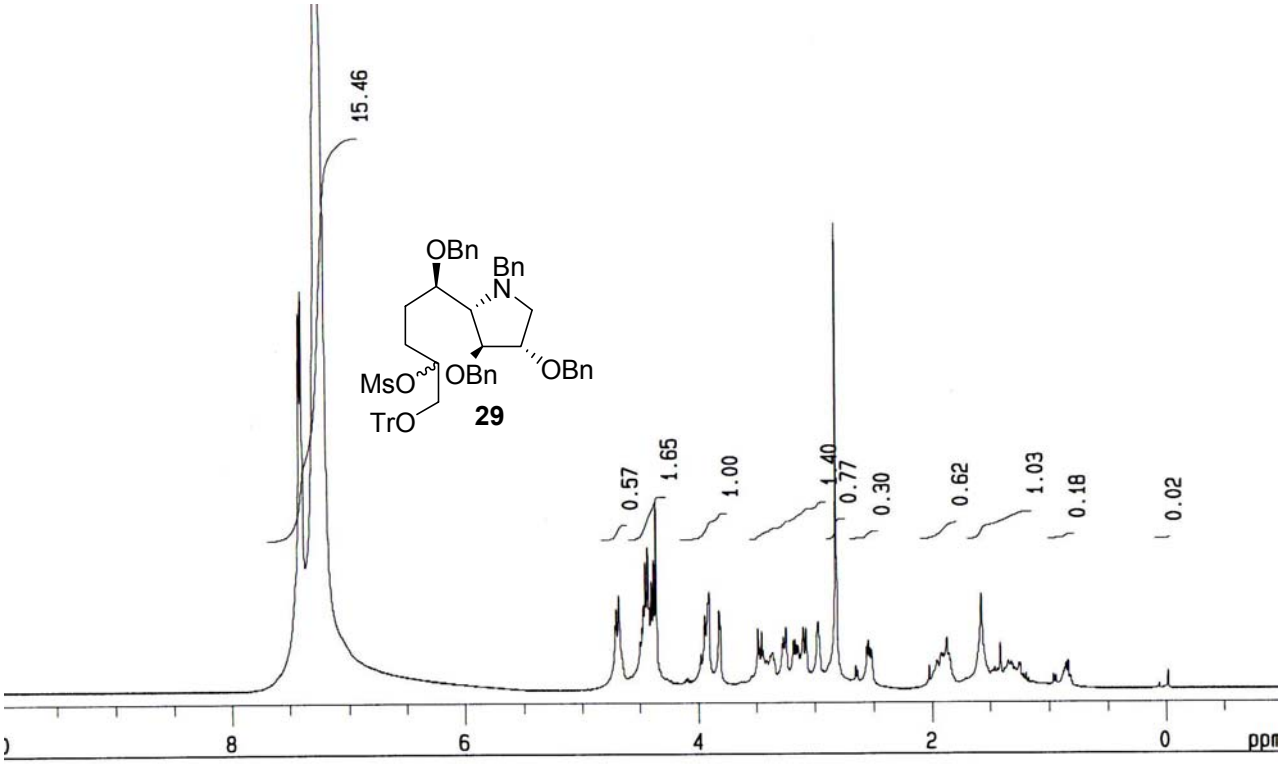


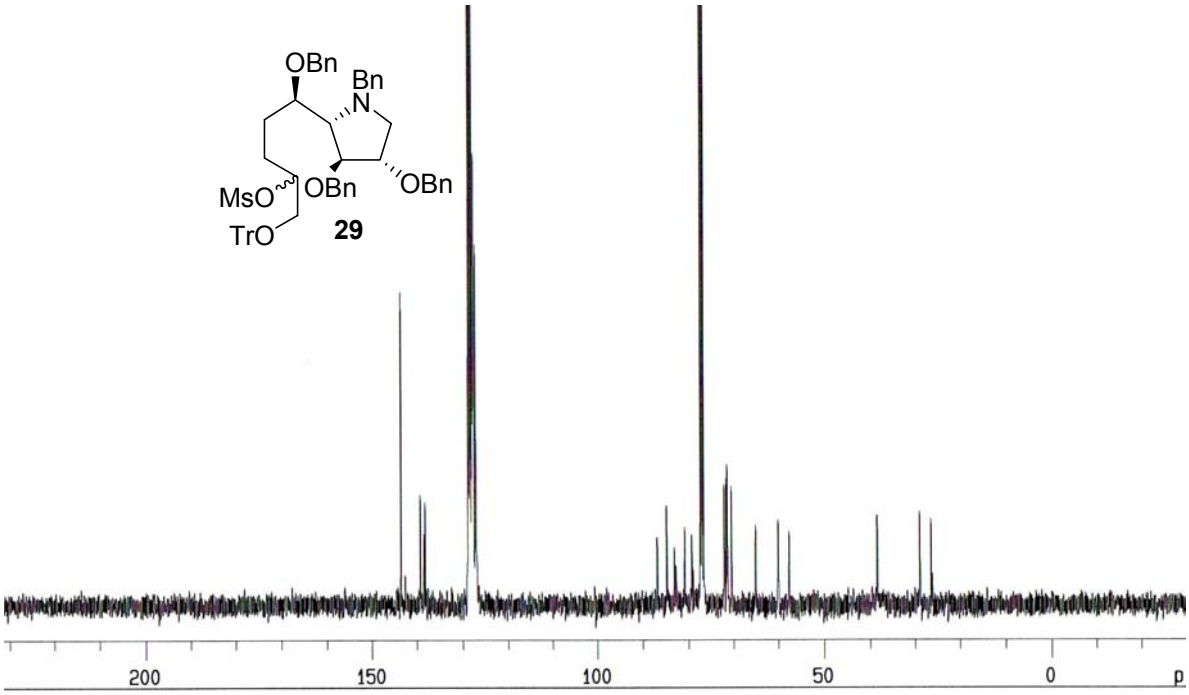

OBn
Bn
N
HO
OBn
OBn
HO
27
55.94
1.73
11.40
5.36
9.30
3.57
1.70
1.00
10.03
1.37
8
6
4
2
0


OBn
Bn
N
HO
OBn
OBn
HO
27
150
100
50
0ppm

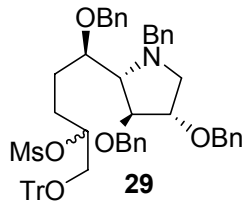

13.77
OBn
Bn
N
HO
OBn
OBn
TrO
28
0.29
1.80
1.00
0.01
0.67
1.35
0.36
0.12
1.39
1.00
0.10
8
6
4
2
0


OBn
Bn
N
HO
OBn
OBn
TrO
28
150
100
50
0
ppm

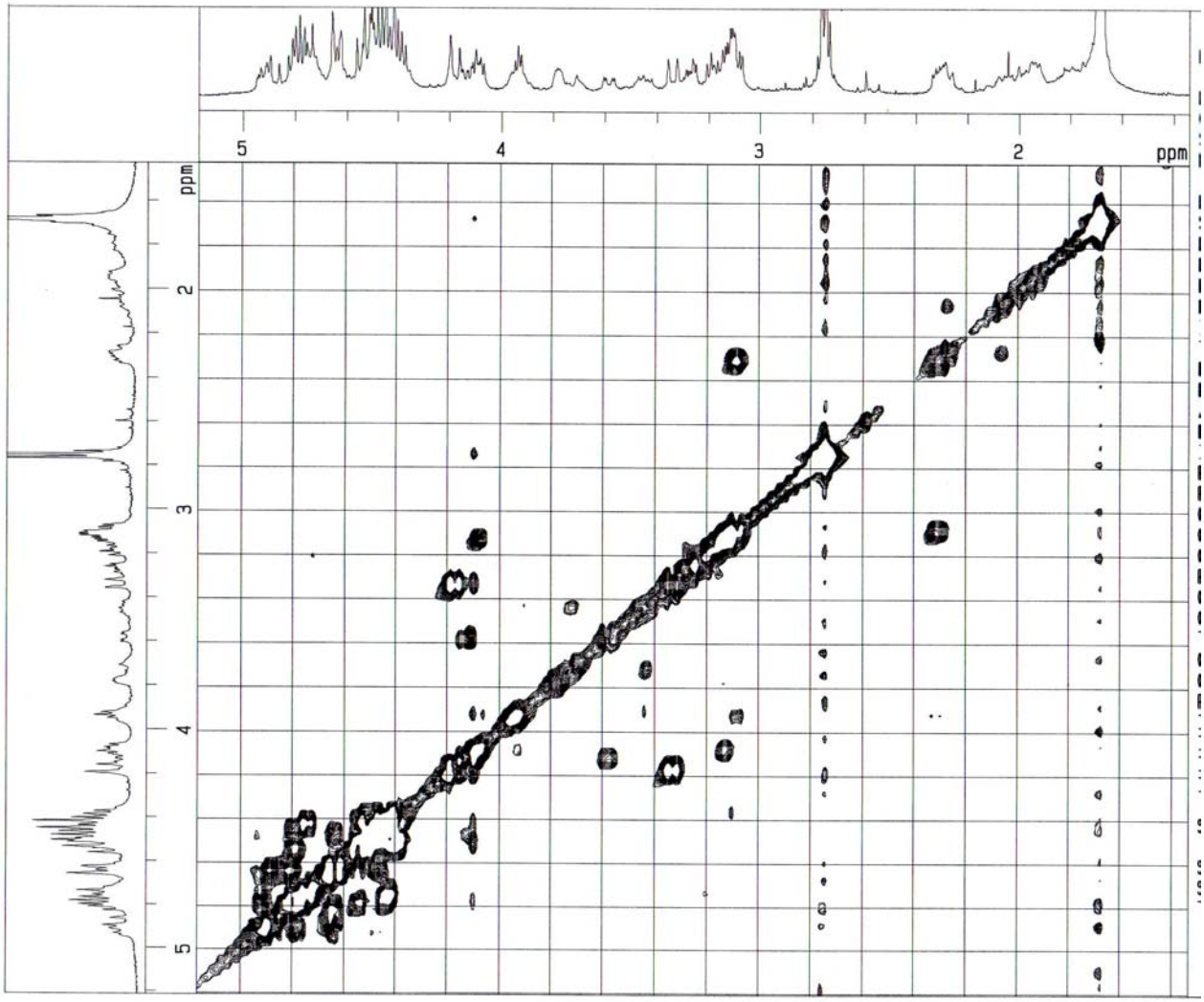

15.46
OBn
Bn
N
MsO
OBn
OBn
TrO
29
0.57
1.65
1.00
1.40
0.77
0.30
0.62
1.03
0.18
0.02
8
6
4
2
0
ppm

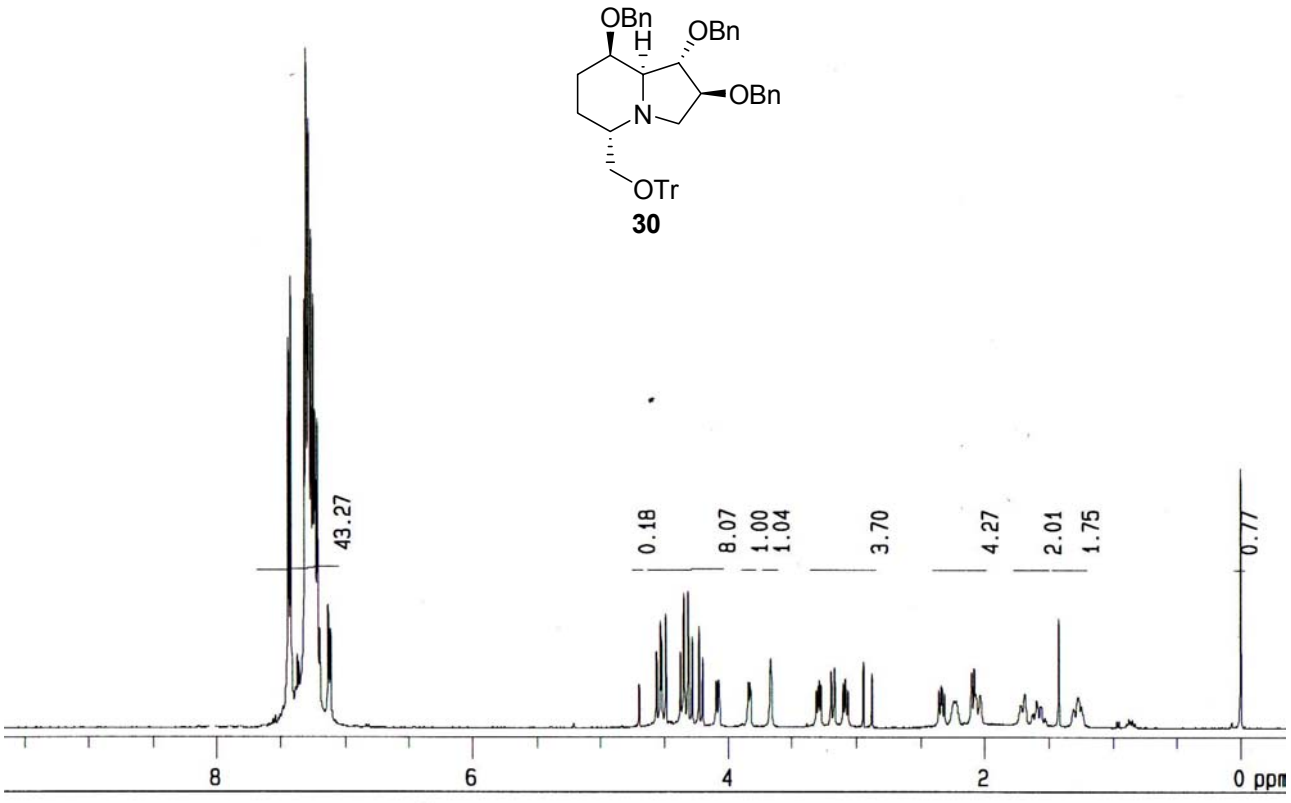

OBn
Bn
N
MsO
OBn
OBn
TrO
29
200
150
100
50
0
p

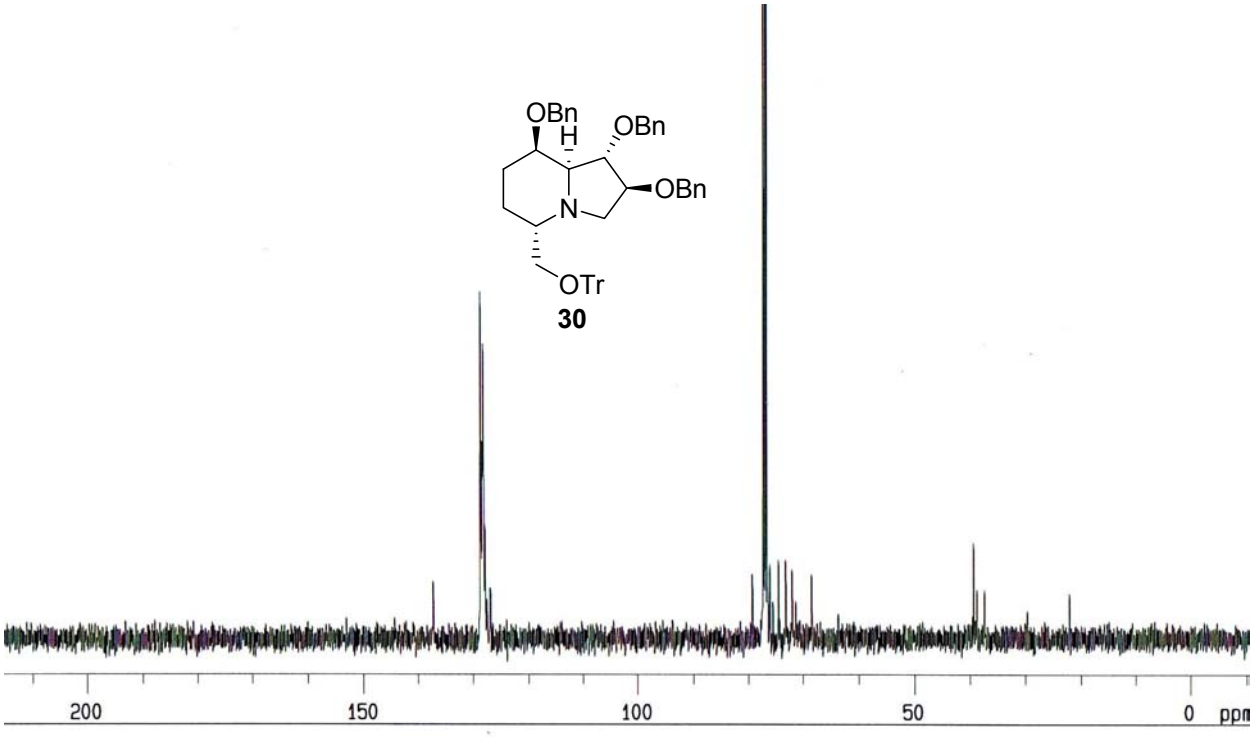
COSY spectrum of compound **29**



29

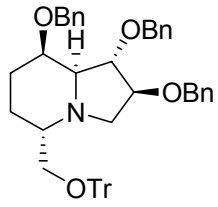



OBn
H
OBn
OBn
N
OTr
30
43.27
0.18
8.07
1.00
1.04
3.70
4.27
2.01
1.75
0.77
8
6
4
2
0 ppm

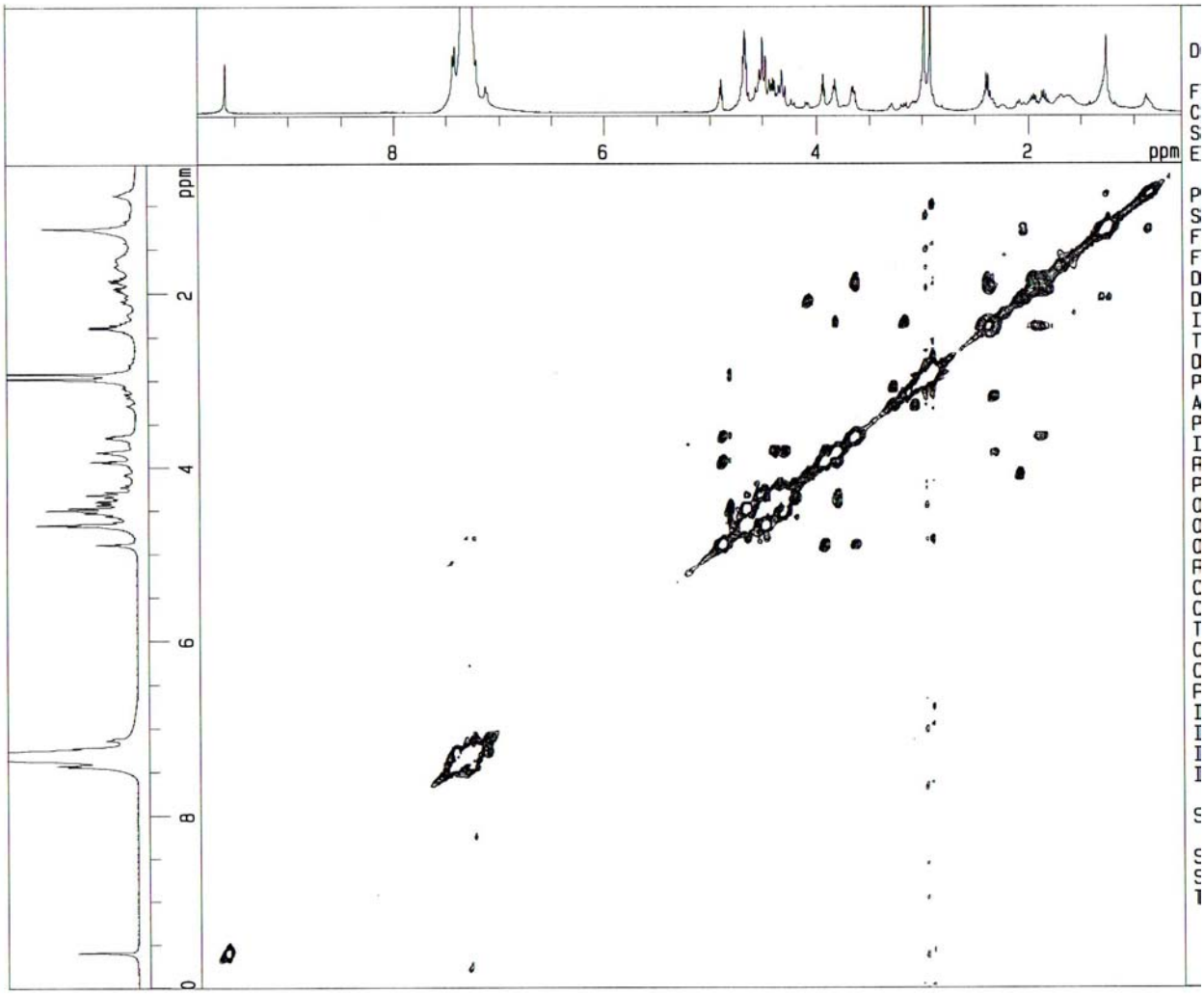


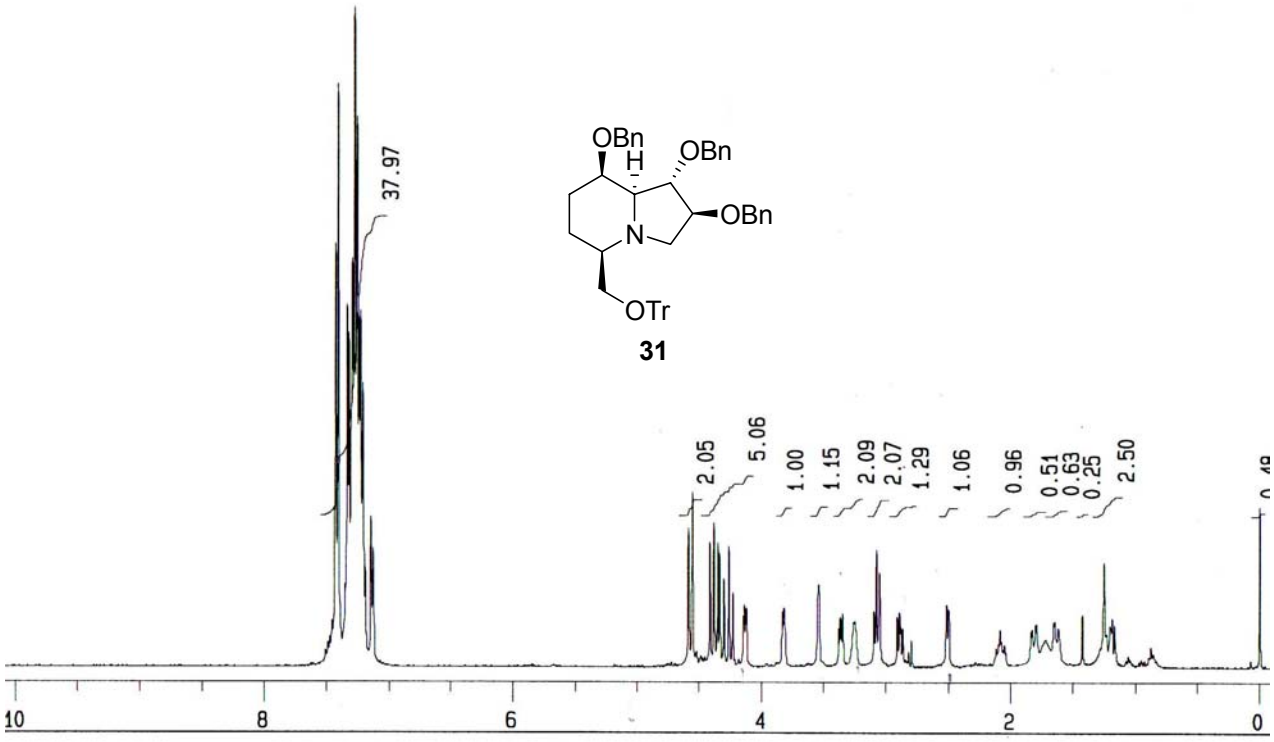
30

COSY spectrum of compound **30**

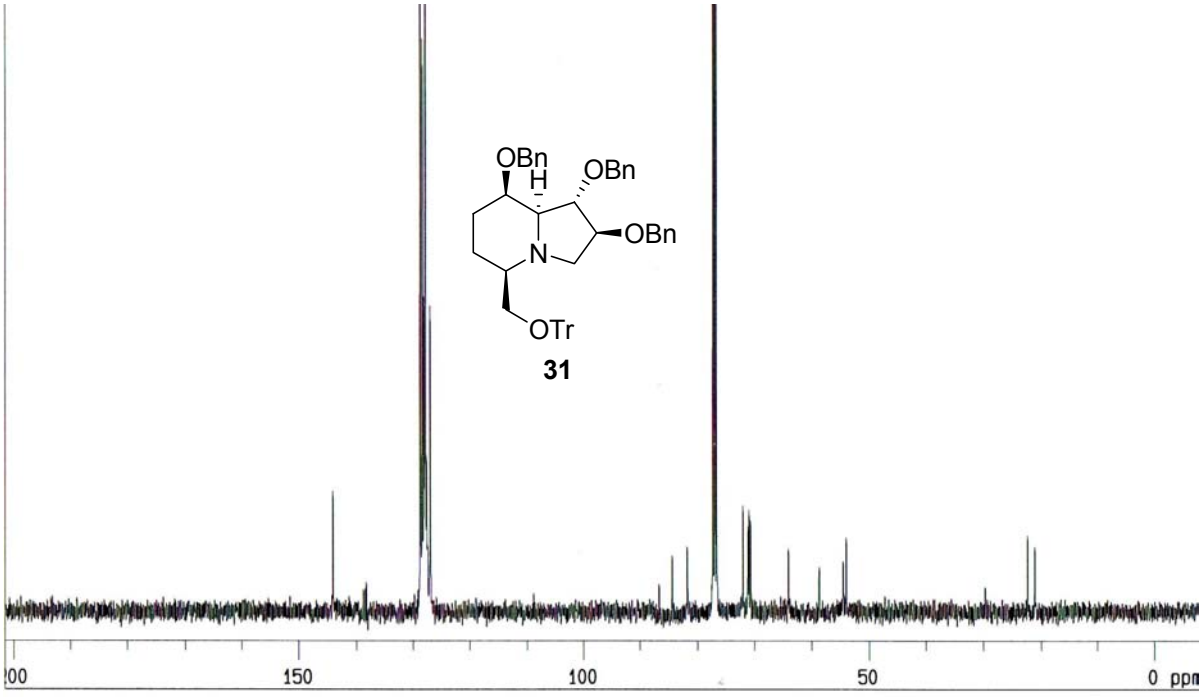


30

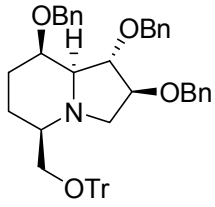



OBn
H
OBn
OBn
N
OTr
37.97
2.05
5.06
1.00
1.15
2.09
2.07
1.29
1.06
0.96
0.51
0.63
0.25
2.50
10
8
6
4
2
0

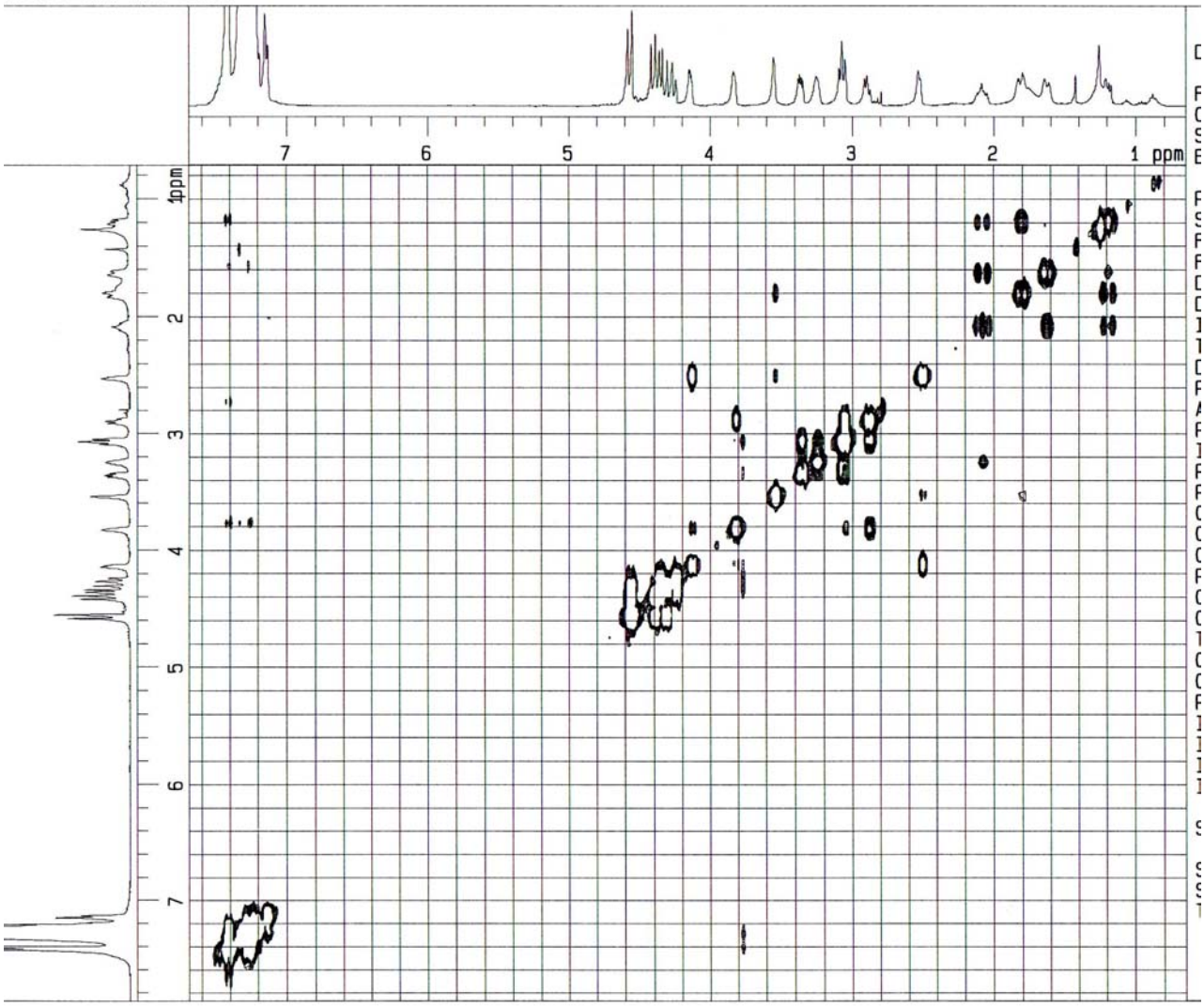
31

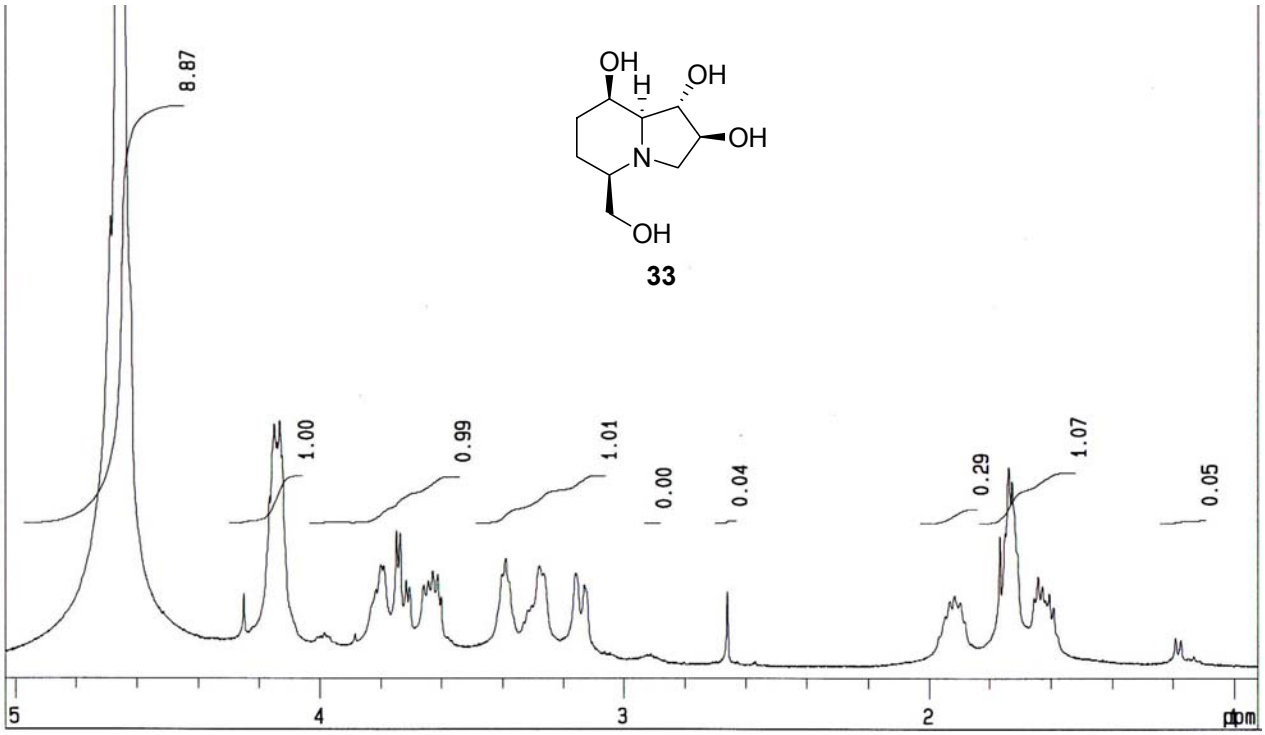

OBn
H
OBn
OBn
N
OTr
31
150
100
50
0 ppm

COSY spectrum of compound **31**

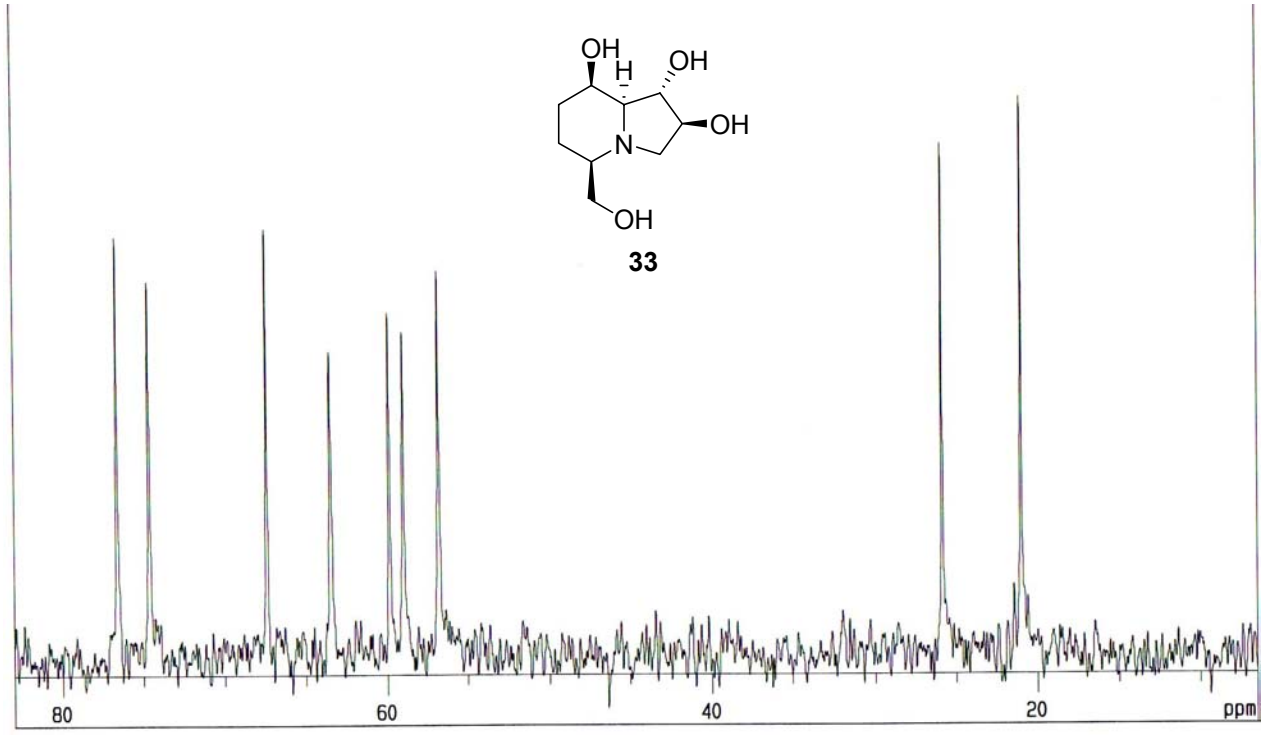


31

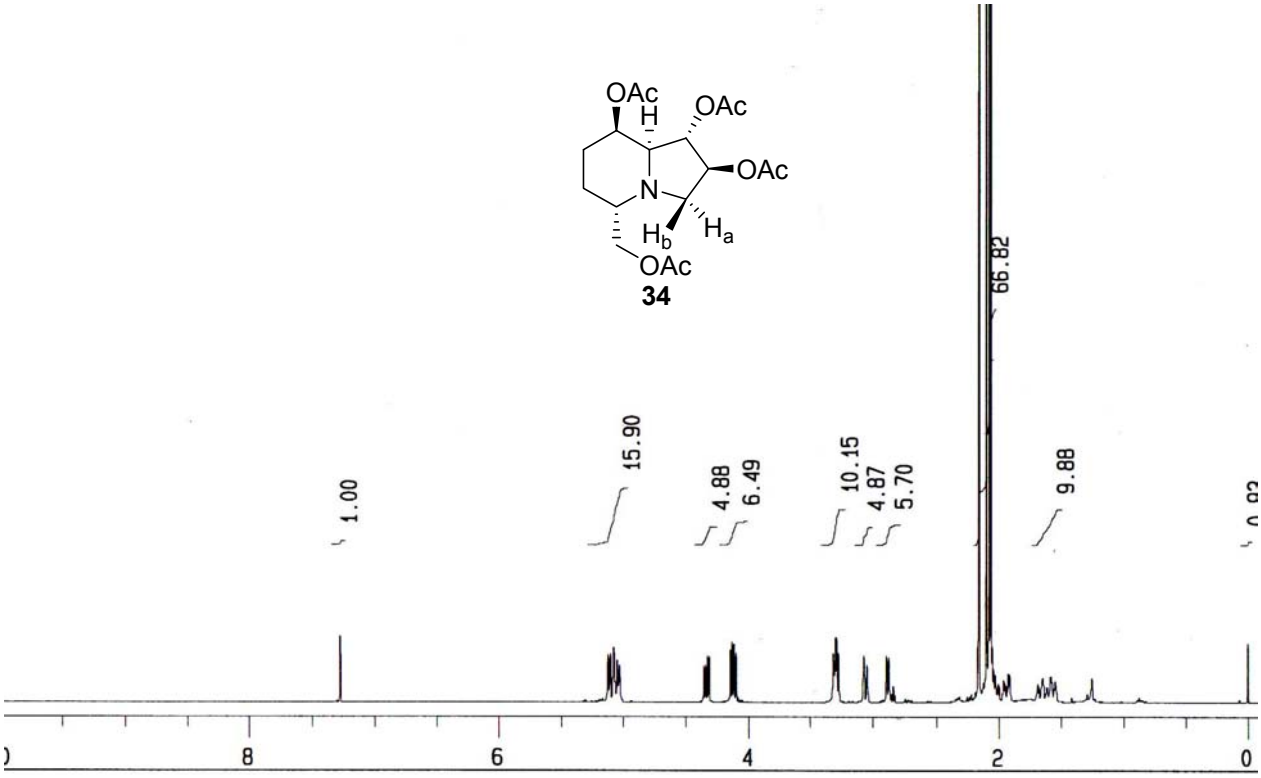


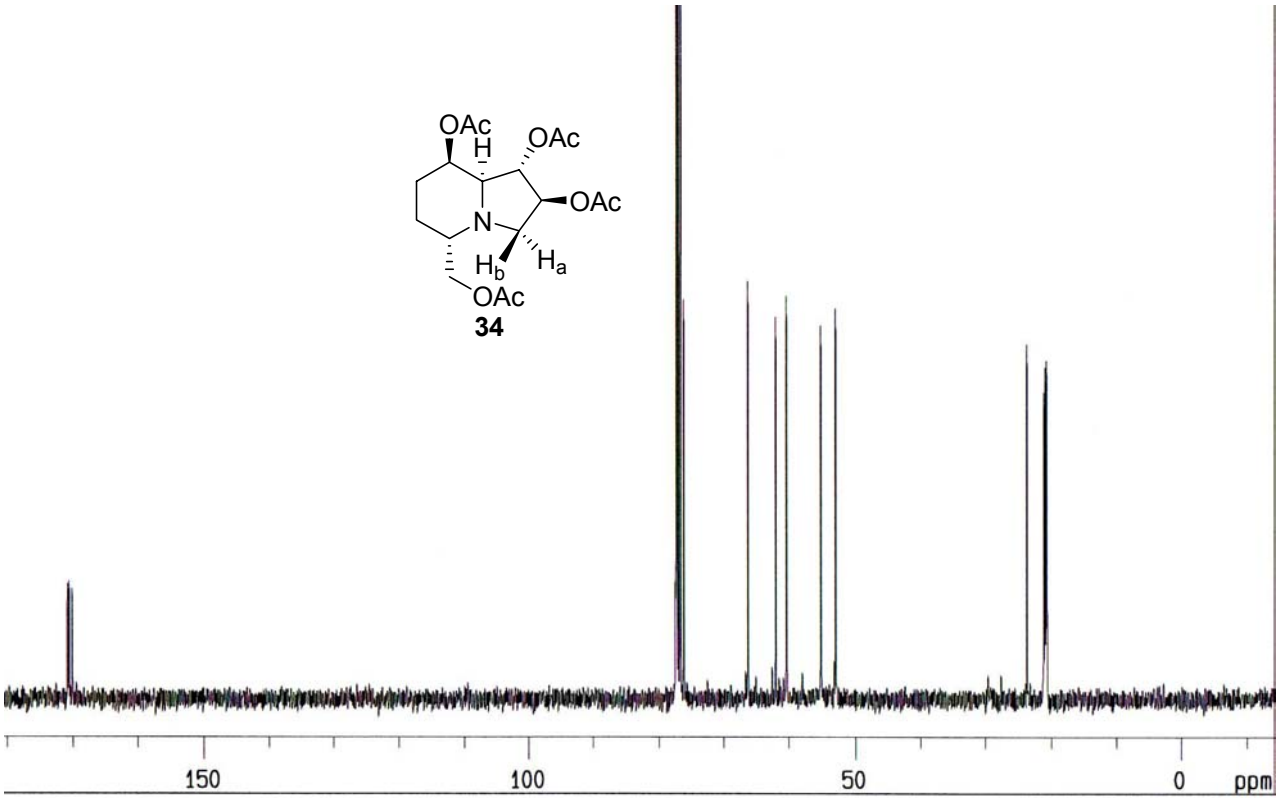


33



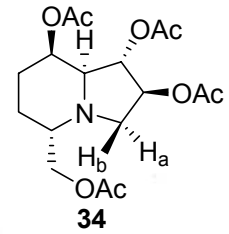
33


OAc
H
OAc
OAc
N
H_b
H_a
OAc
34
66.82
15.90
4.88
6.49
10.15
4.87
5.70
9.88
1.00
8
6
4
2
0

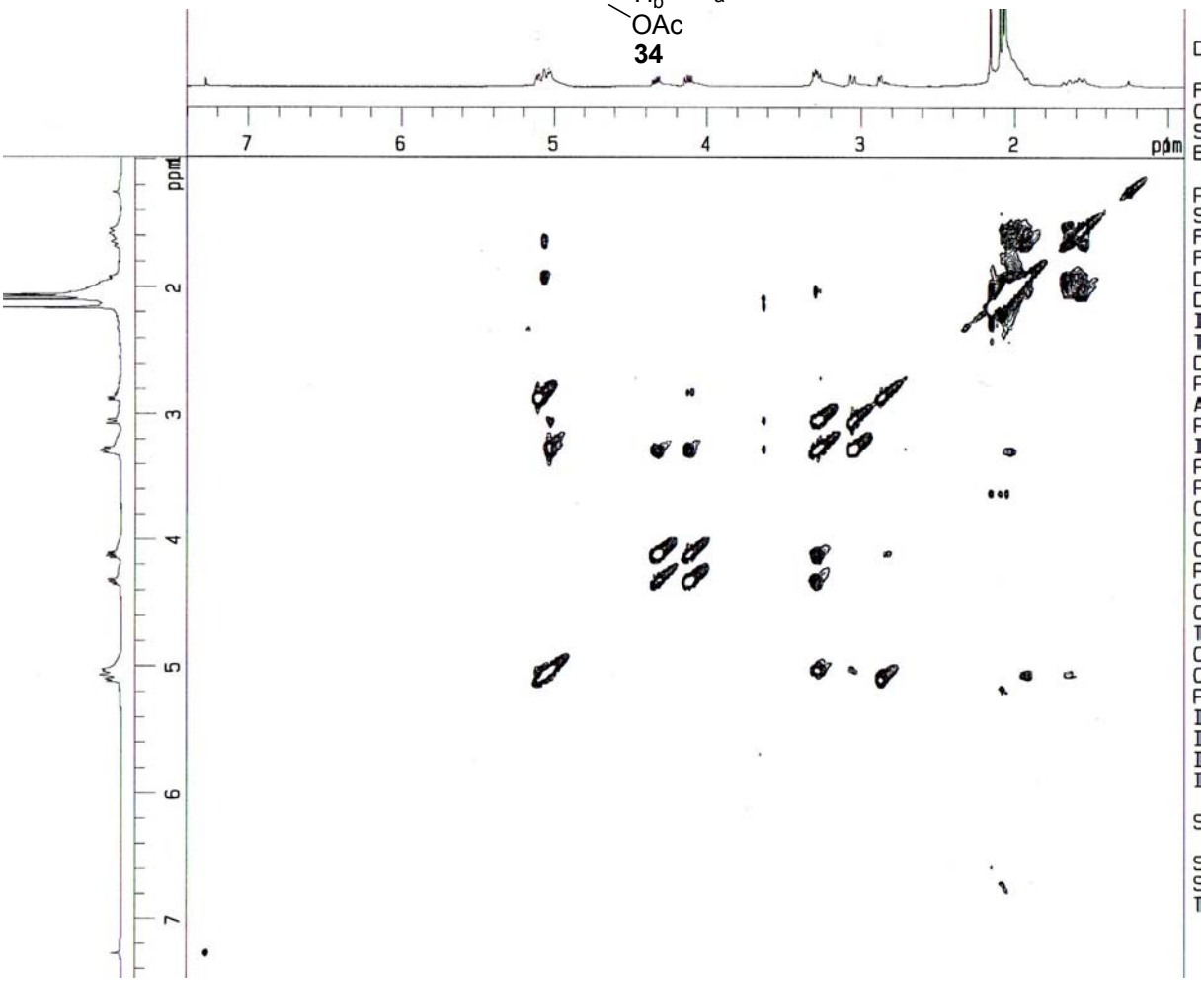


34

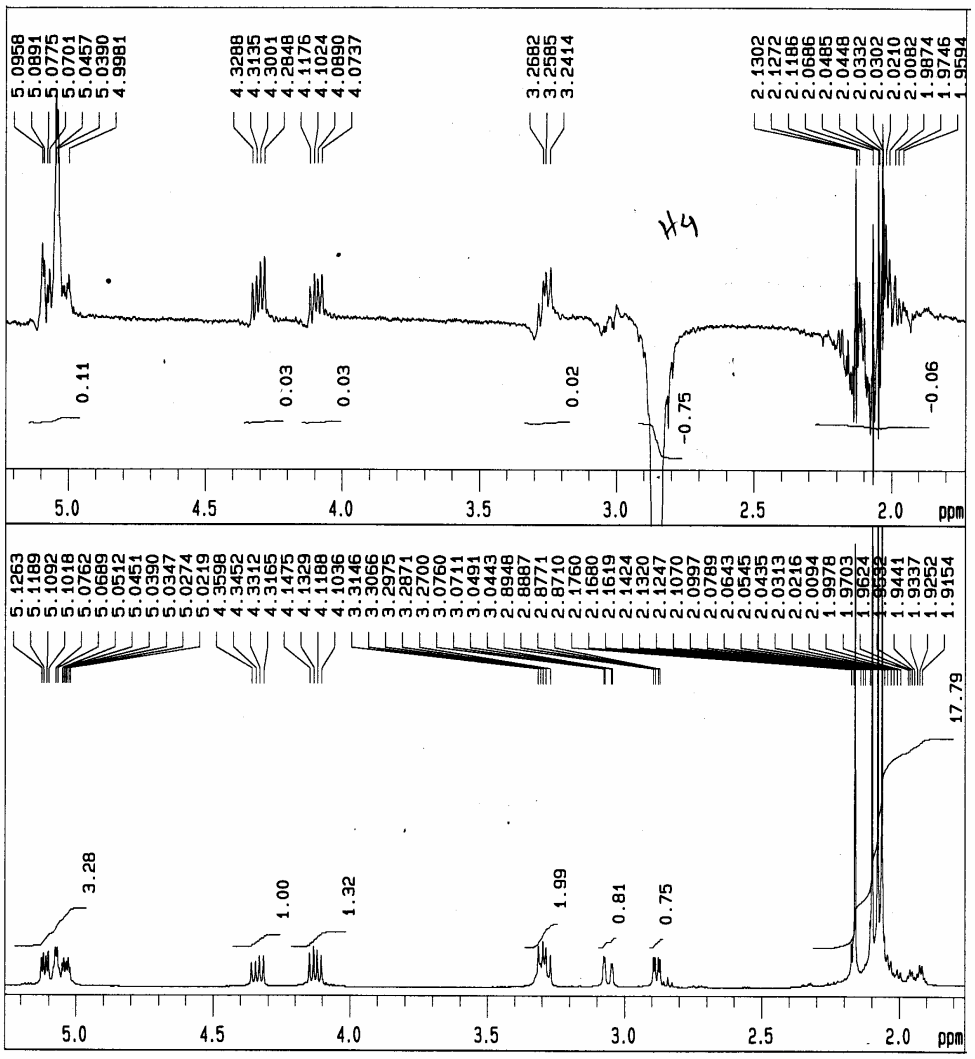
COSY spectrum of compound **34**

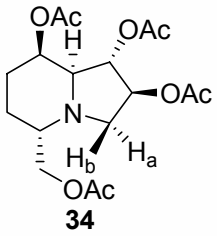


34



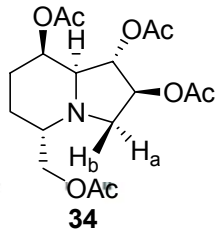
NOE spectrum of compound **34** (irradiation of H-4)



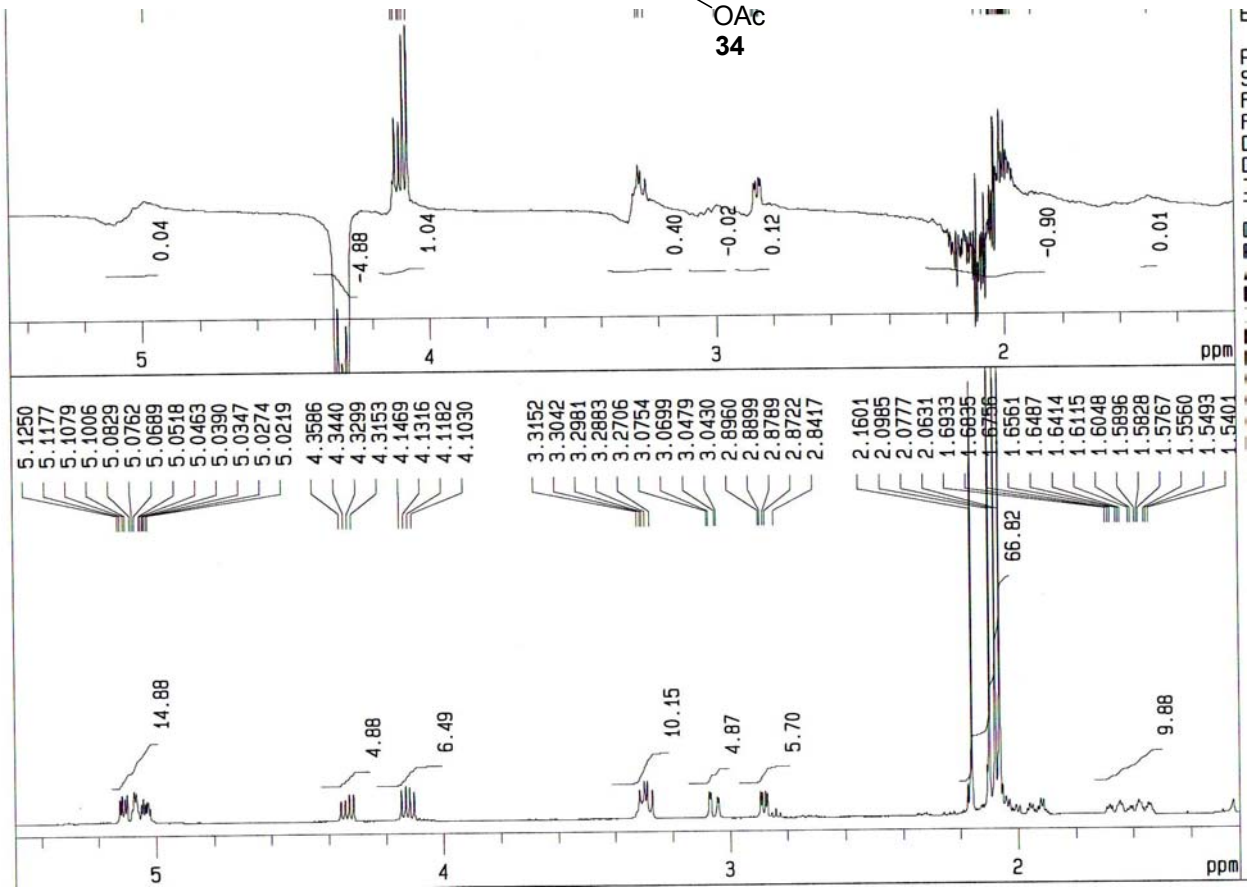


34

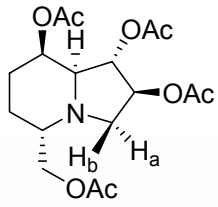
NOE spectrum of compound **34** (irradiation of H-9)



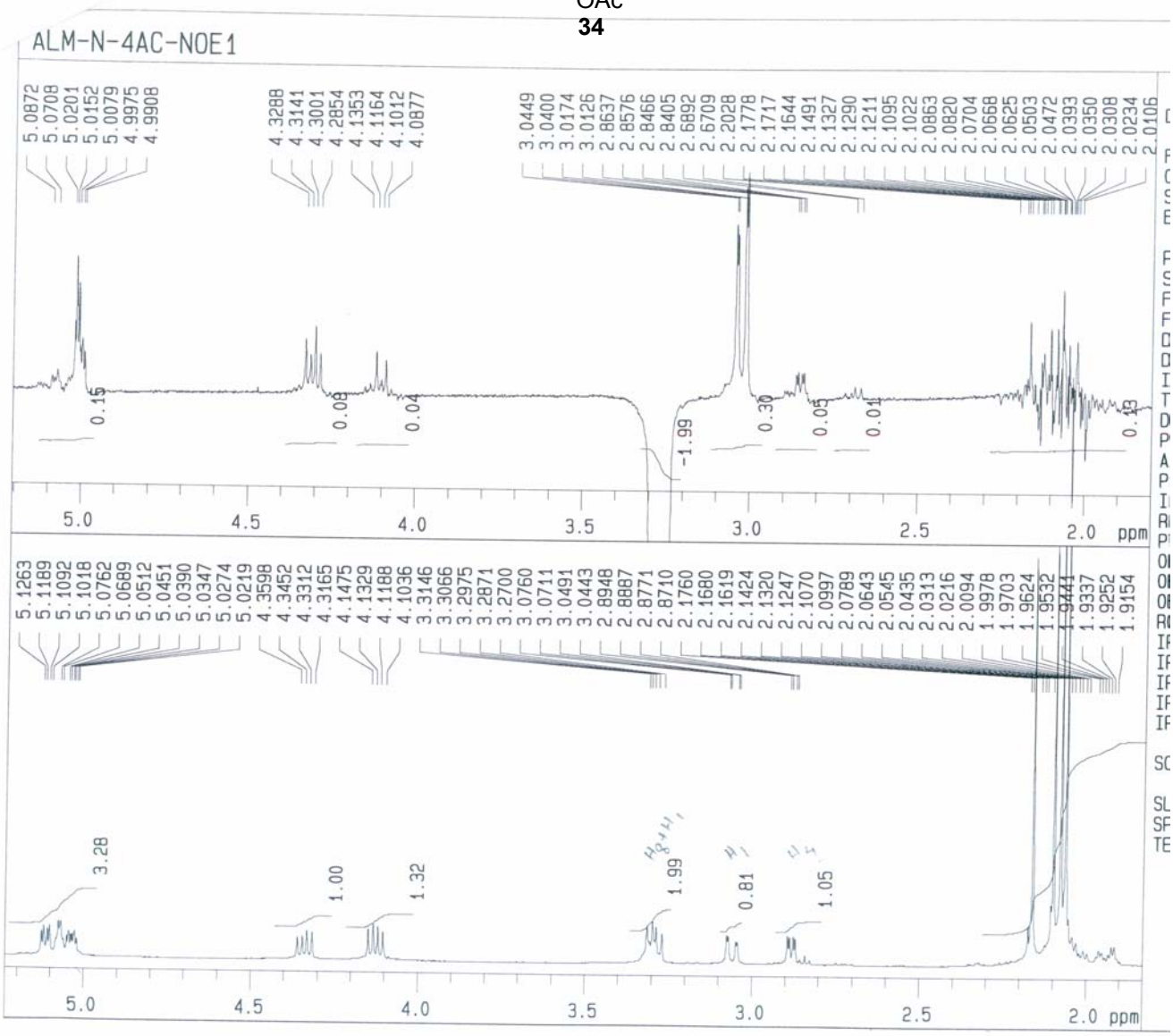
34



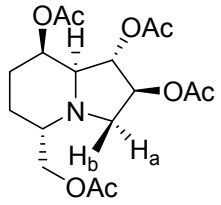
NOE spectrum of compound **34** (irradiation of H-8 and H-1b)



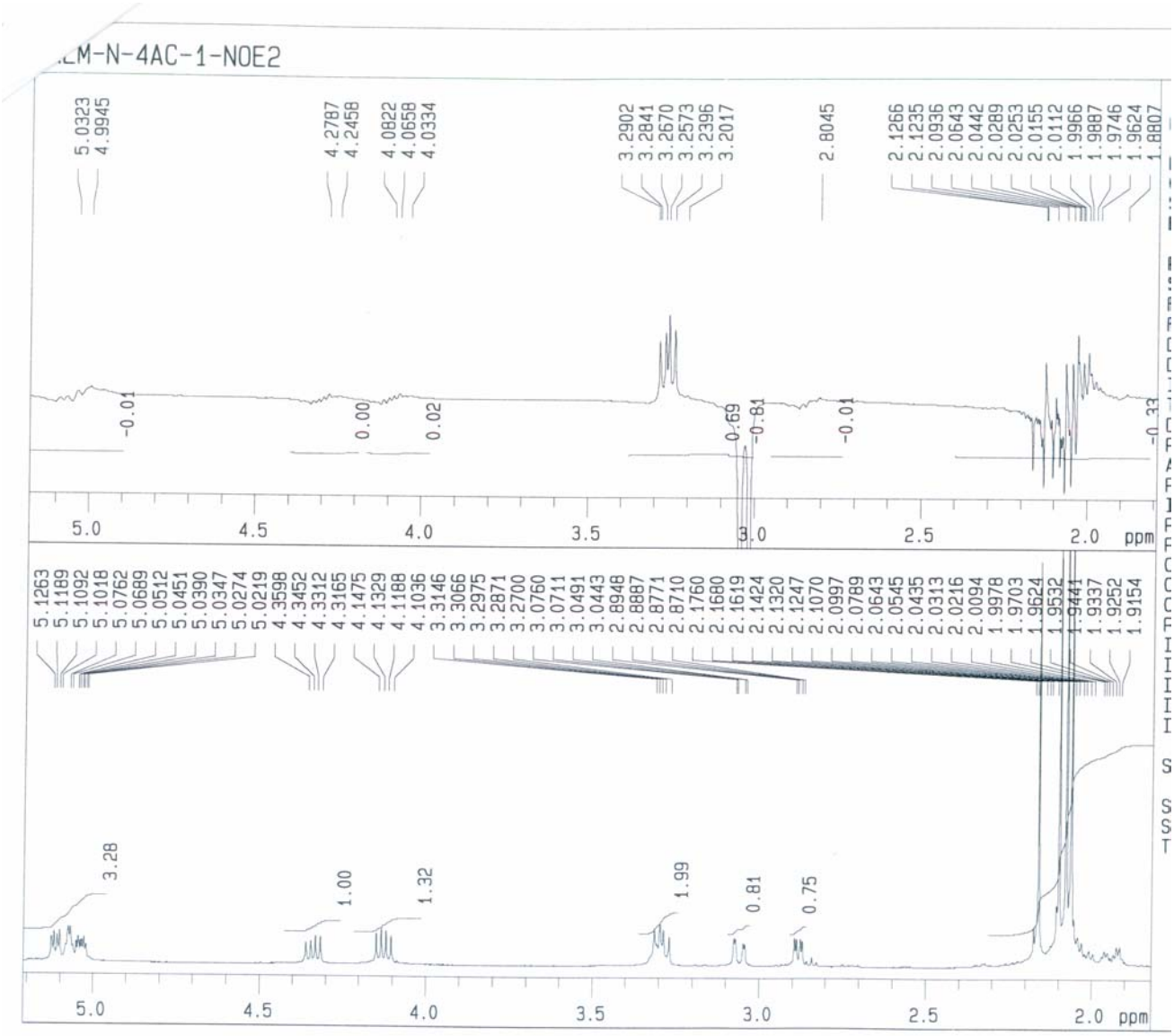
34

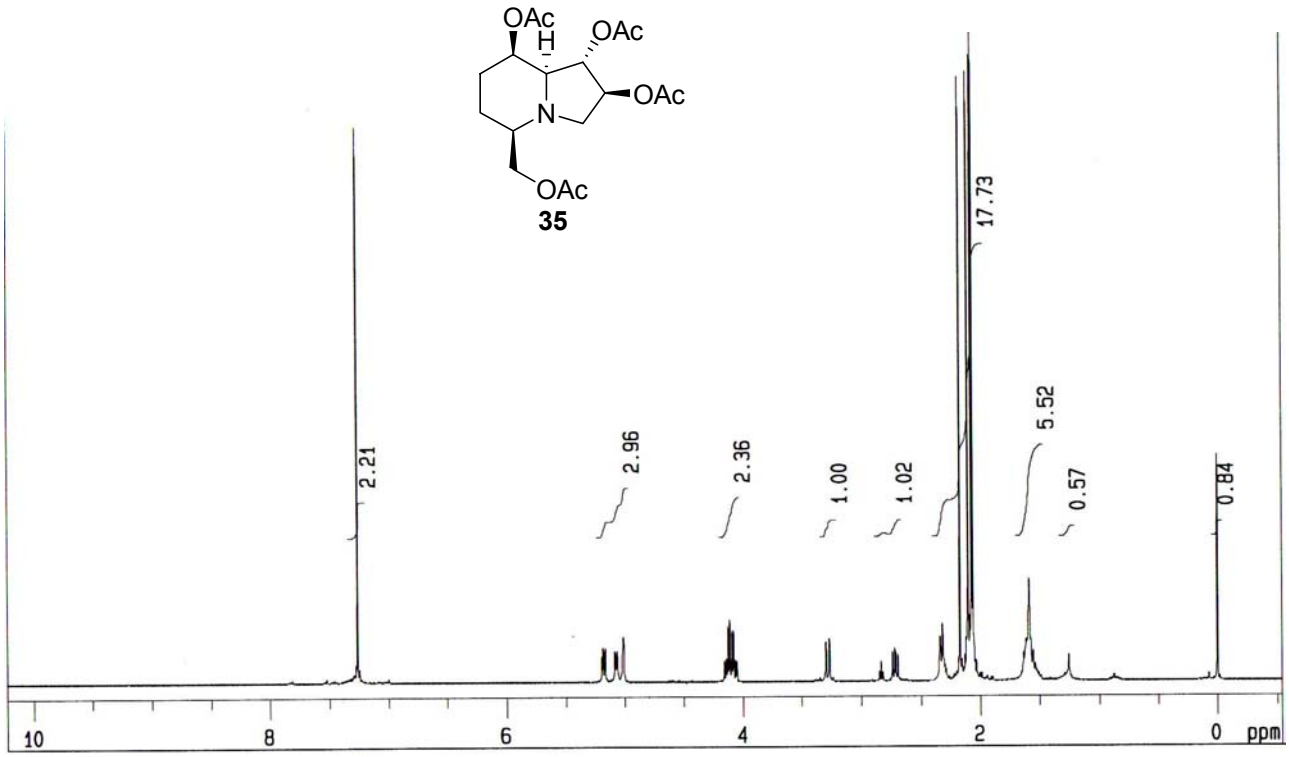


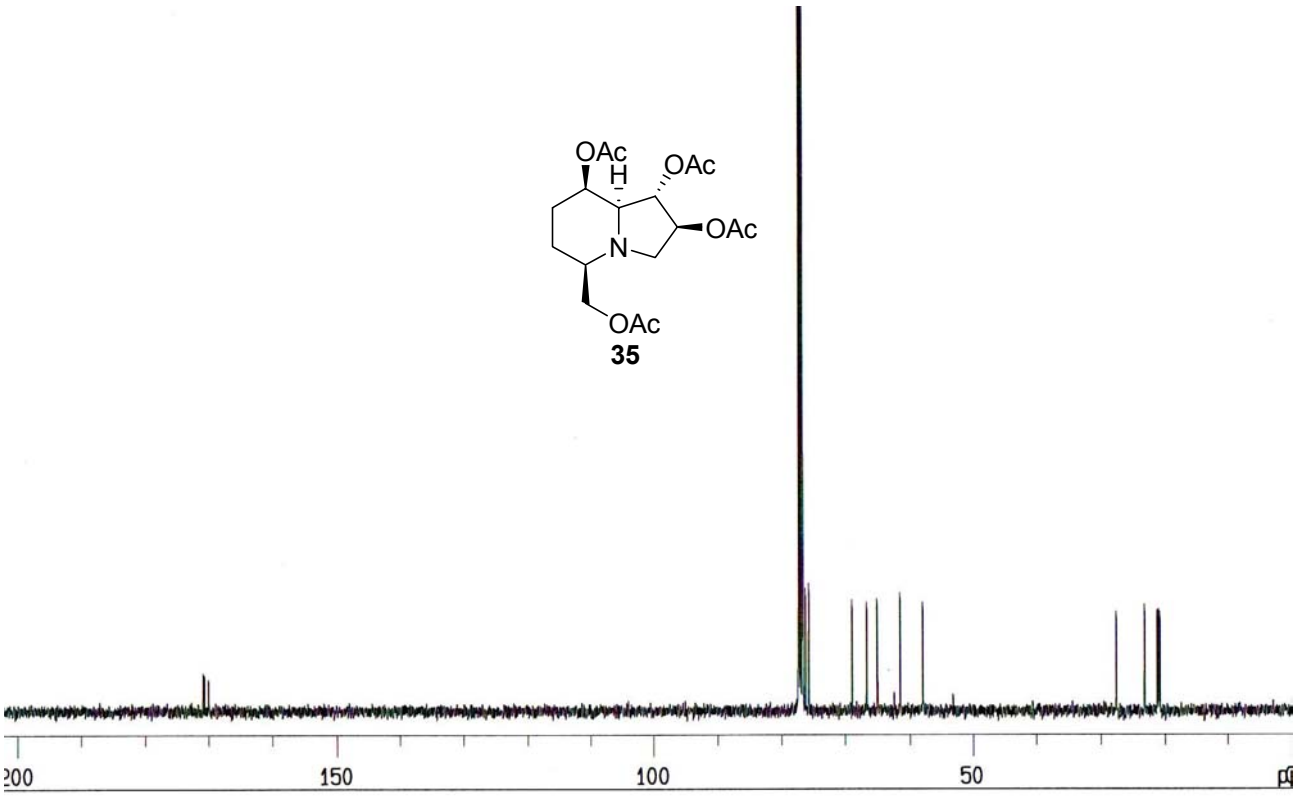
NOE spectrum of compound **34** (irradiation of H-1_b)



34

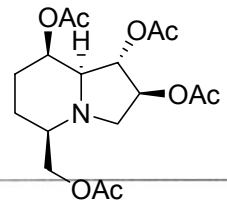



OAc
H
OAc
OAc
N
OAc
35
2.21
2.96
2.36
1.00
1.02
17.73
5.52
0.57
0.84
10
8
6
4
2
0
ppm

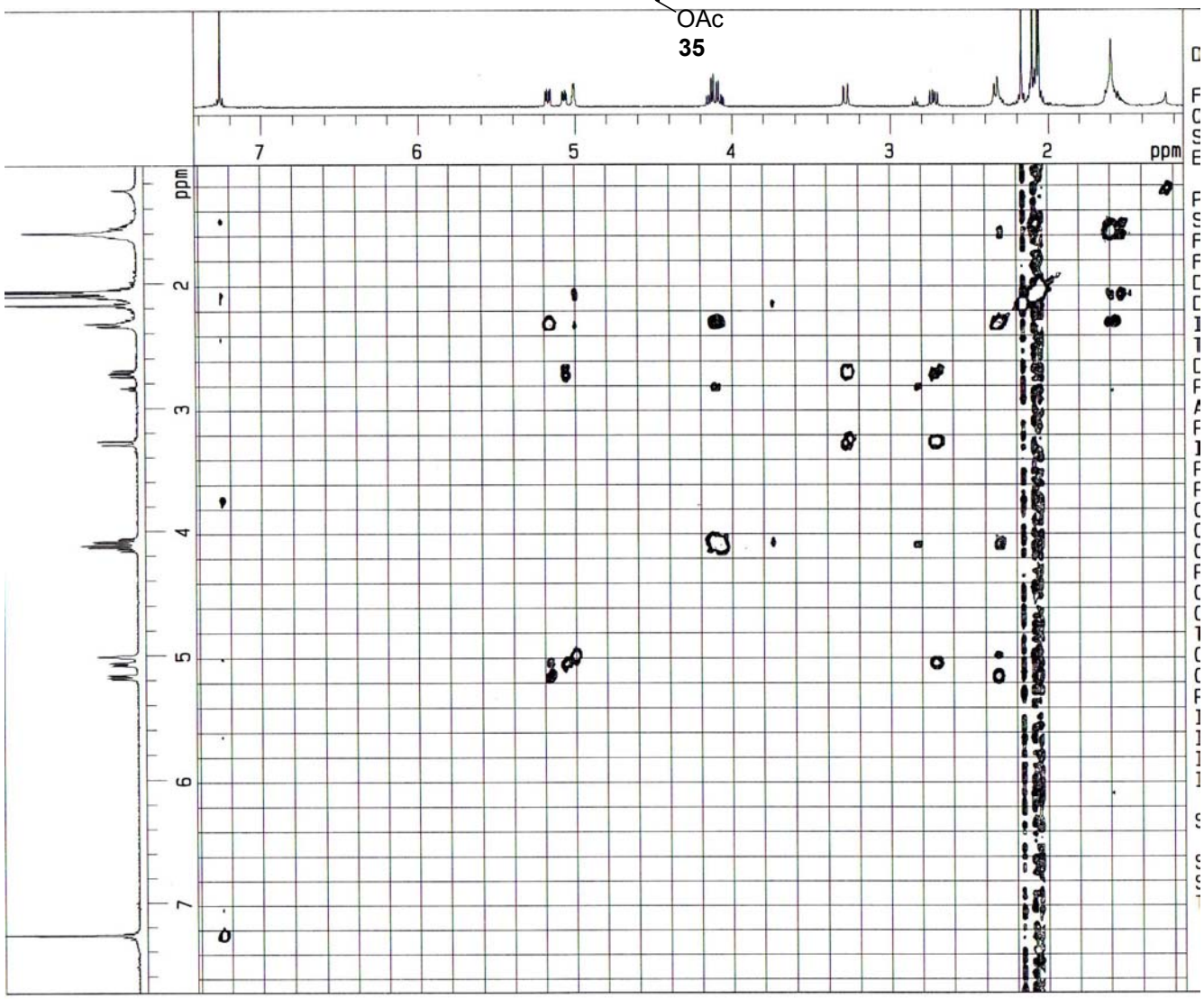


35

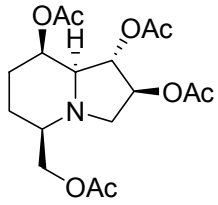
COSY spectrum of compound **35**



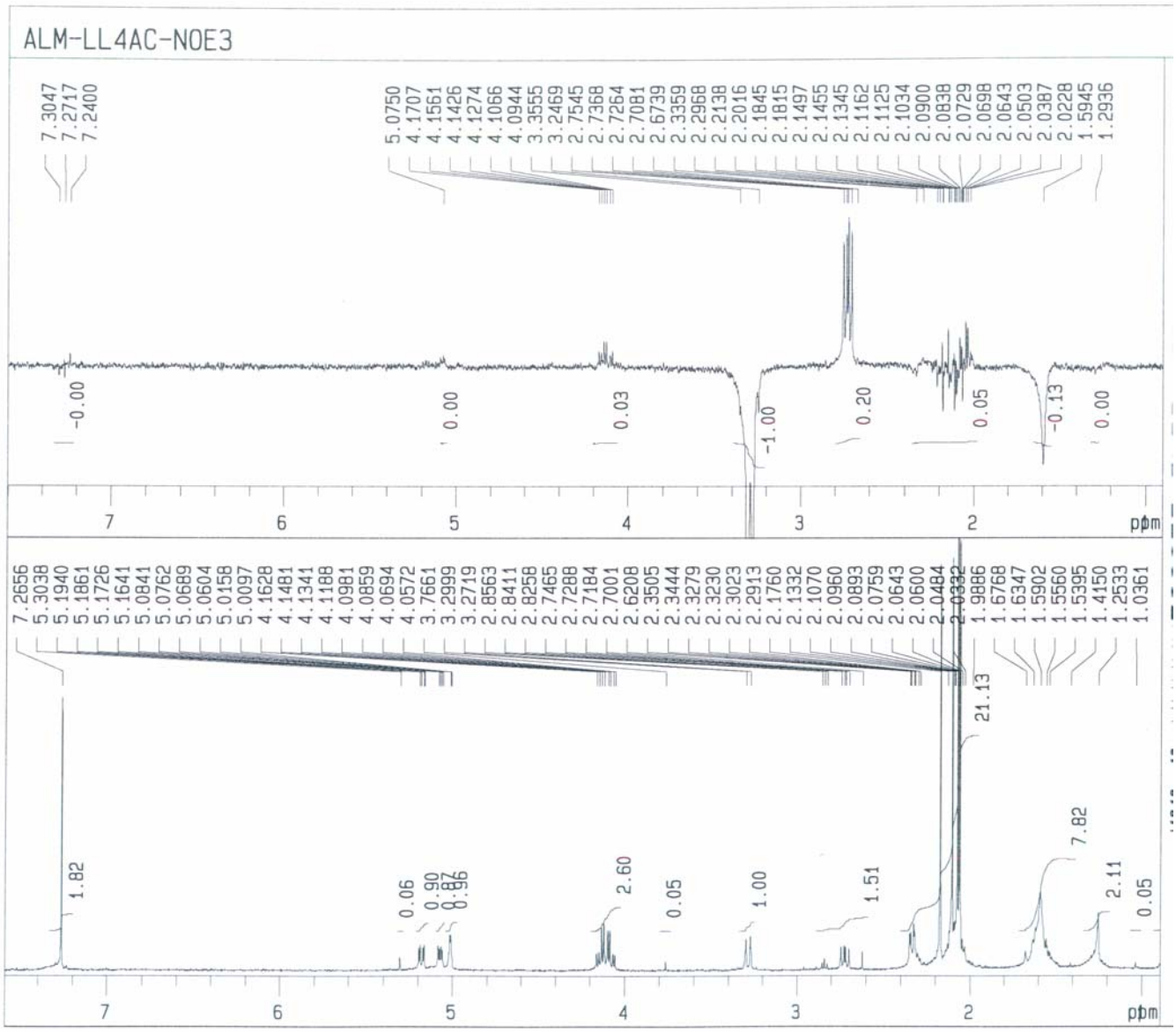
35



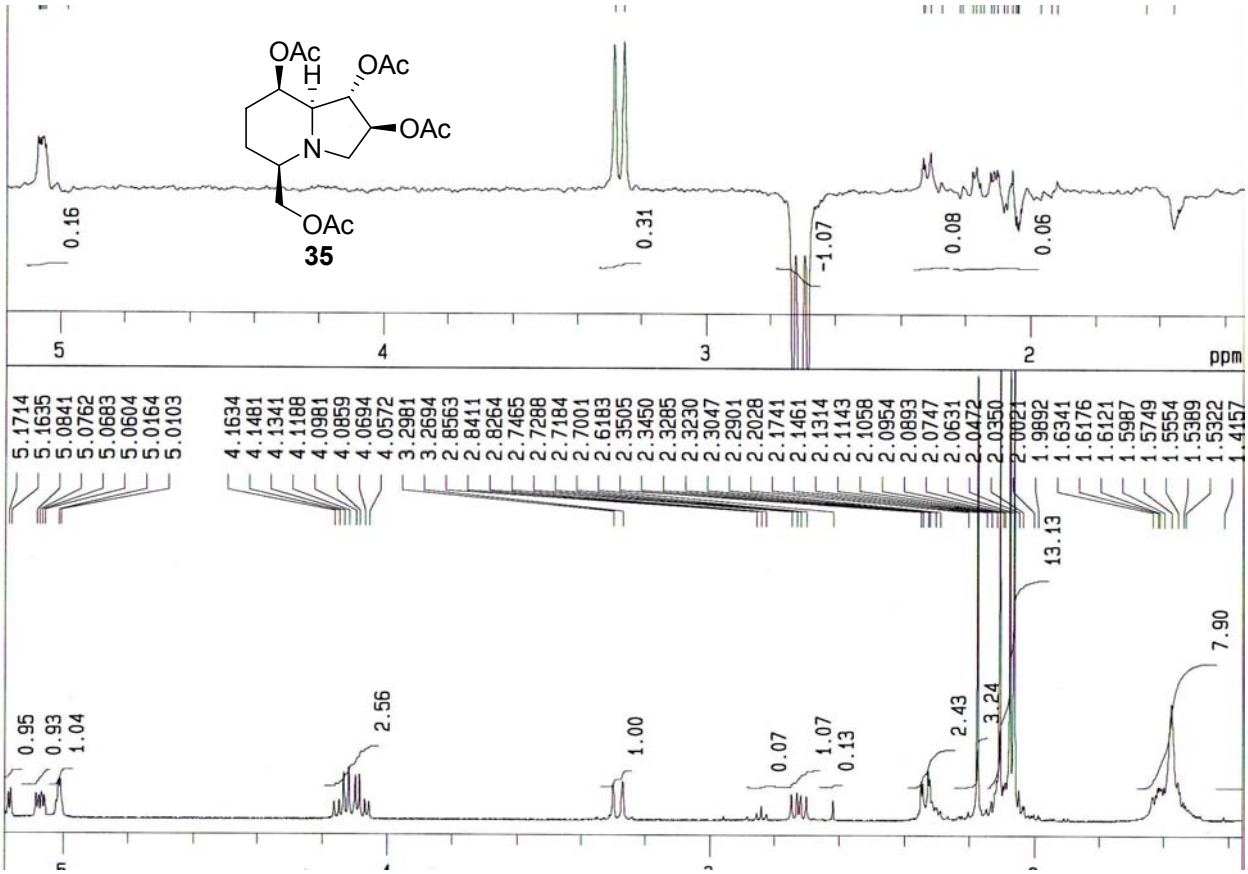
NOE spectrum of compound **35**



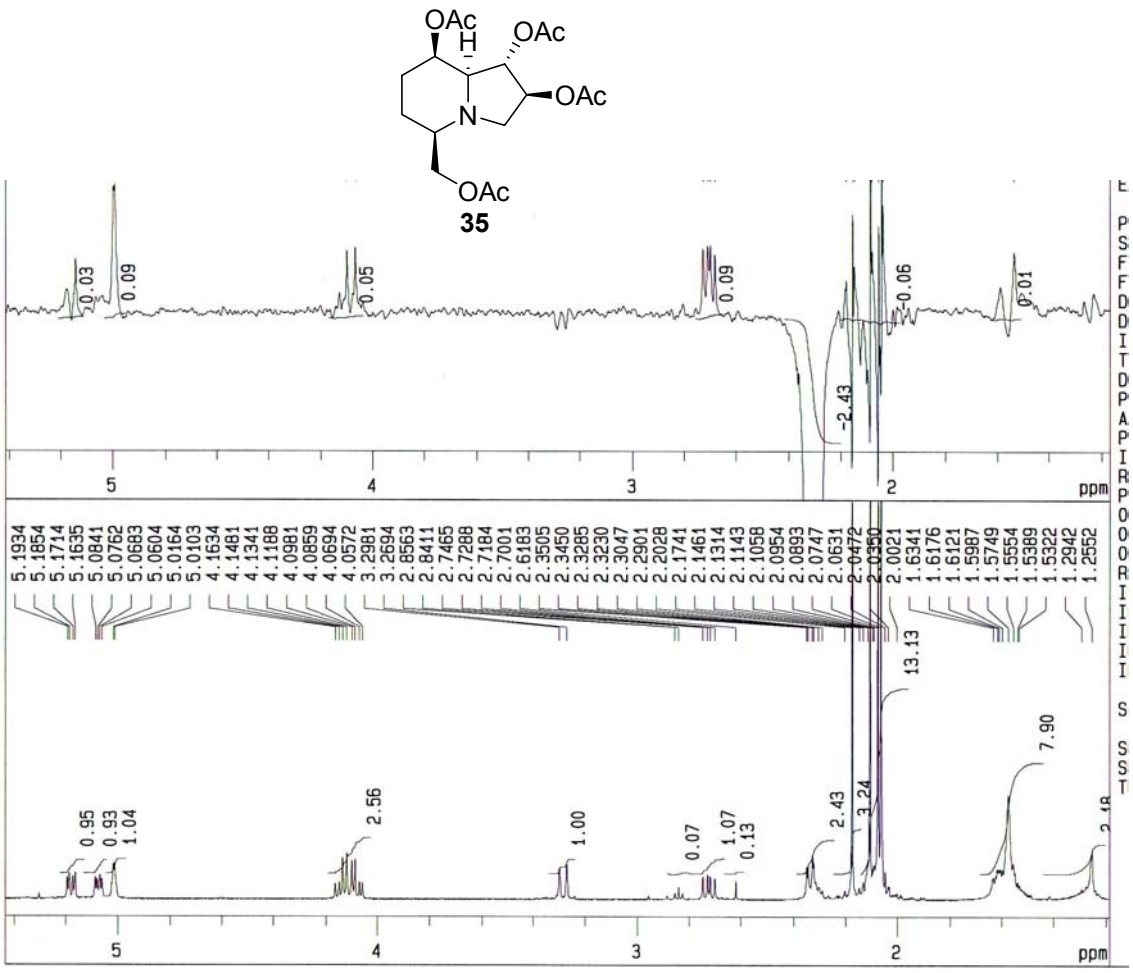
35

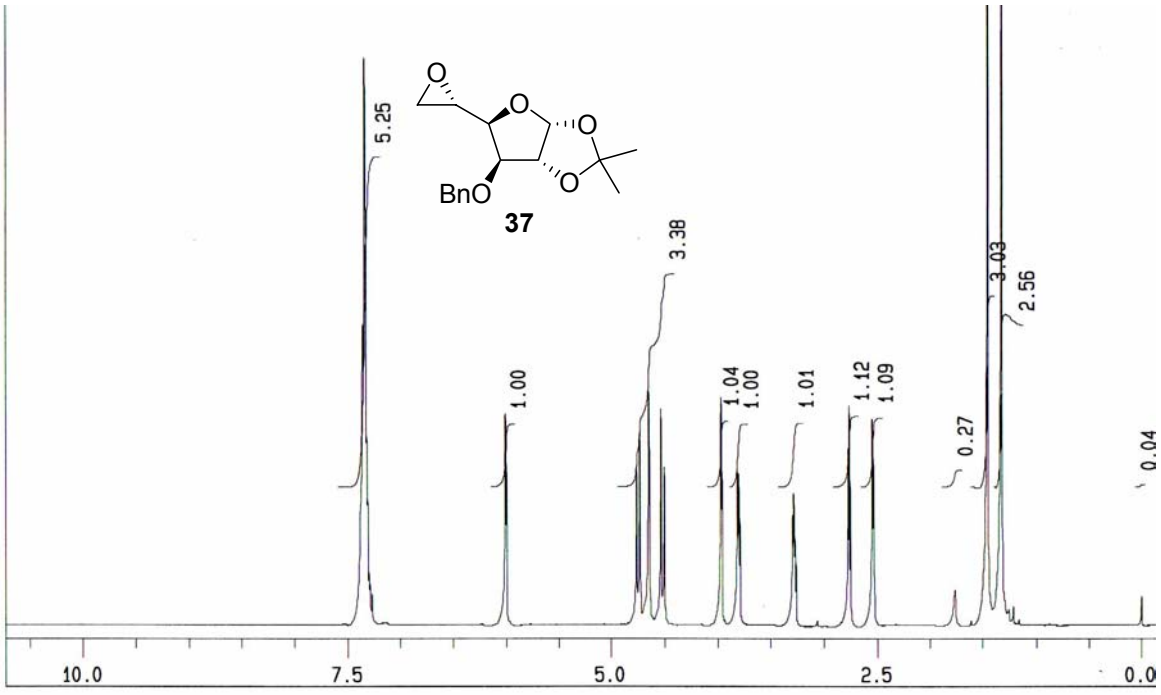


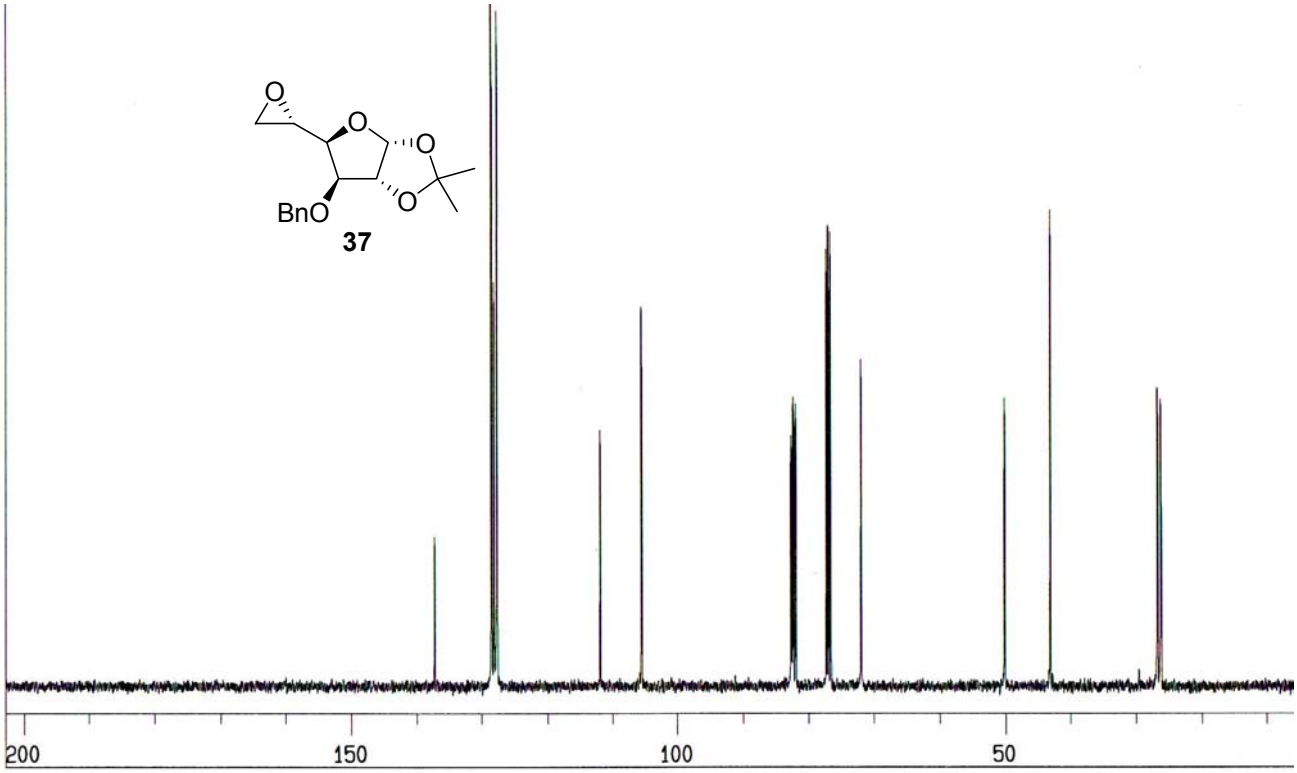
NOE spectrum of compound **35**



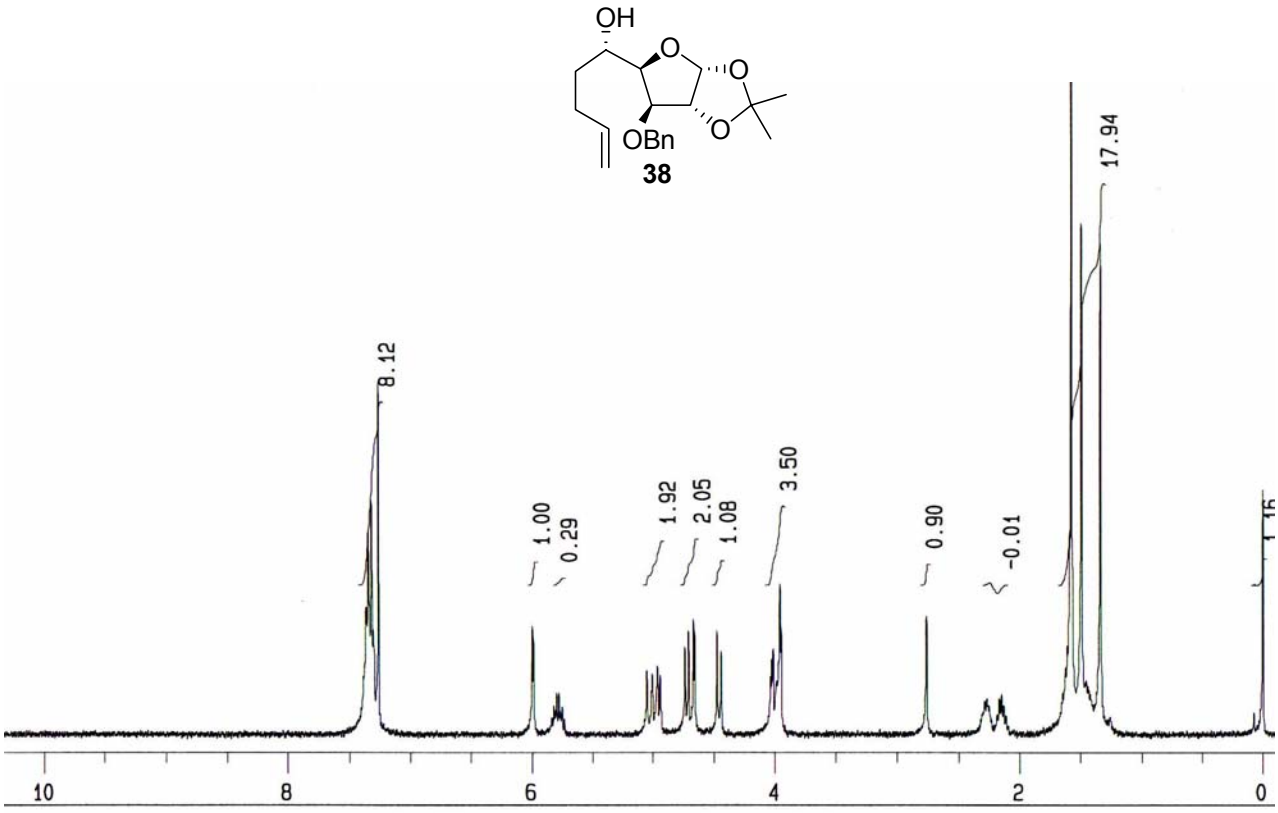
NOE spectrum of compound **35**

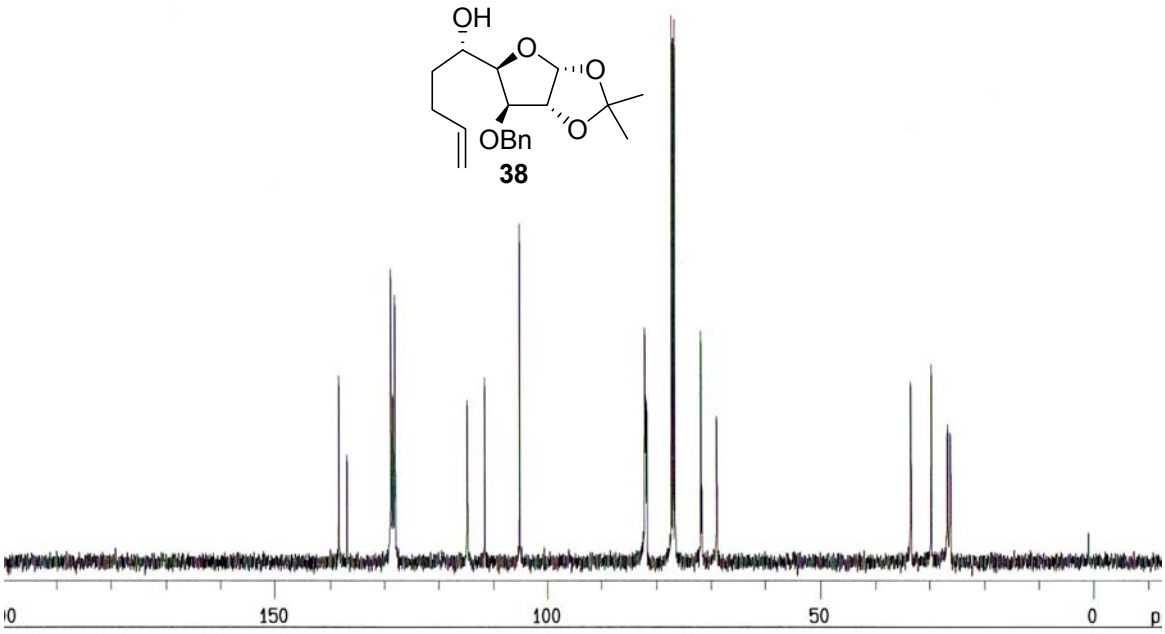


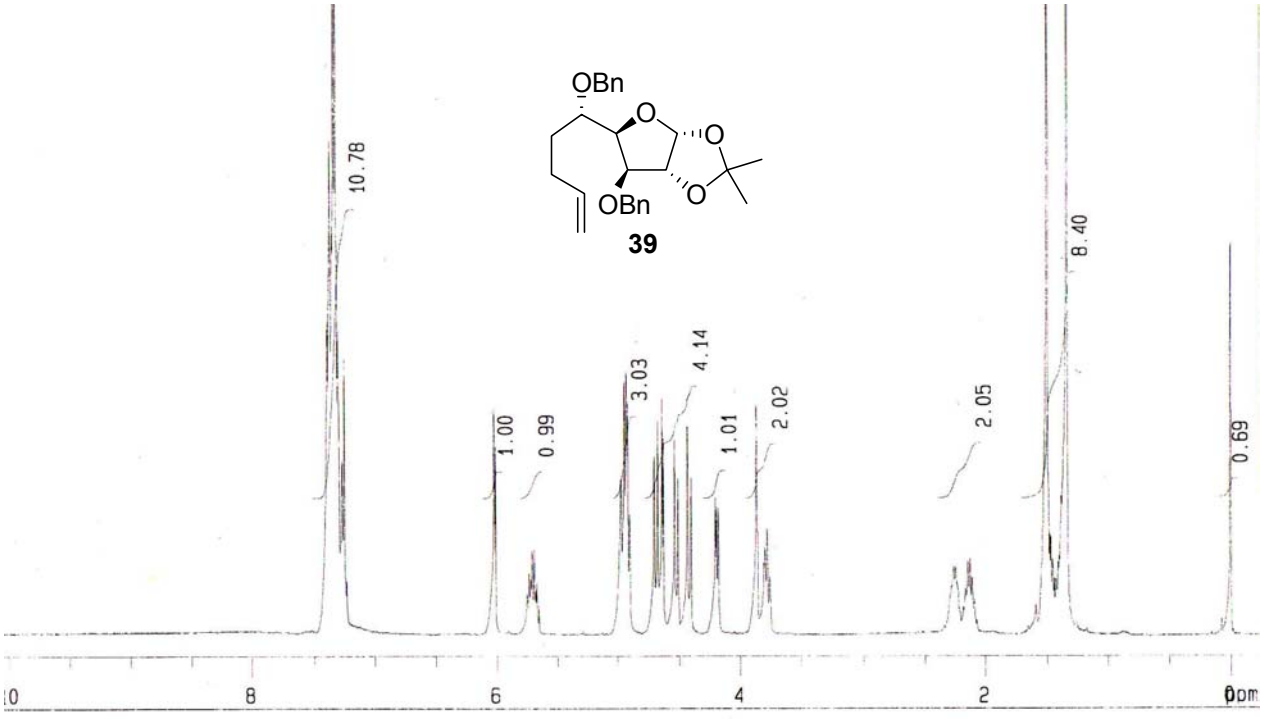

O
O
O
O
BnO
37
5.25
1.00
3.38
1.04
1.00
1.01
1.12
1.09
0.27
3.03
2.56
0.04
10.0
7.5
5.0
2.5
0.0

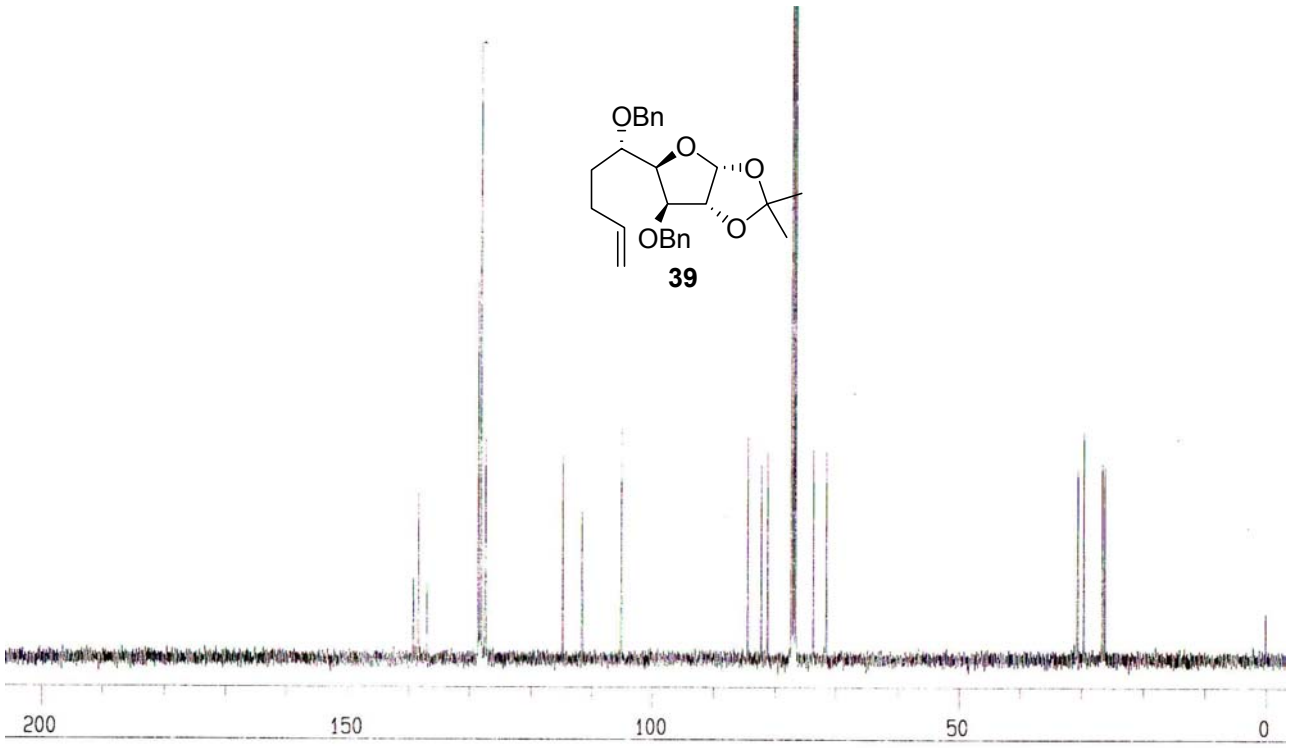


37

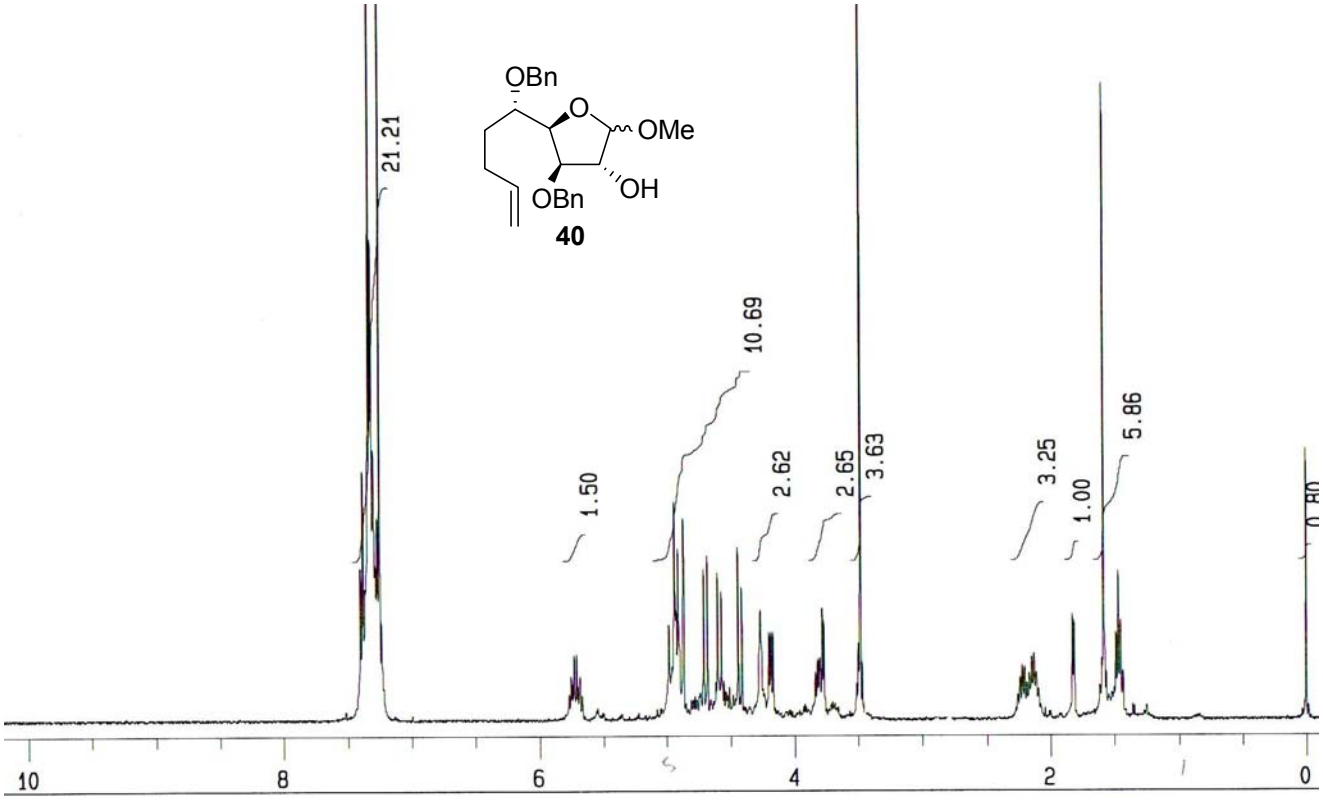

OH
O
O
O
OBn
38
8.12
1.00
0.29
1.92
2.05
1.08
3.50
0.90
-0.01
17.94
10
8
6
4
2
0

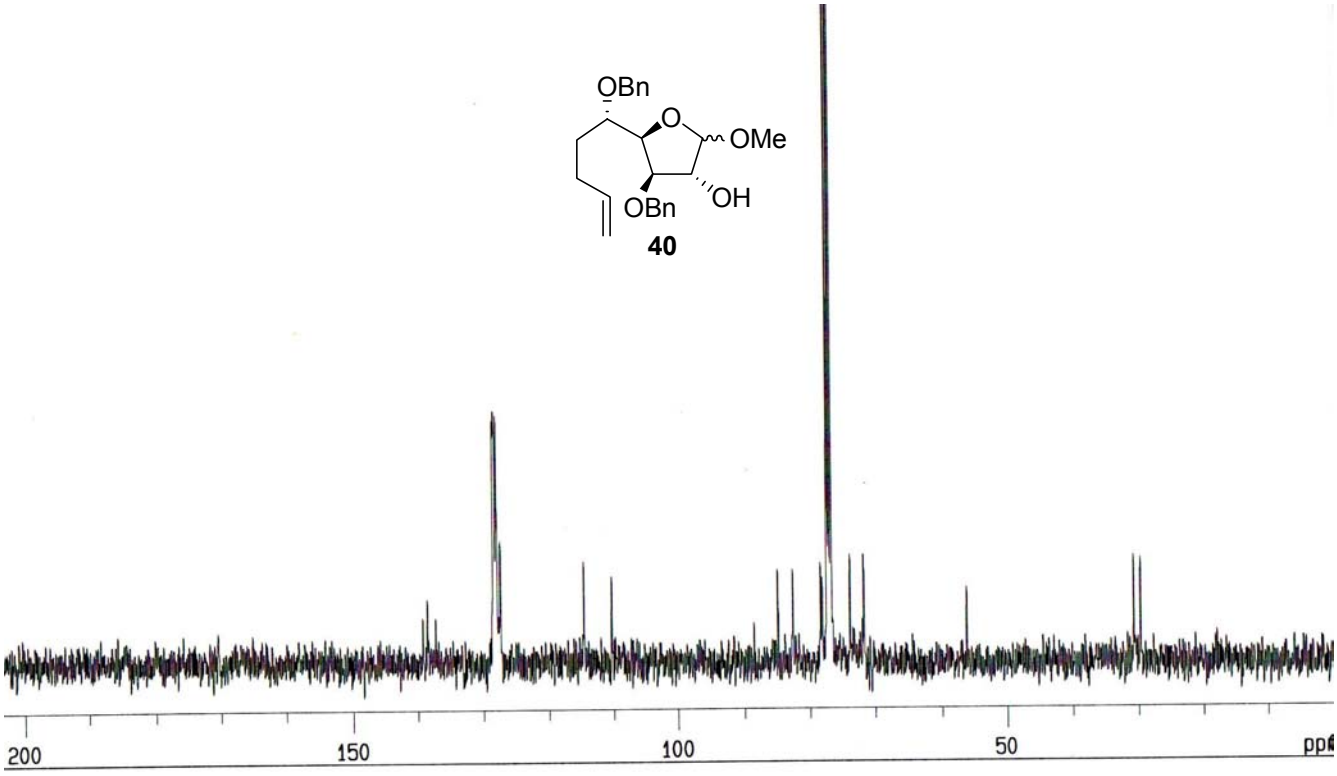

OH
O
O
O
OBn
38
150
100
50
0

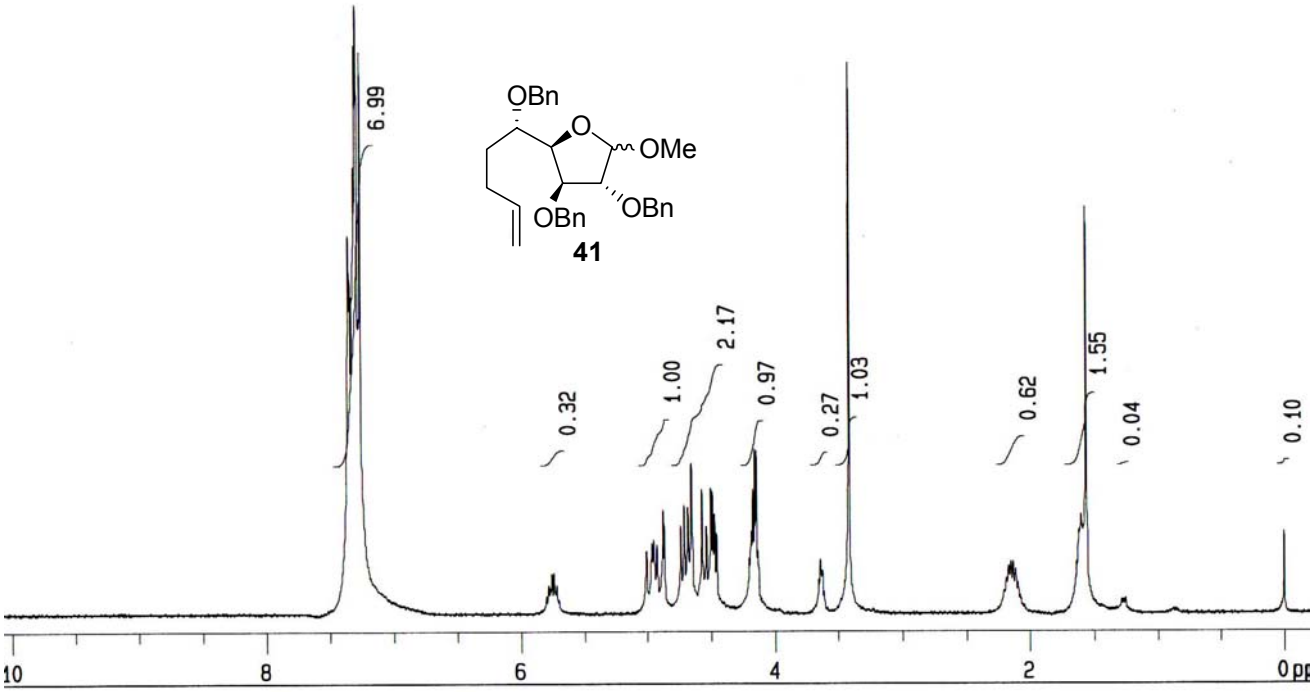

OBn
O
O
O
OBn
39
10.78
1.00
0.99
3.03
4.14
1.01
2.02
2.05
8.40
0.69
10
8
6
4
2
0ppm

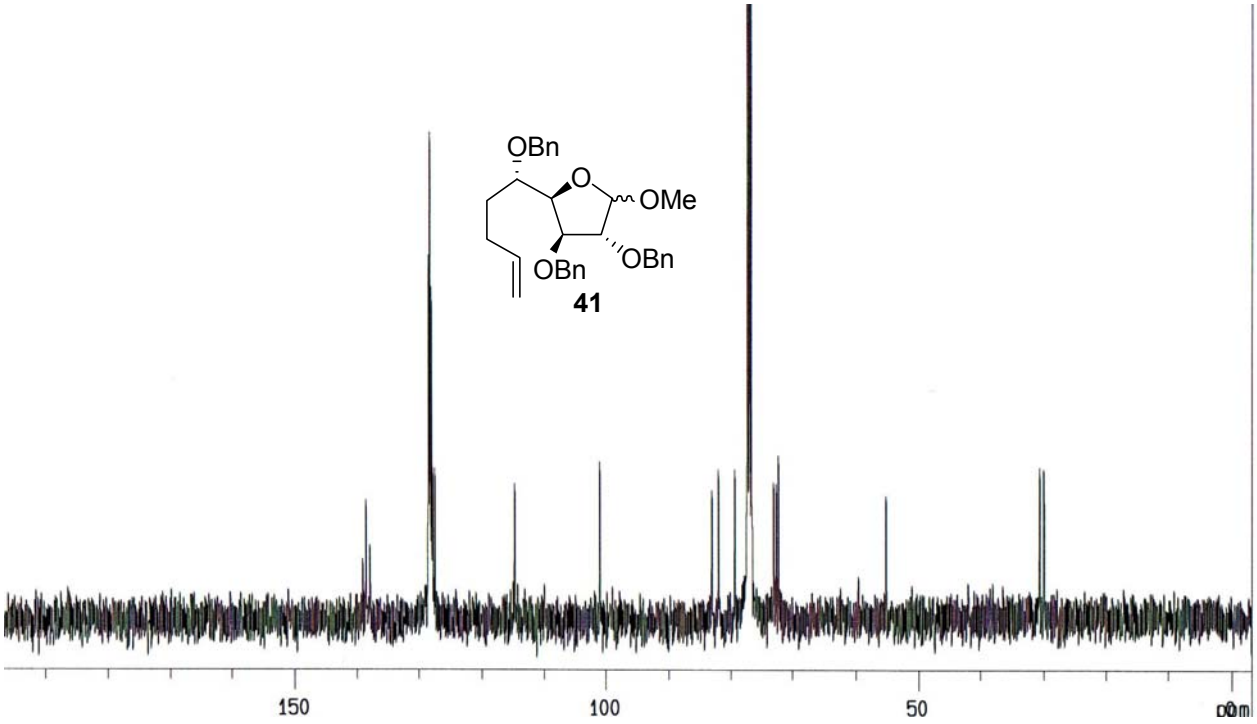


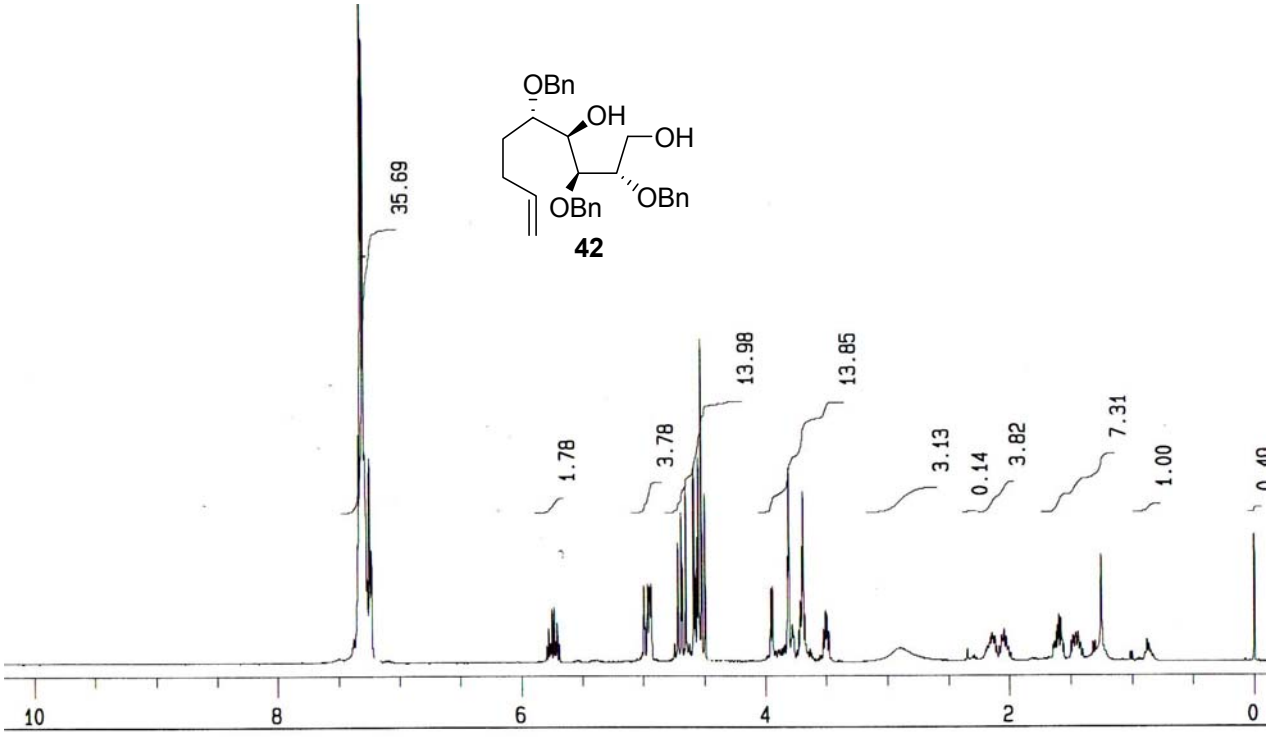
39

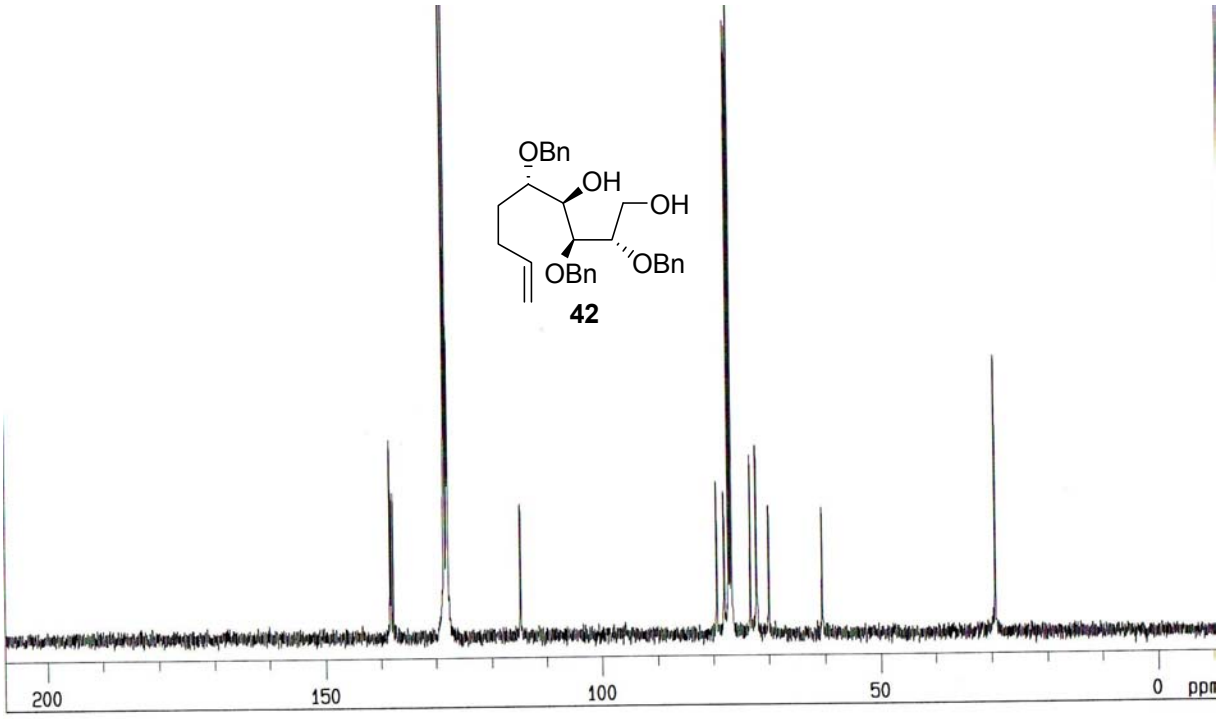

OBn
O
OMe
OBn
OH
40
21.21
1.50
10.69
2.62
2.65
3.63
3.25
1.00
5.86
10
8
6
4
2
0


OBn
O
OMe
OBn
OH
40
200
150
100
50
ppm

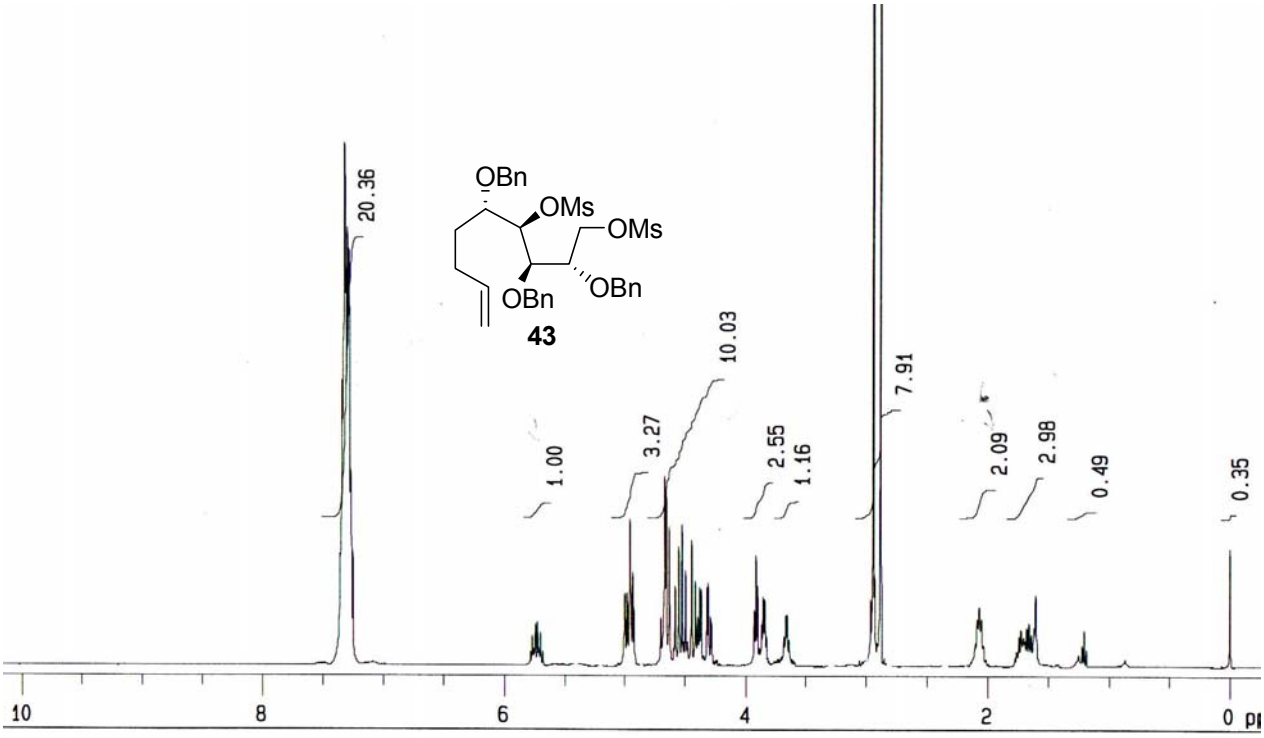

OBn
O
OMe
OBn
OBn
41
6.99
0.32
1.00
2.17
0.97
0.27
1.03
0.62
1.55
0.04
0.10
10
8
6
4
2
0 pp

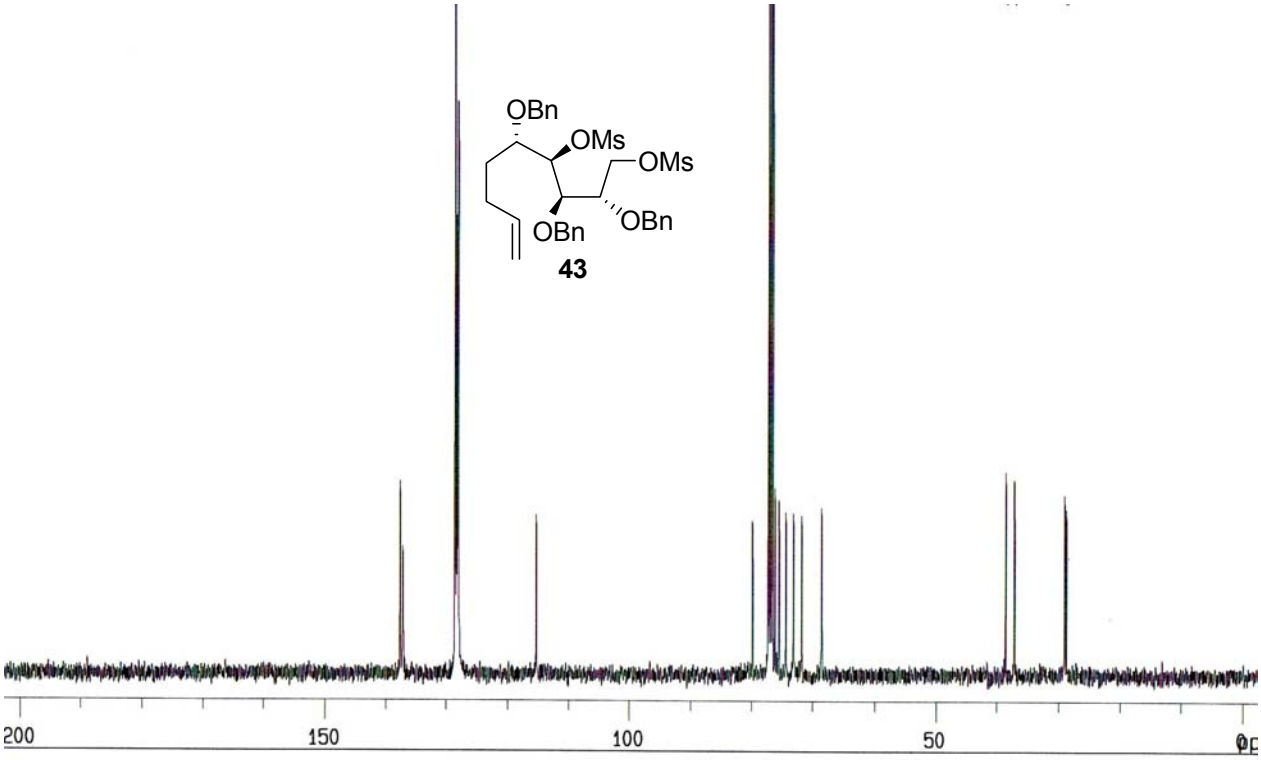

OBn
O
OMe
OBn
OBn
41
150
100
50
0
ppm


OBn
OH
OH
OBn
OBn
42
35.69
1.78
3.78
13.98
13.85
3.13
0.14
3.82
7.31
1.00
10
8
6
4
2
0

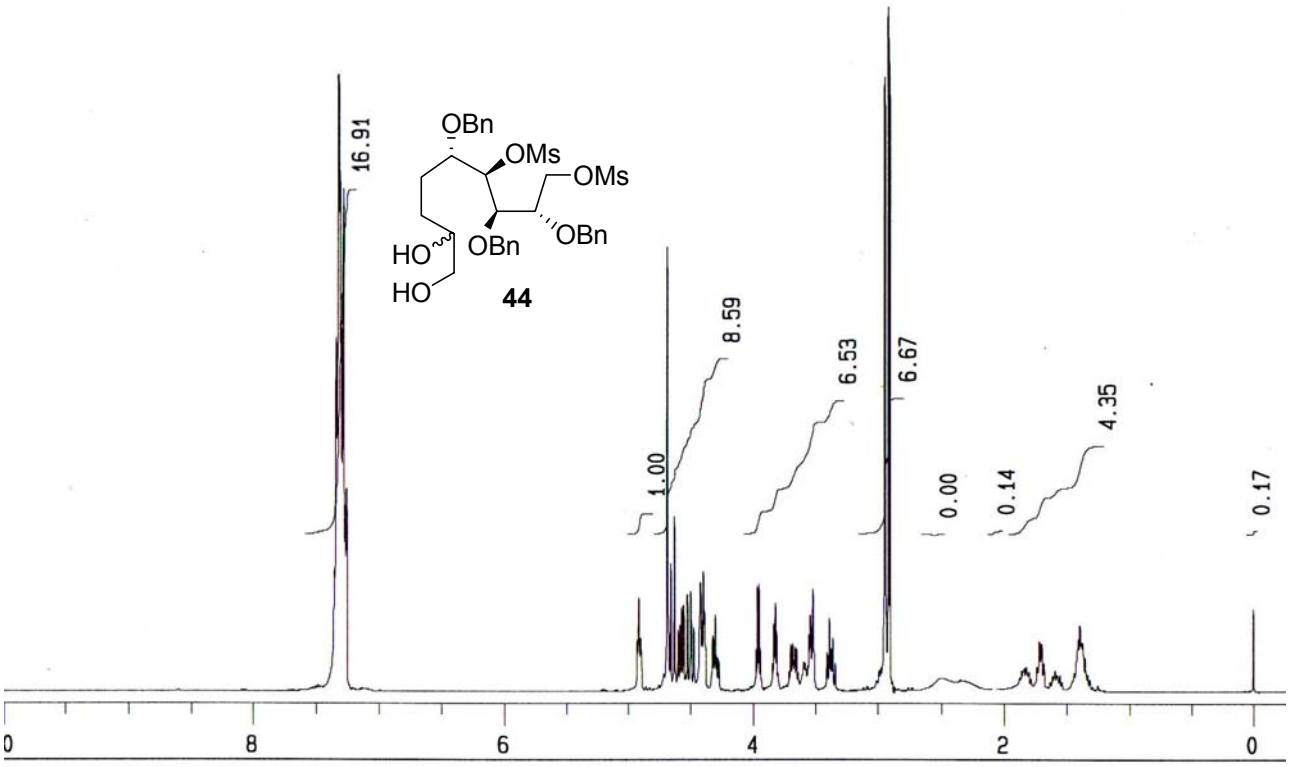


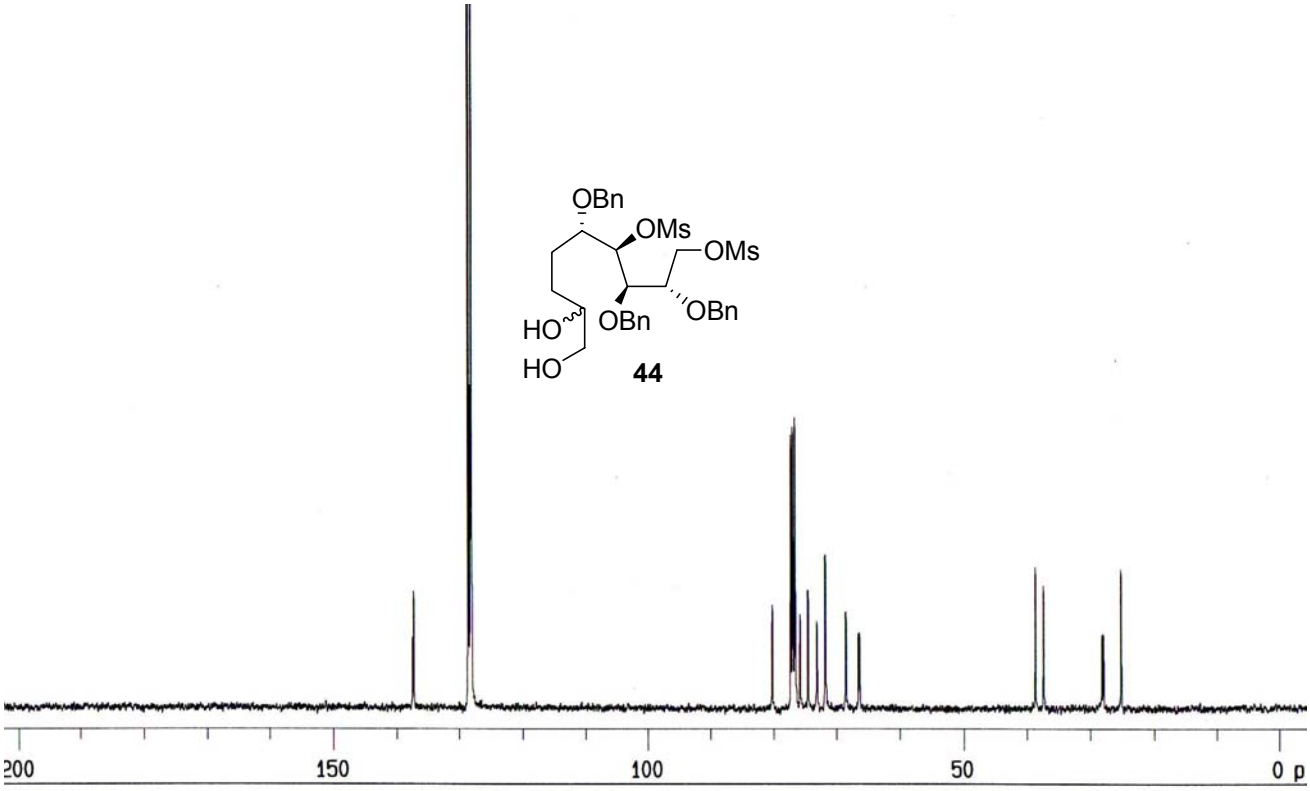
42


OBn
OMs
OMs
OBn
OBn
43
20.36
1.00
3.27
10.03
2.55
1.16
7.91
2.09
2.98
0.49
0.35
10
8
6
4
2
0 p



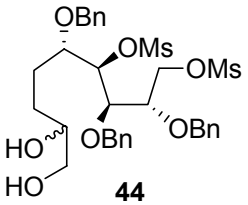
43


OBn
OMs
OMs
OBn
OBn
HO
HO
44
16.91
1.00
8.59
6.53
6.67
0.00
0.14
4.35
0.17
0
8
6
4
2
0

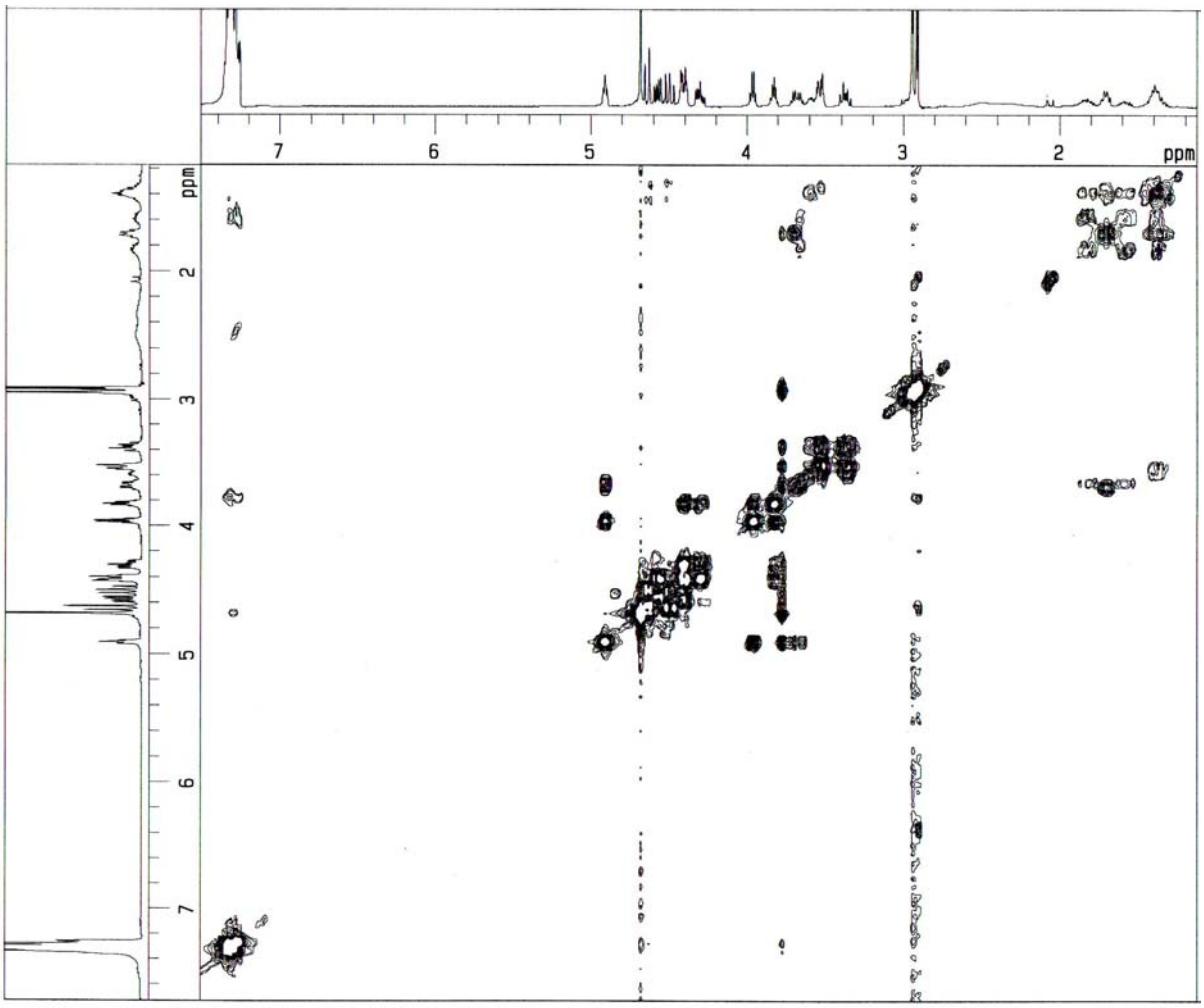


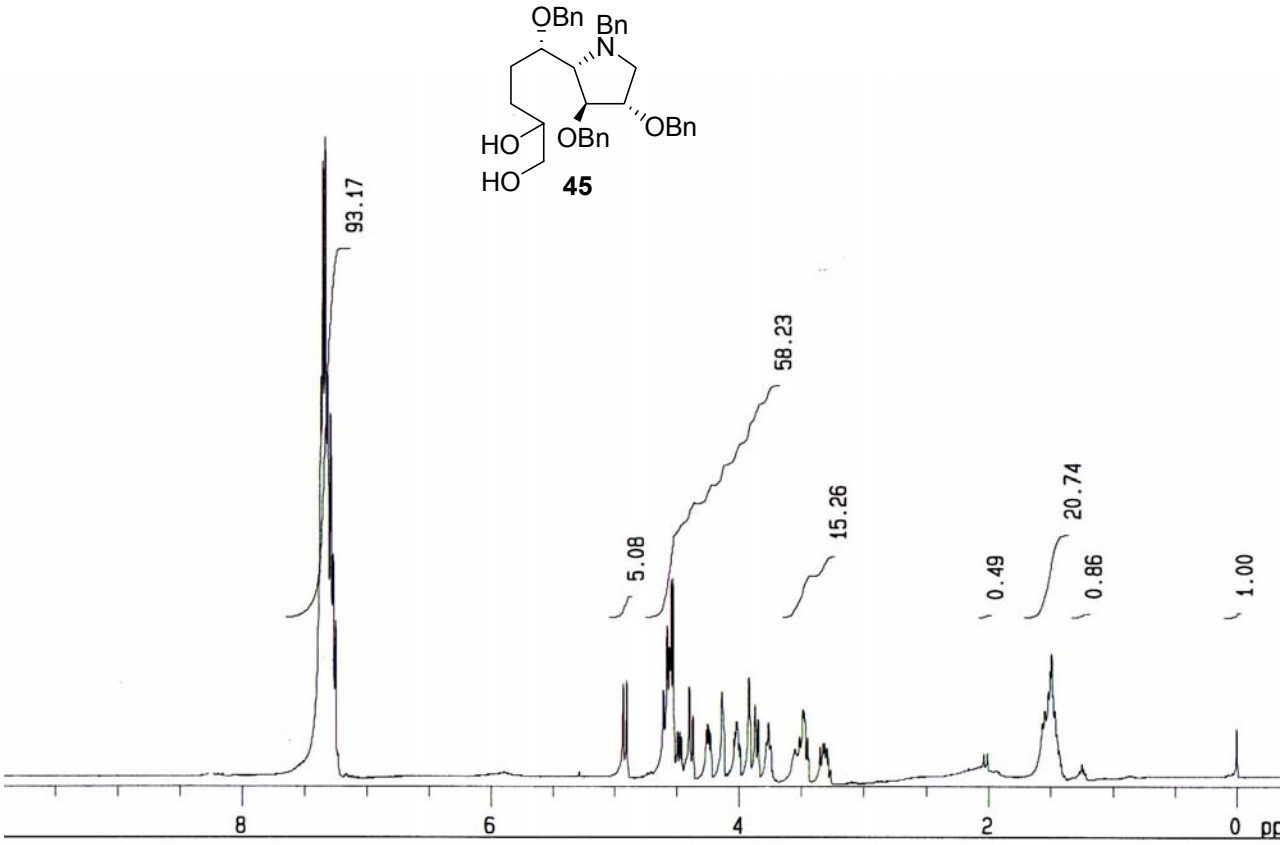
44

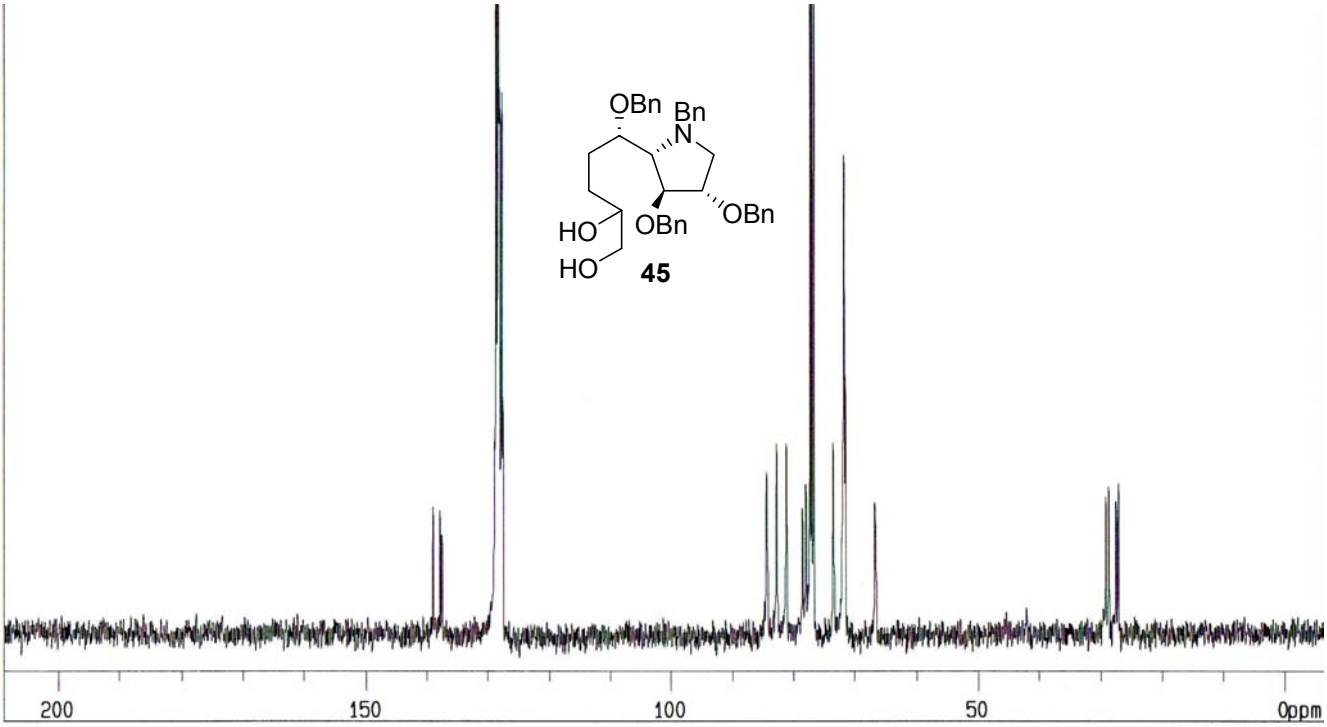
COSY spectrum of compound **44**



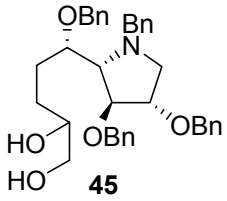
44



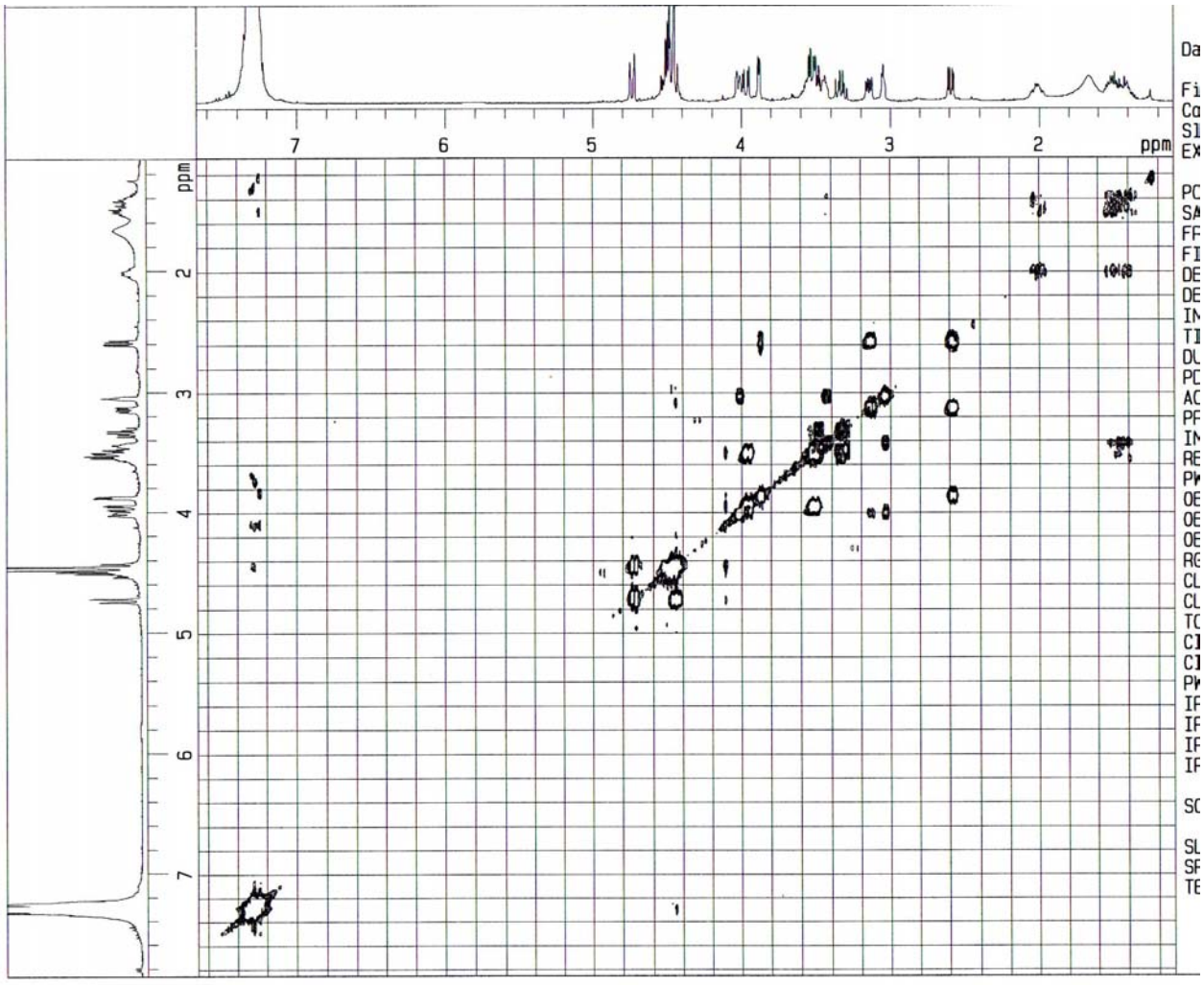

OBn
Bn
N
HO
OBn
OBn
HO
45
93.17
58.23
15.26
5.08
0.49
20.74
0.86
1.00
8
6
4
2
0
ppm

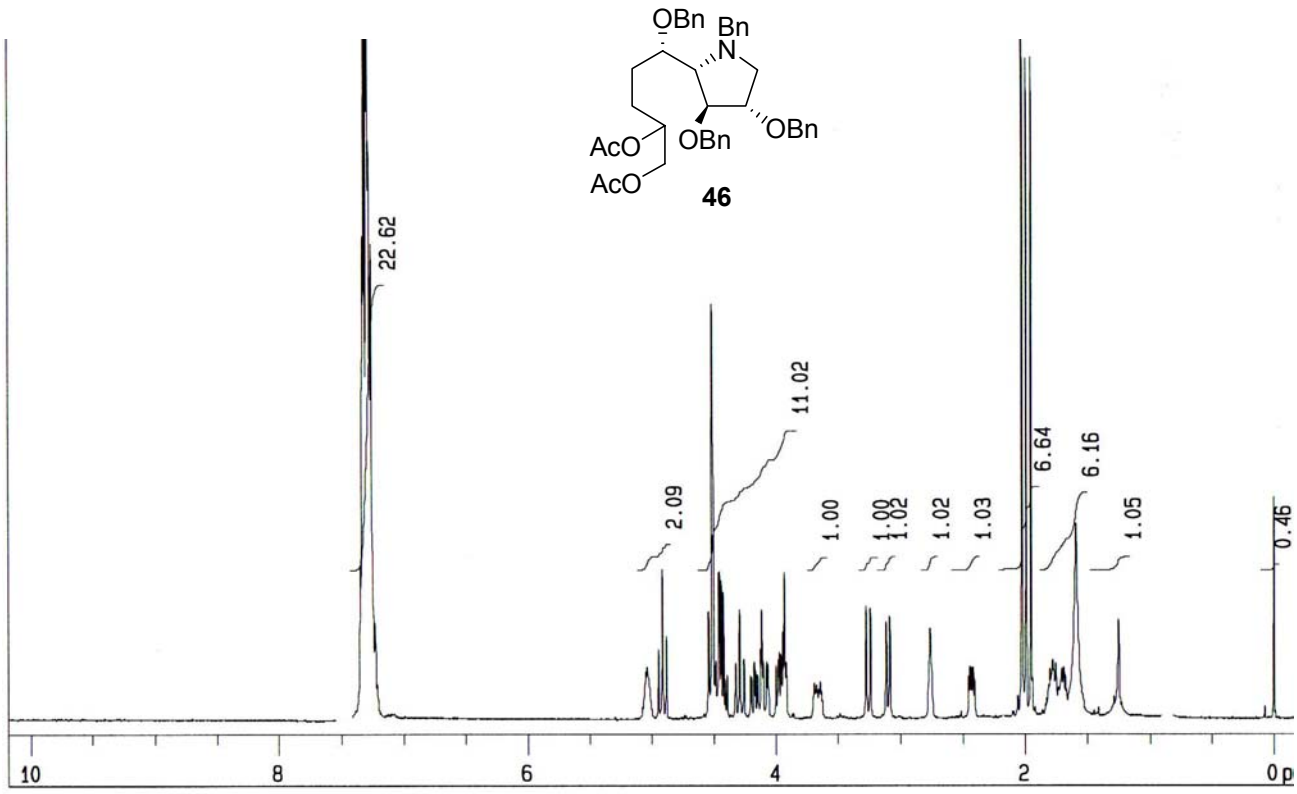

OBn
Bn
N
OBn
HO
OBn
HO
45
200
150
100
50
0ppm

COSY spectrum of compound **45**

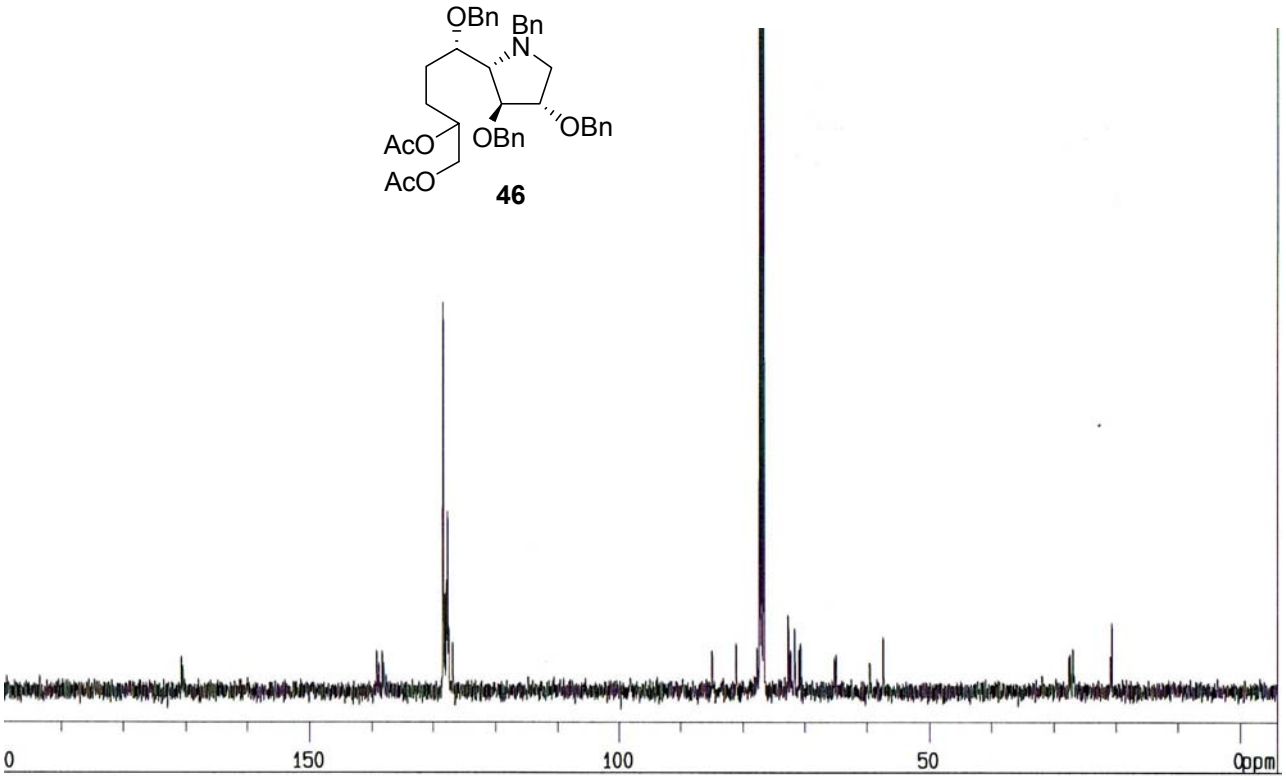


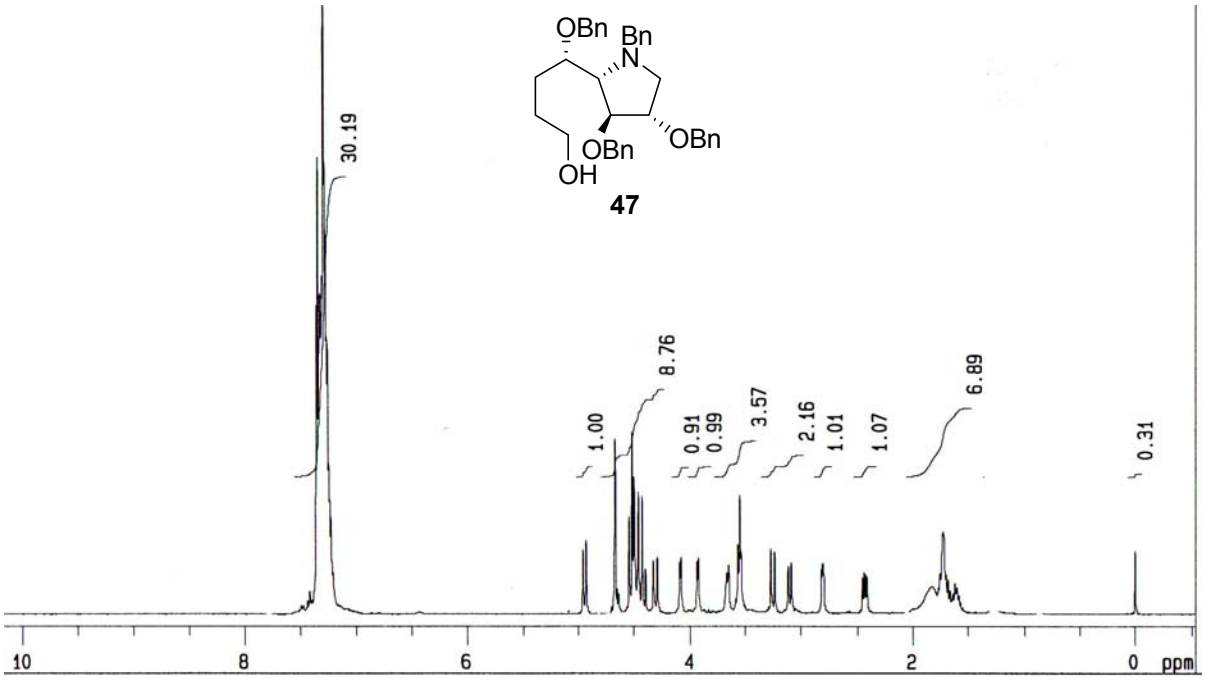
45

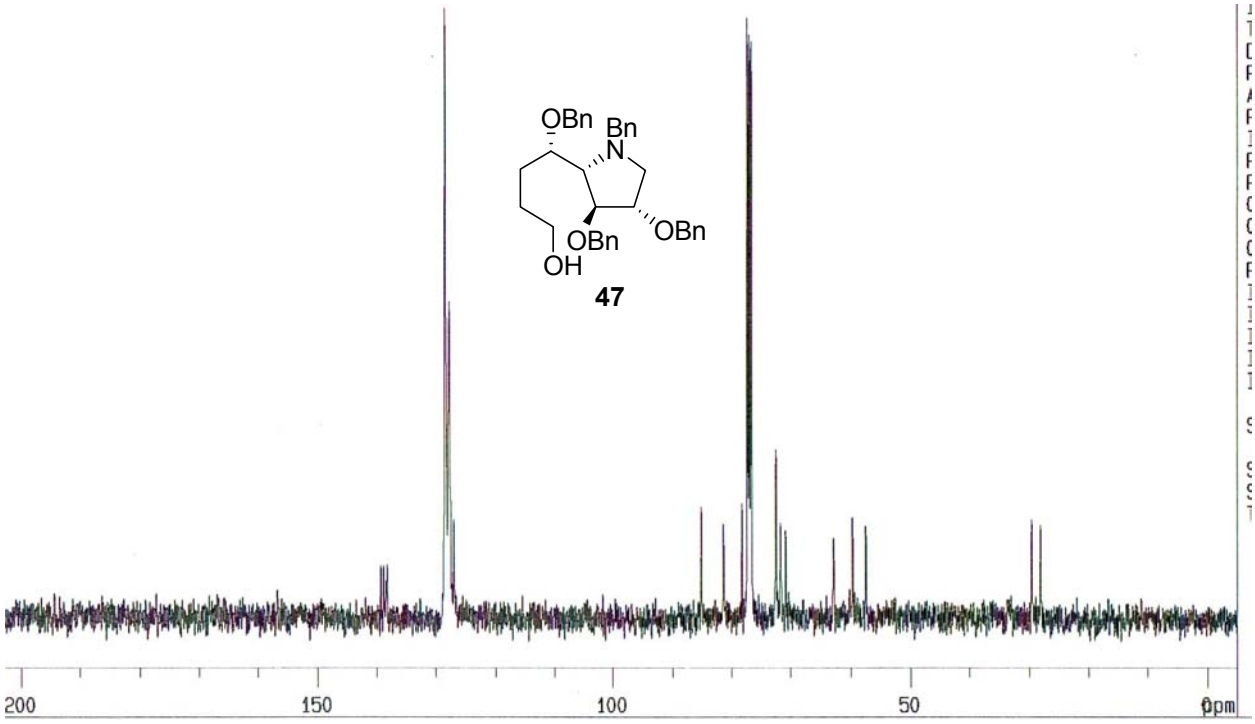



OBn
Bn
N
AcO
AcO
OBn
OBn
22.62
2.09
11.02
1.00
1.00
1.02
1.02
1.03
6.64
6.16
1.05
0.46
10
8
6
4
2
0p

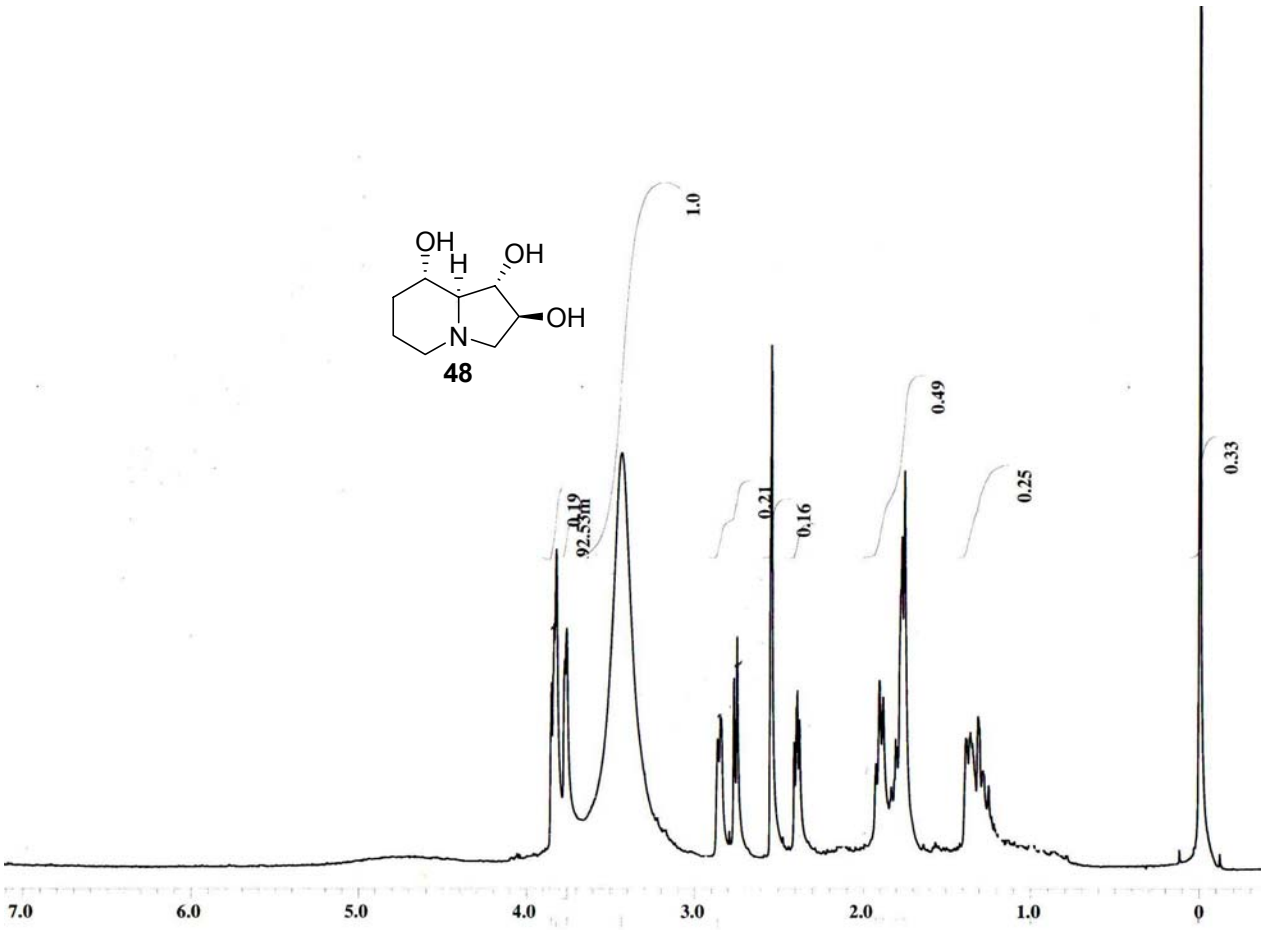
46

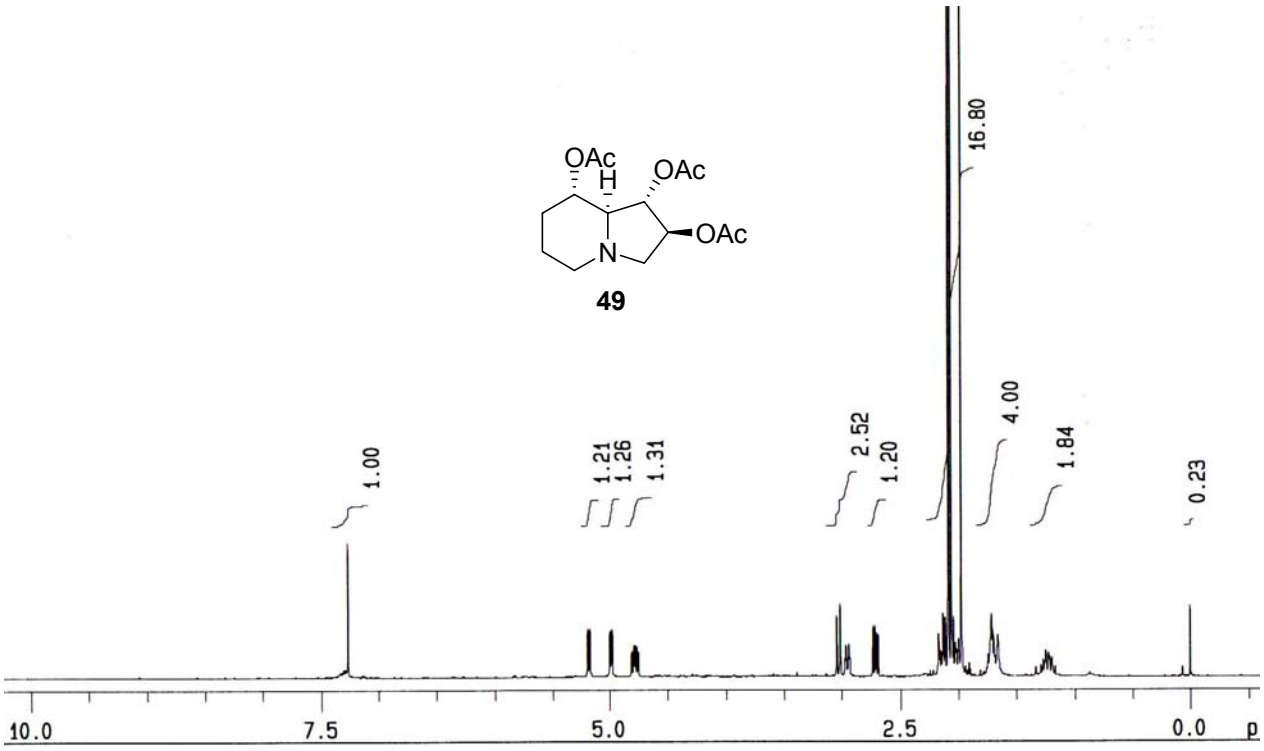

OBn
Bn
N
OBn
OBn
AcO
AcO
46
0
150
100
50
0ppm

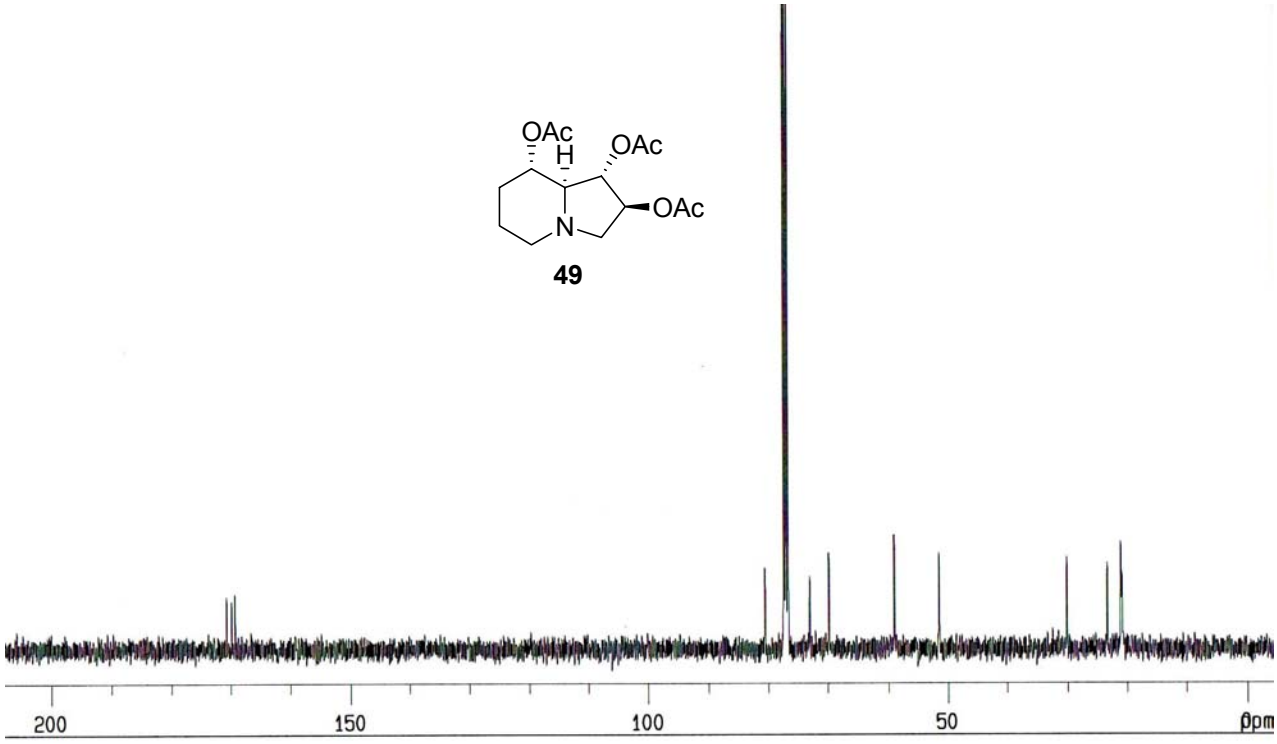

OBn
Bn
N
OBn
OBn
OH
47
30.19
1.00
8.76
0.91
0.99
3.57
2.16
1.01
1.07
6.89
0.31
10
8
6
4
2
0
ppm



47

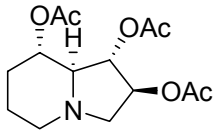

OH
H
OH
OH
N
48
1.0
0.19
0.21
0.16
0.49
0.25
0.33
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0


OAc
H
OAc
OAc
N
49
1.00
1.21
1.26
1.31
2.52
1.20
16.80
4.00
1.84
0.23
10.0
7.5
5.0
2.5
0.0
p

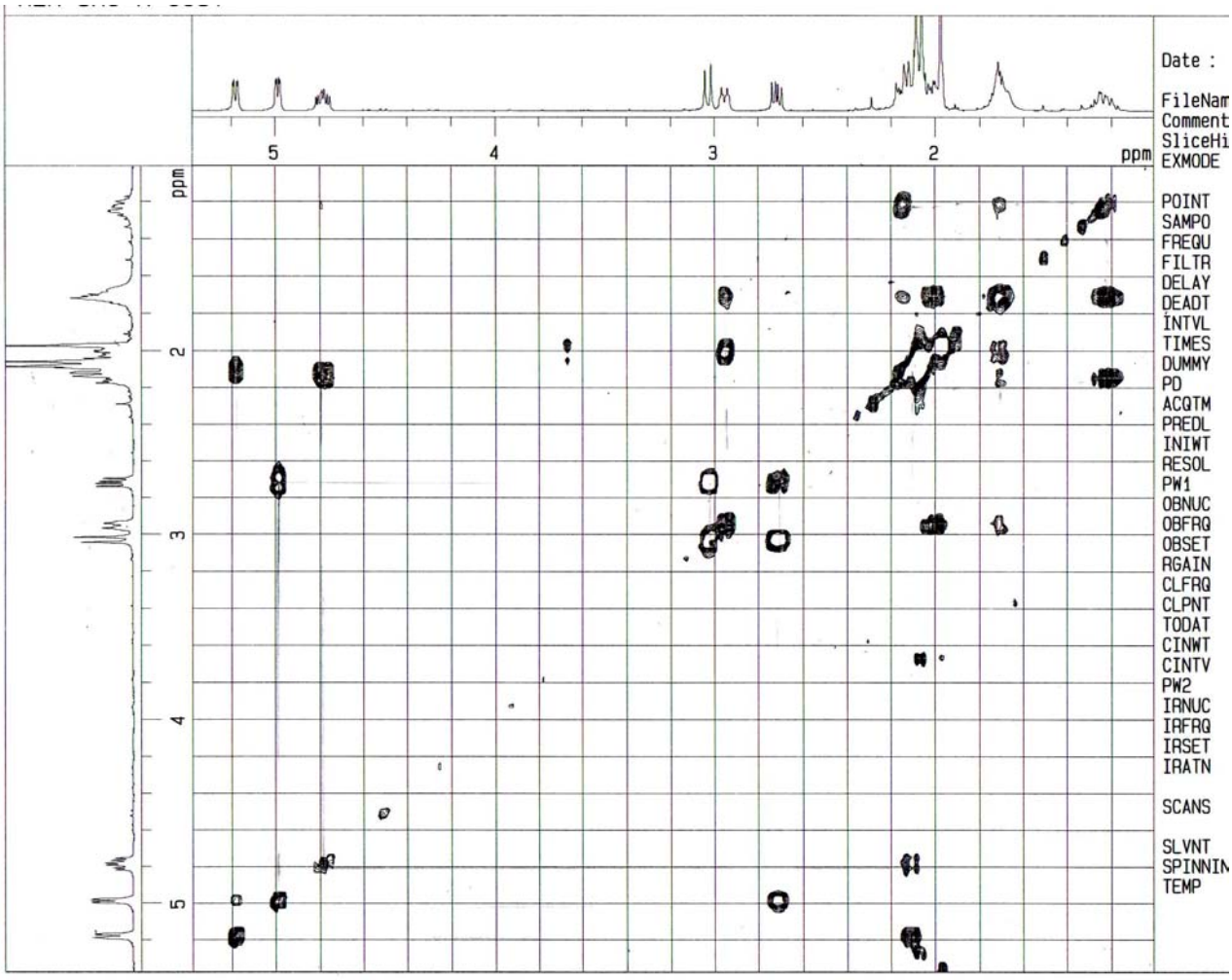


49

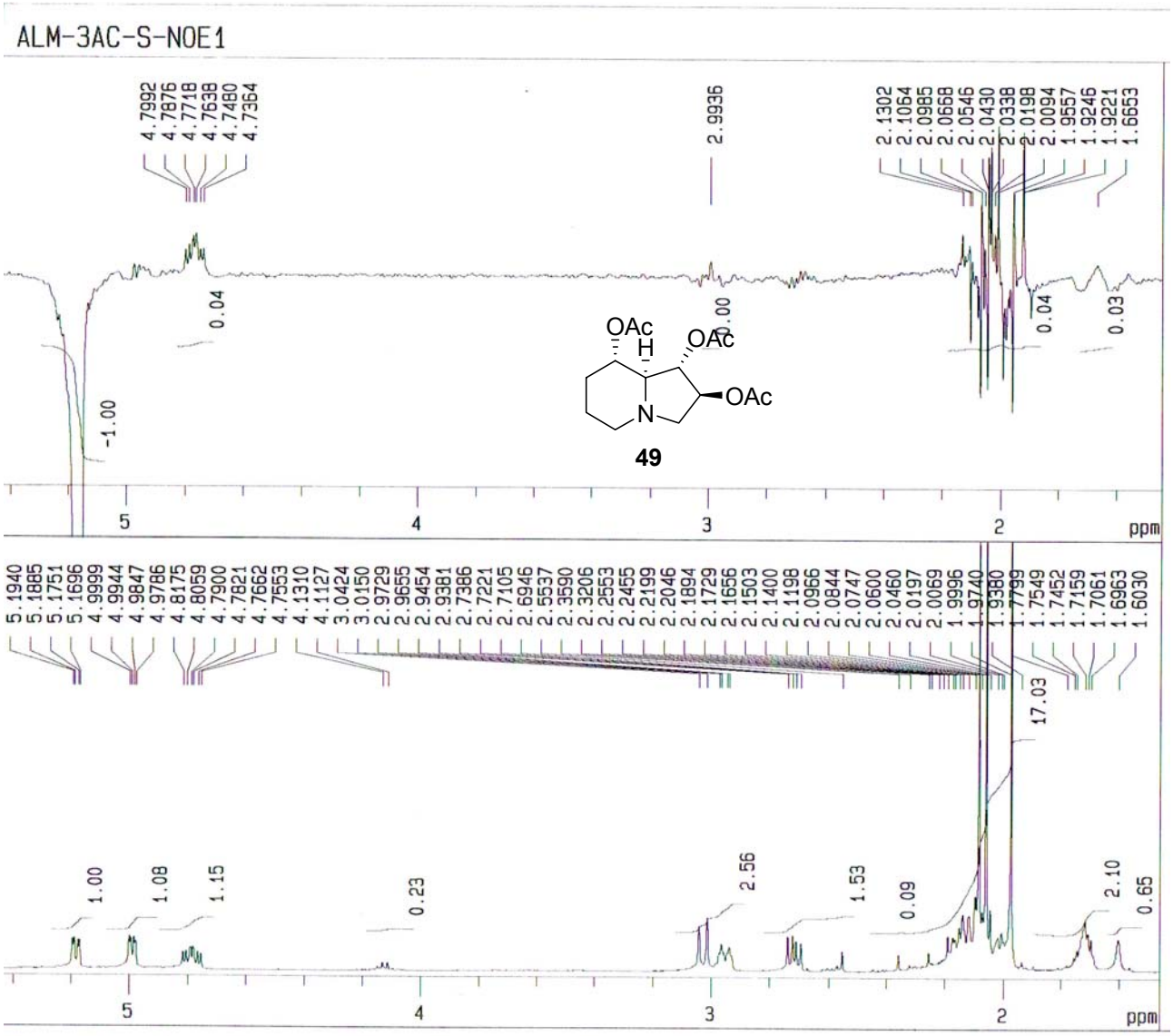
COSY spectrum of compound **49**



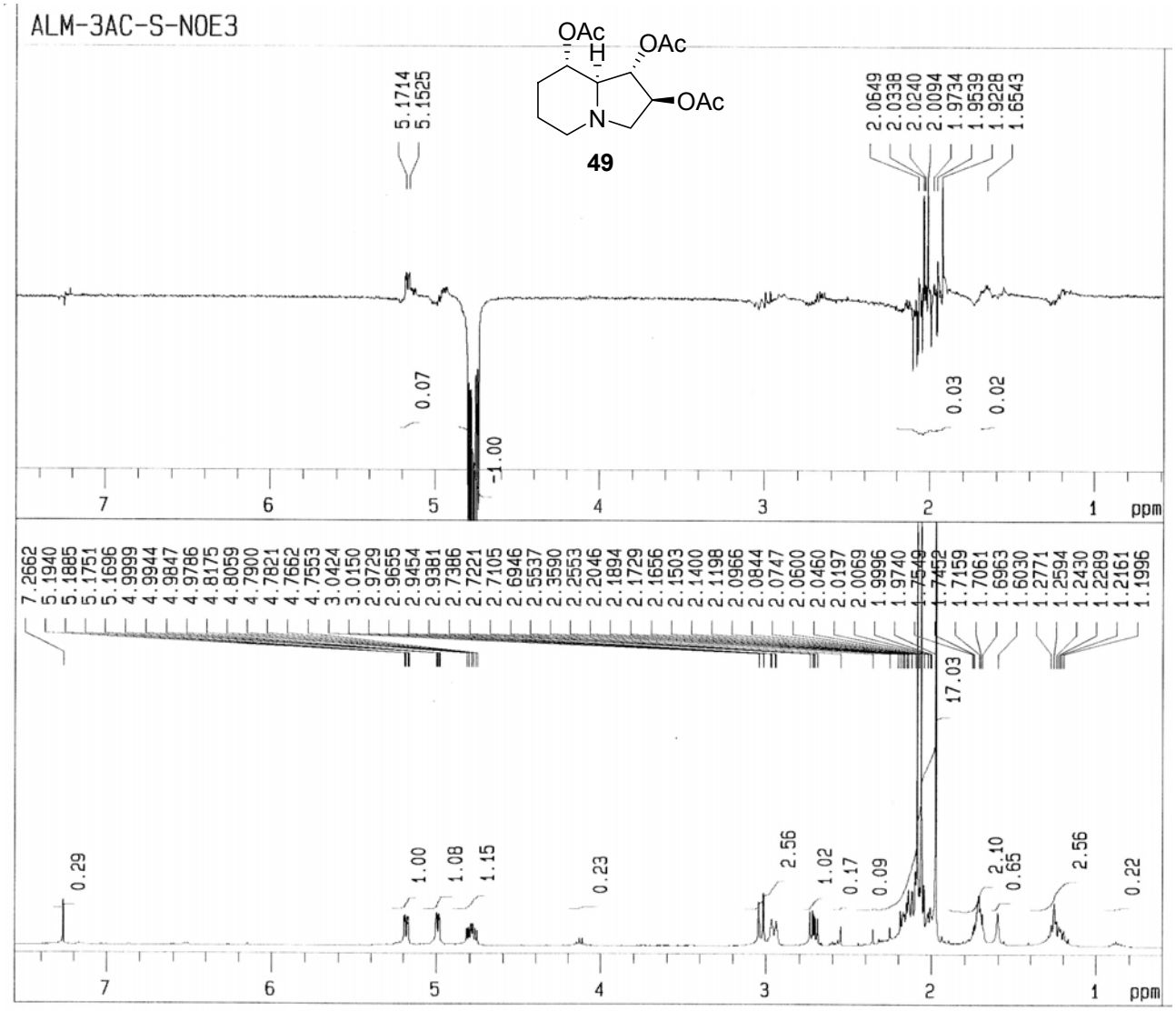
49



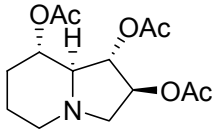
NOE spectrum of compound **49**



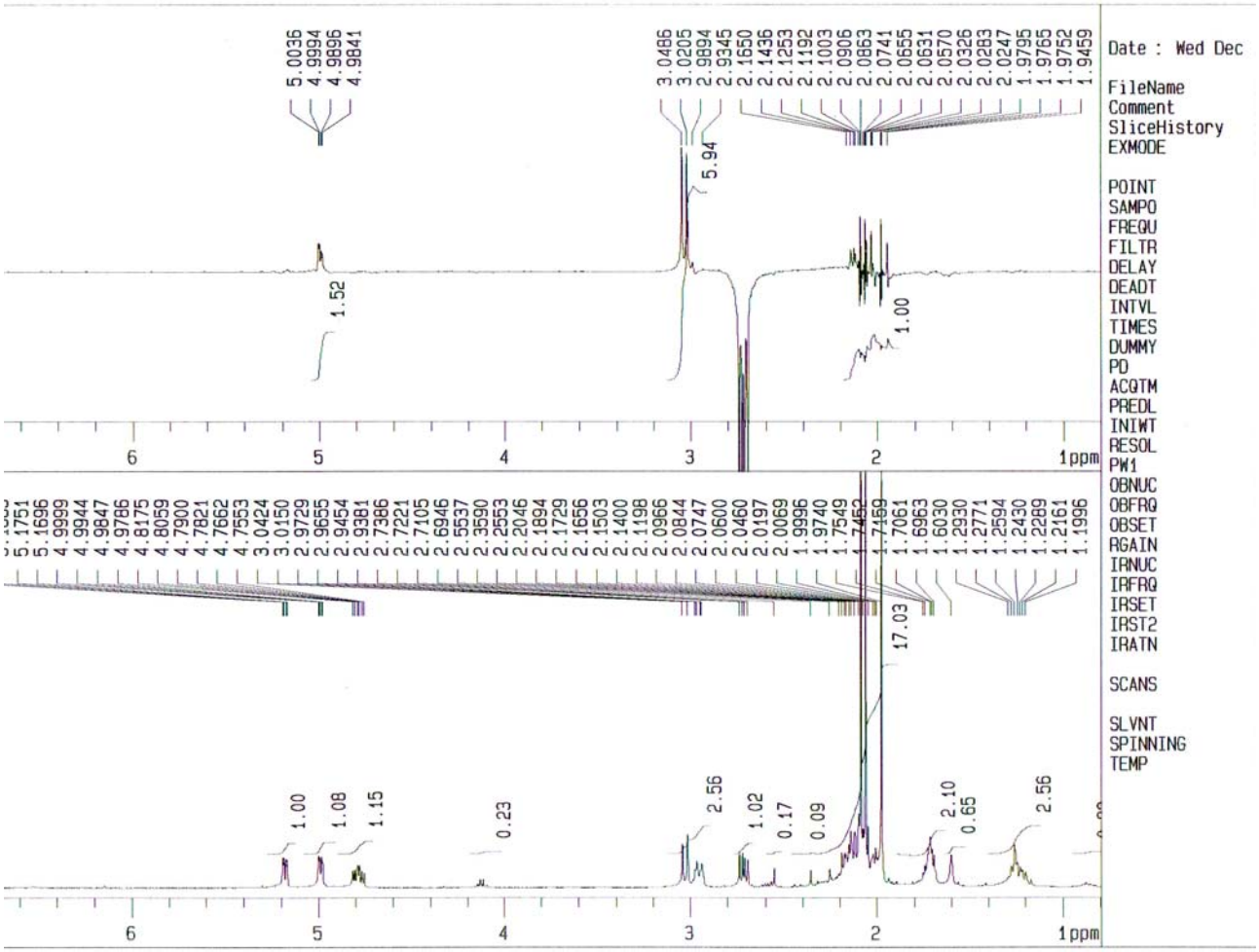
NOE spectrum of compound **49**

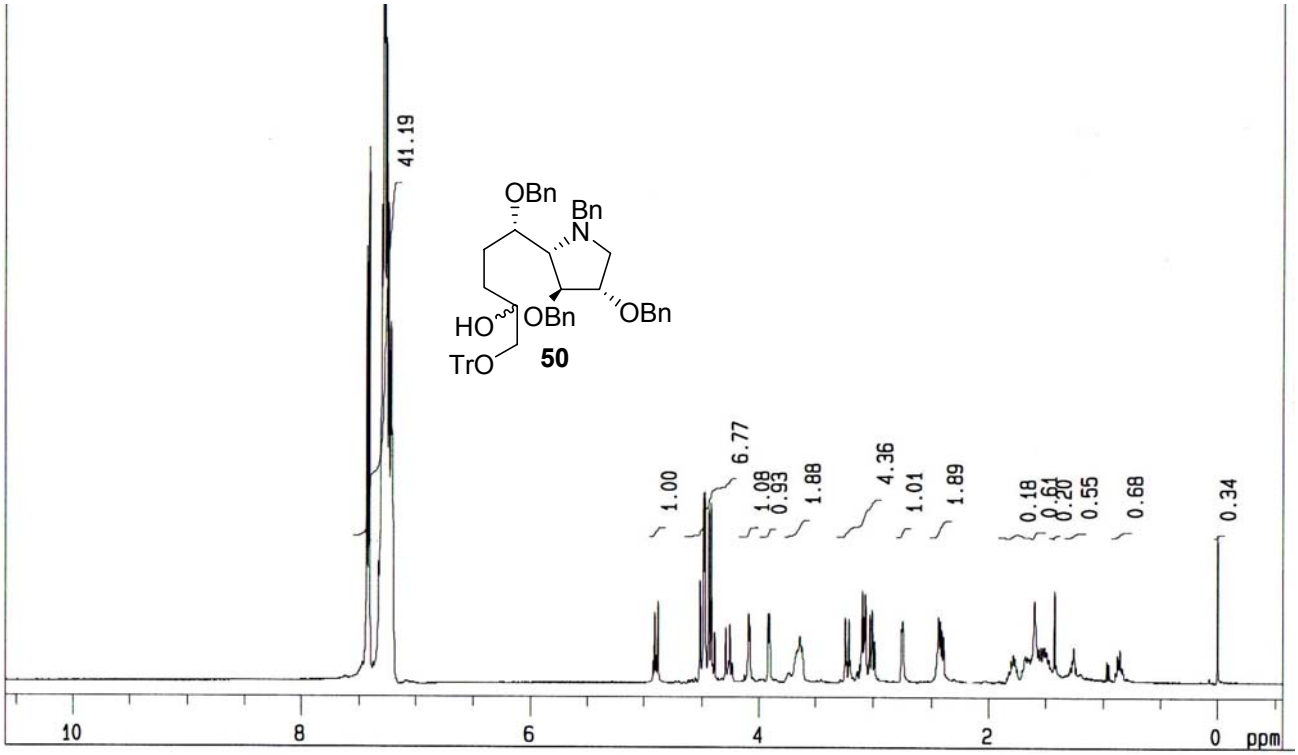


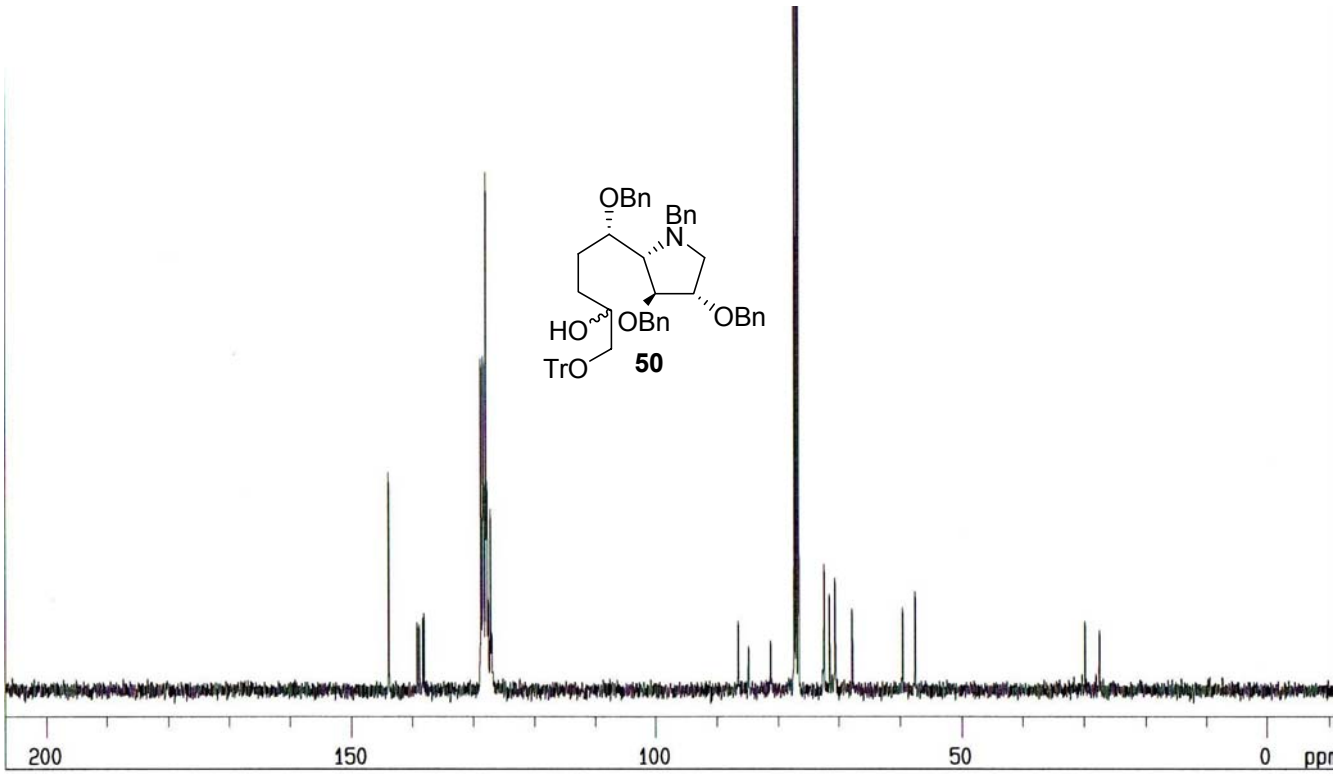
NOE spectrum of compound **49**

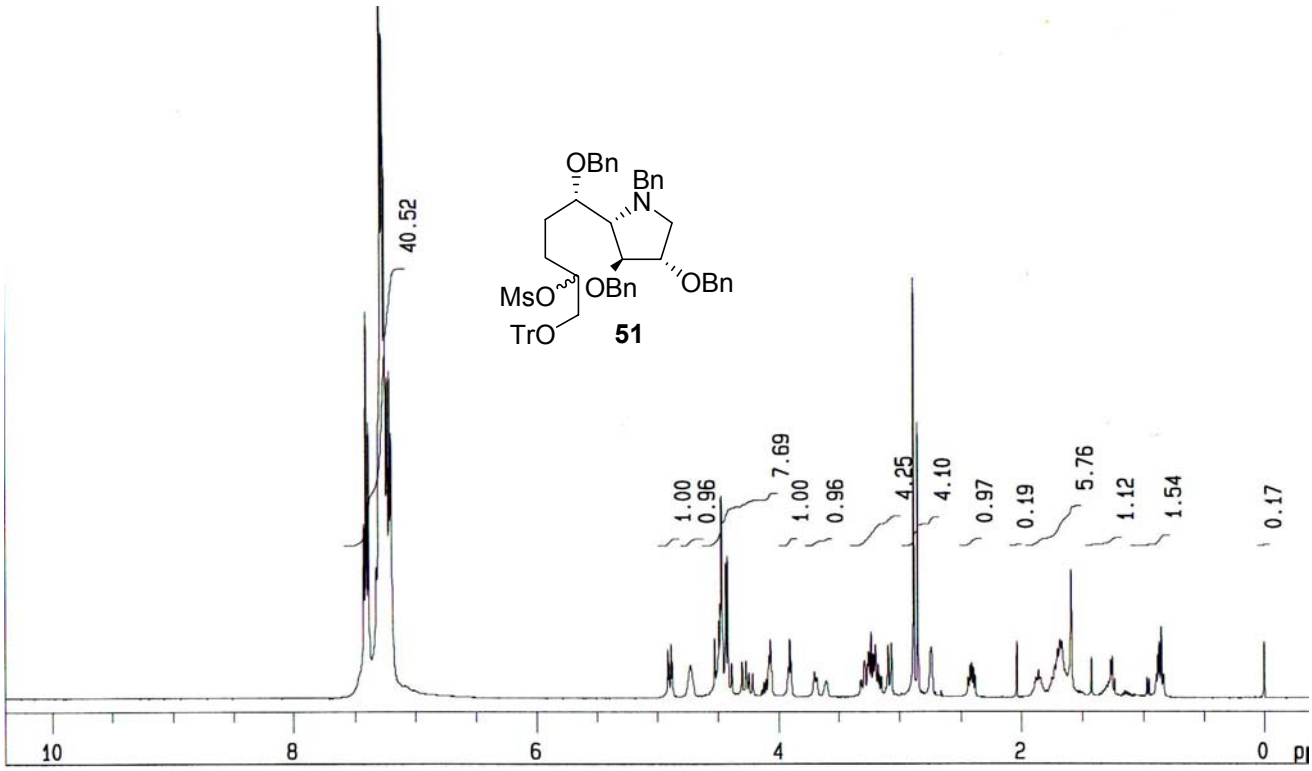


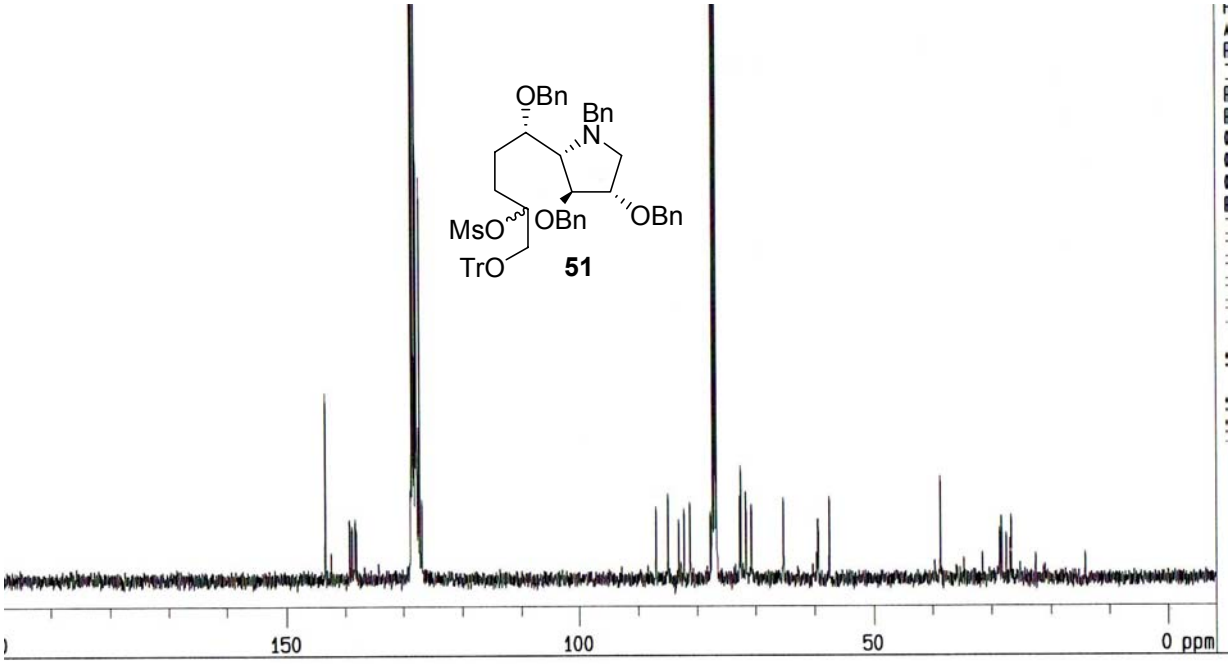
49

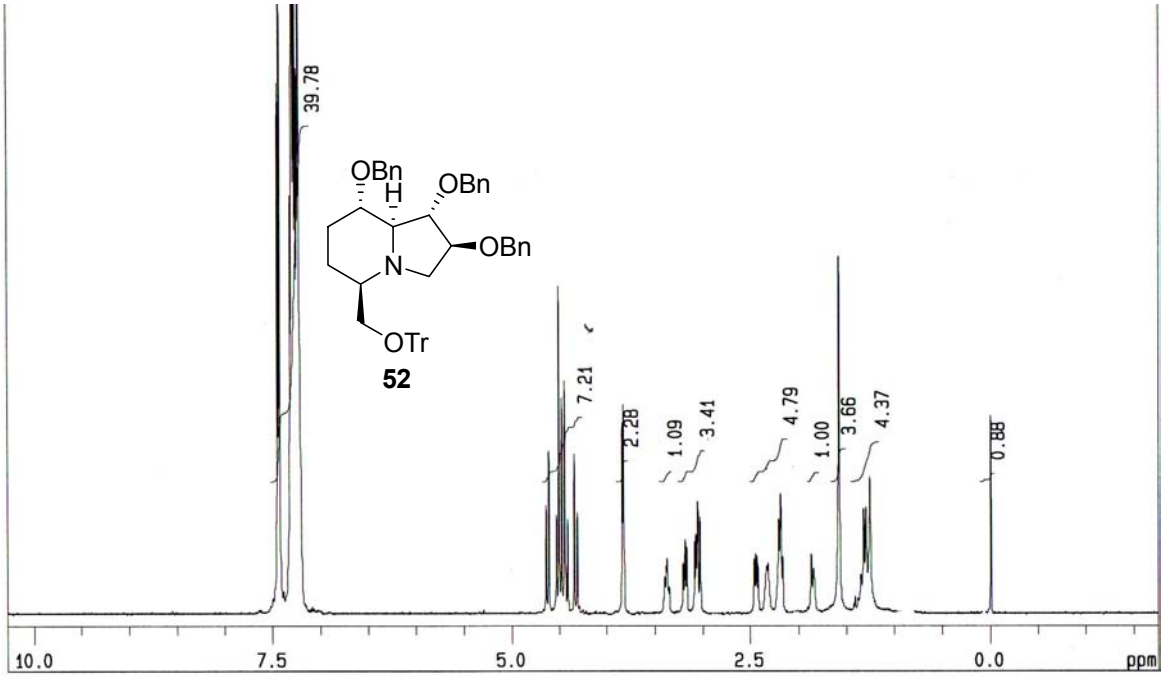


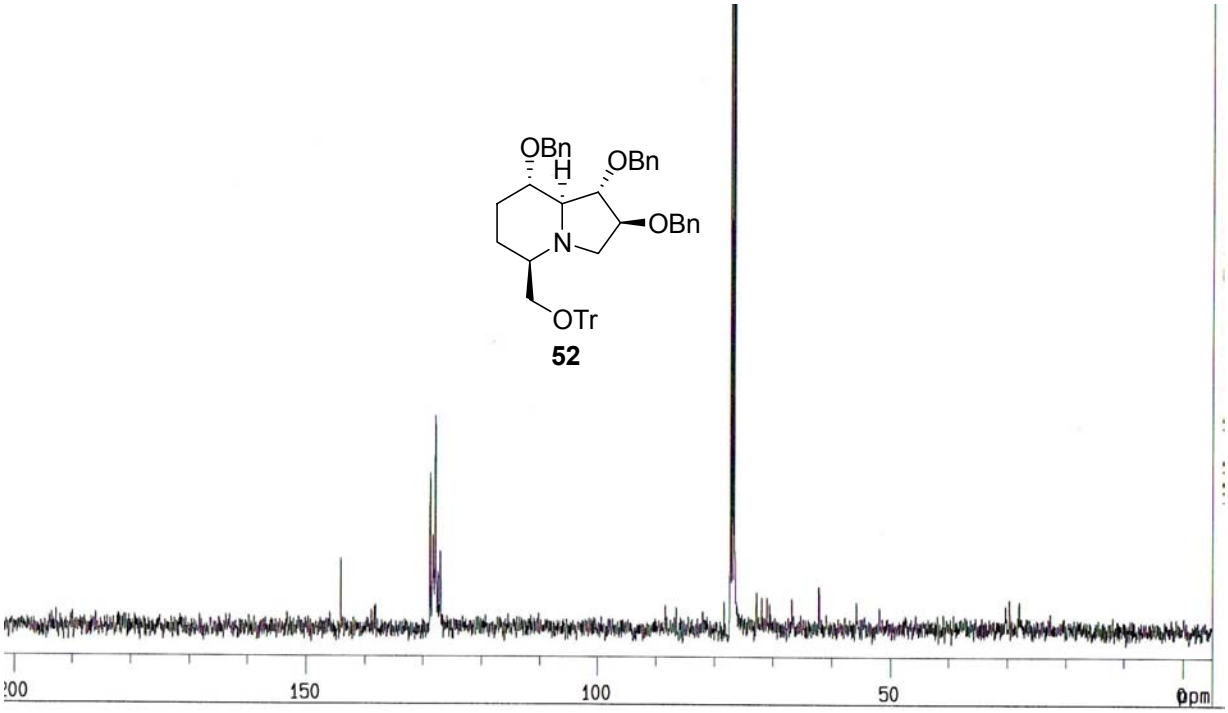

41.19
OBn
Bn
N
HO
OBn
OBn
TrO
50
1.00
6.77
1.08
0.93
1.88
4.36
1.01
1.89
0.18
0.61
0.20
0.55
0.68
0.34
10
8
6
4
2
0
ppm

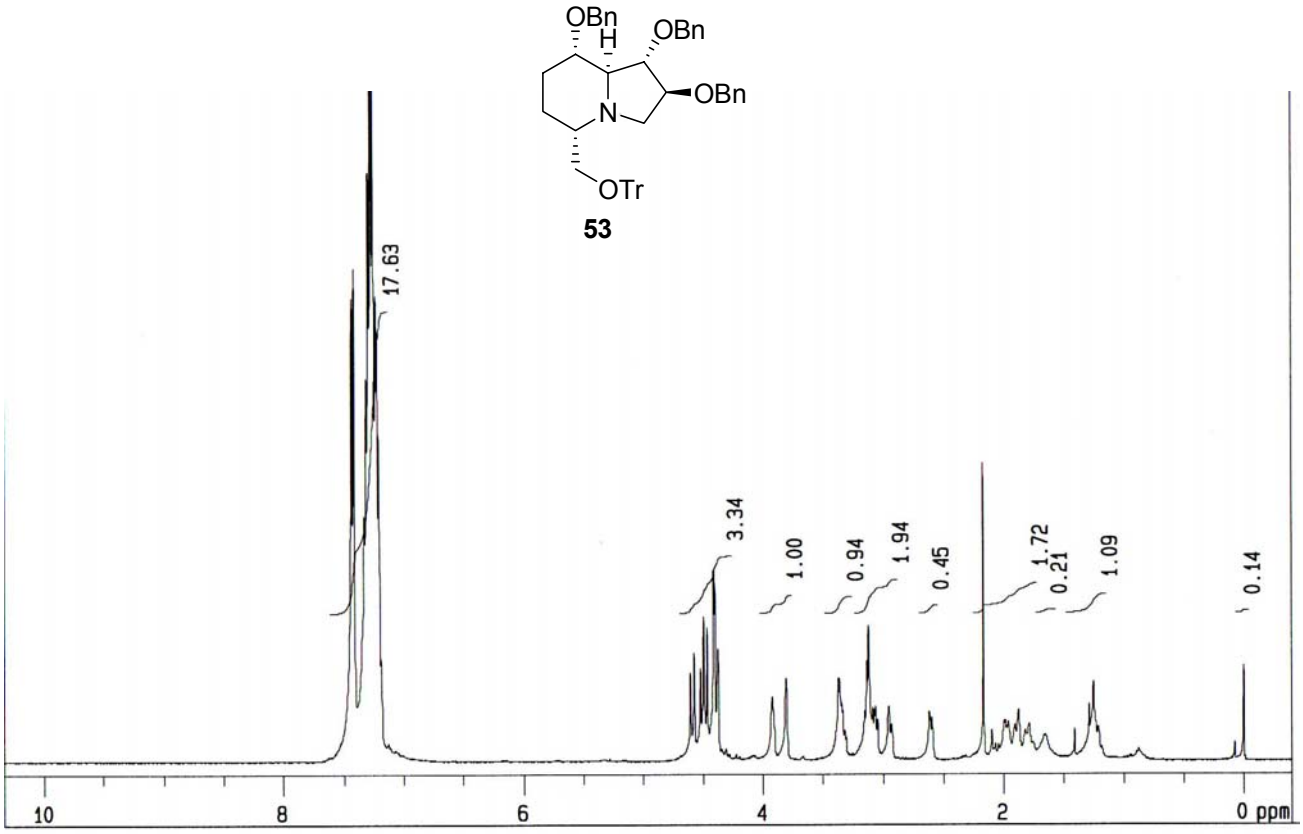

OBn
Bn
N
HO
OBn
OBn
TrO
50
200
150
100
50
0
ppr


OBn
Bn
N
MsO
OBn
OBn
TrO
51
40.52
1.00
0.96
7.69
1.00
0.96
4.25
4.10
0.97
0.19
5.76
1.12
1.54
0.17
10
8
6
4
2
0

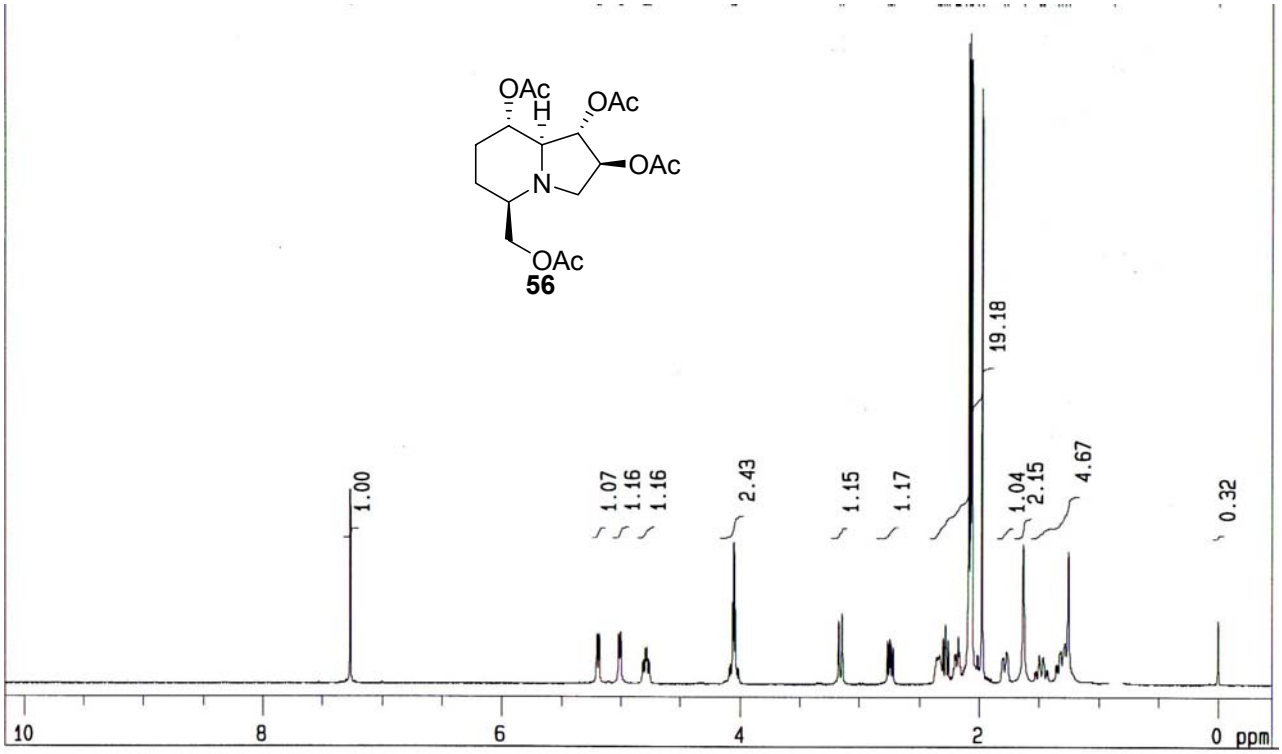

OBn
Bn
N
MsO
OBn
OBn
TrO
51
150
100
50
0 ppm

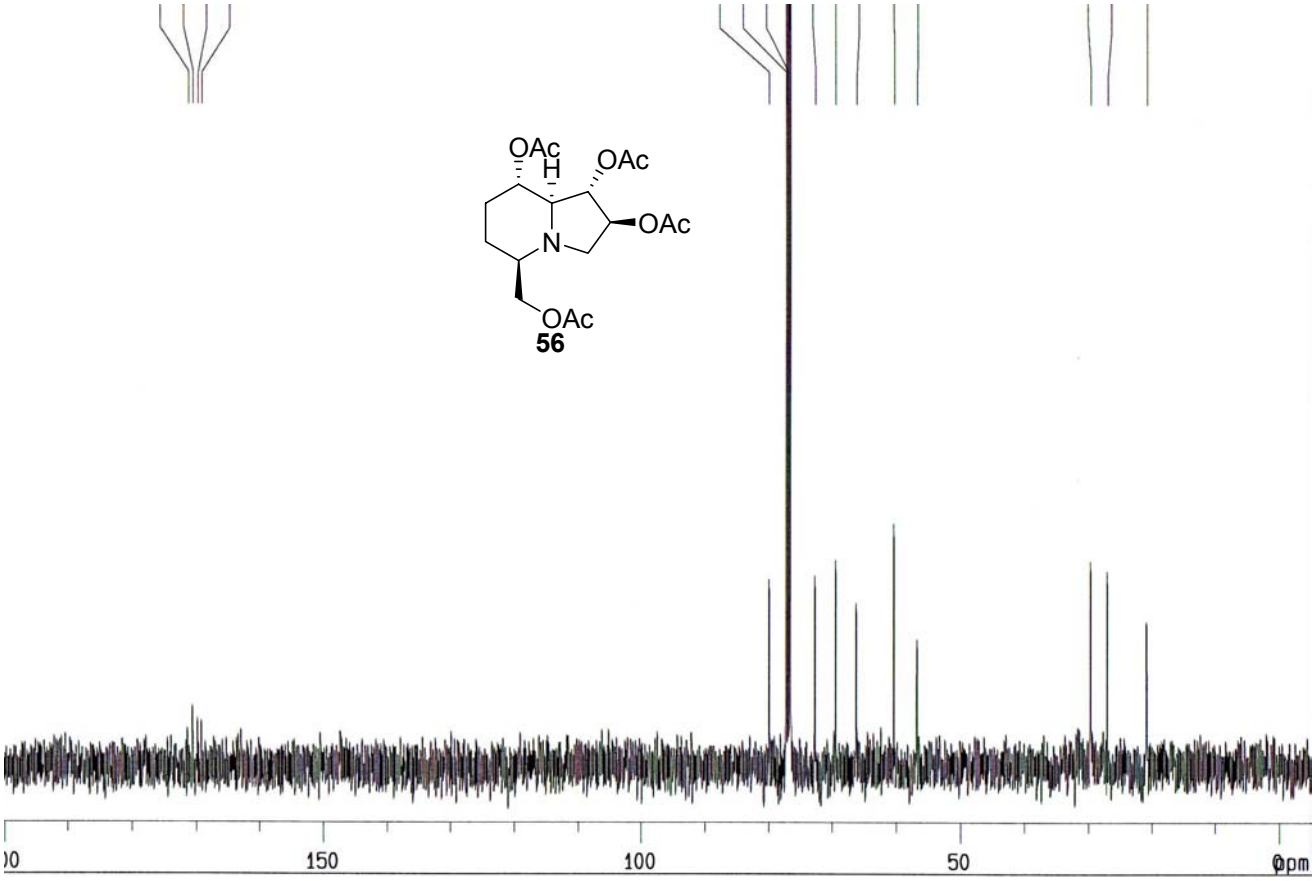

39.78
OBn
H
OBn
OBn
N
OTr
52
7.21
2.28
1.09
3.41
4.79
1.00
3.66
4.37
0.88
10.0
7.5
5.0
2.5
0.0
ppm


OBn
H
OBn
OBn
N
OTr
52
150
100
50
0ppm

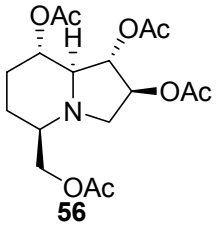

OBn
H
OBn
OBn
N
OTr
17.63
3.34
1.00
0.94
1.94
0.45
1.72
0.21
1.09
0.14
10
8
6
4
2
0 ppm

53


OAc
H
OAc
OAc
N
OAc
56
1.00
1.07
1.16
1.16
2.43
1.15
1.17
19.18
1.04
2.15
4.67
0.32
10
8
6
4
2
0 ppm

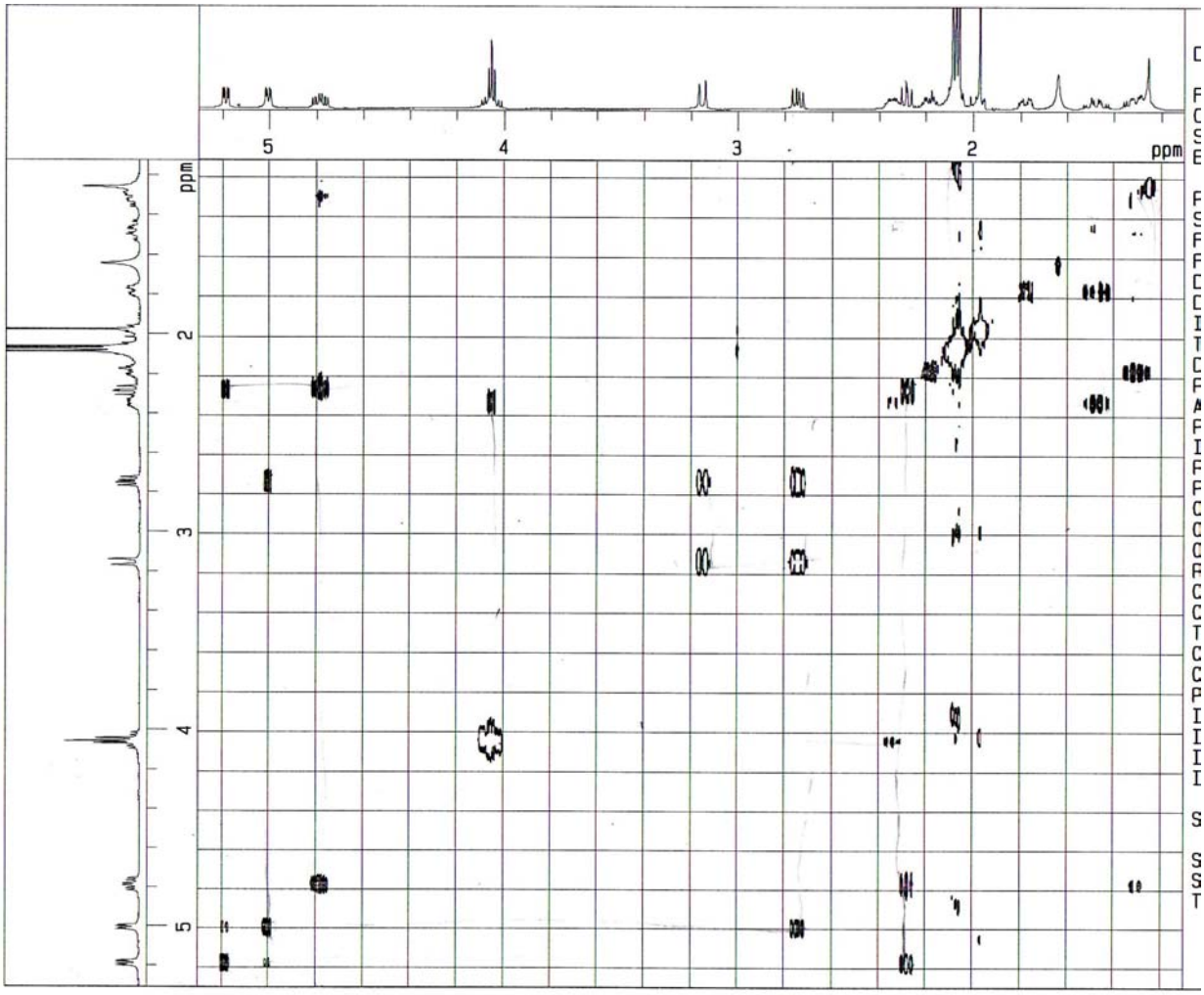


56

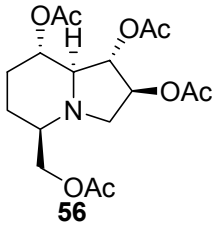


56

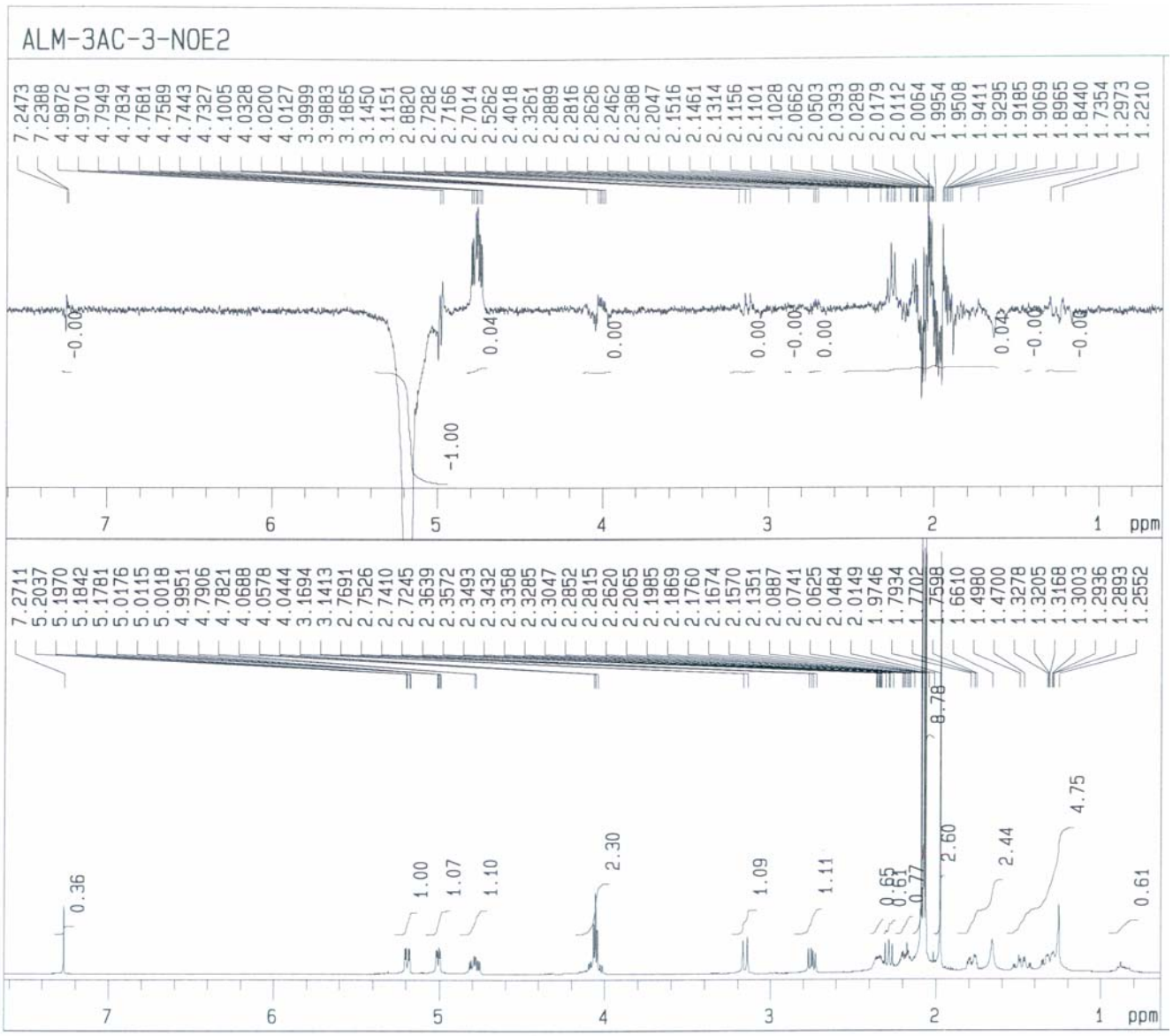
COSY spectrum of compound **56**



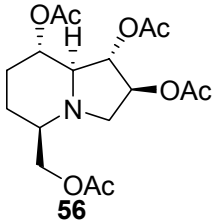
NOE spectrum of compound **56**



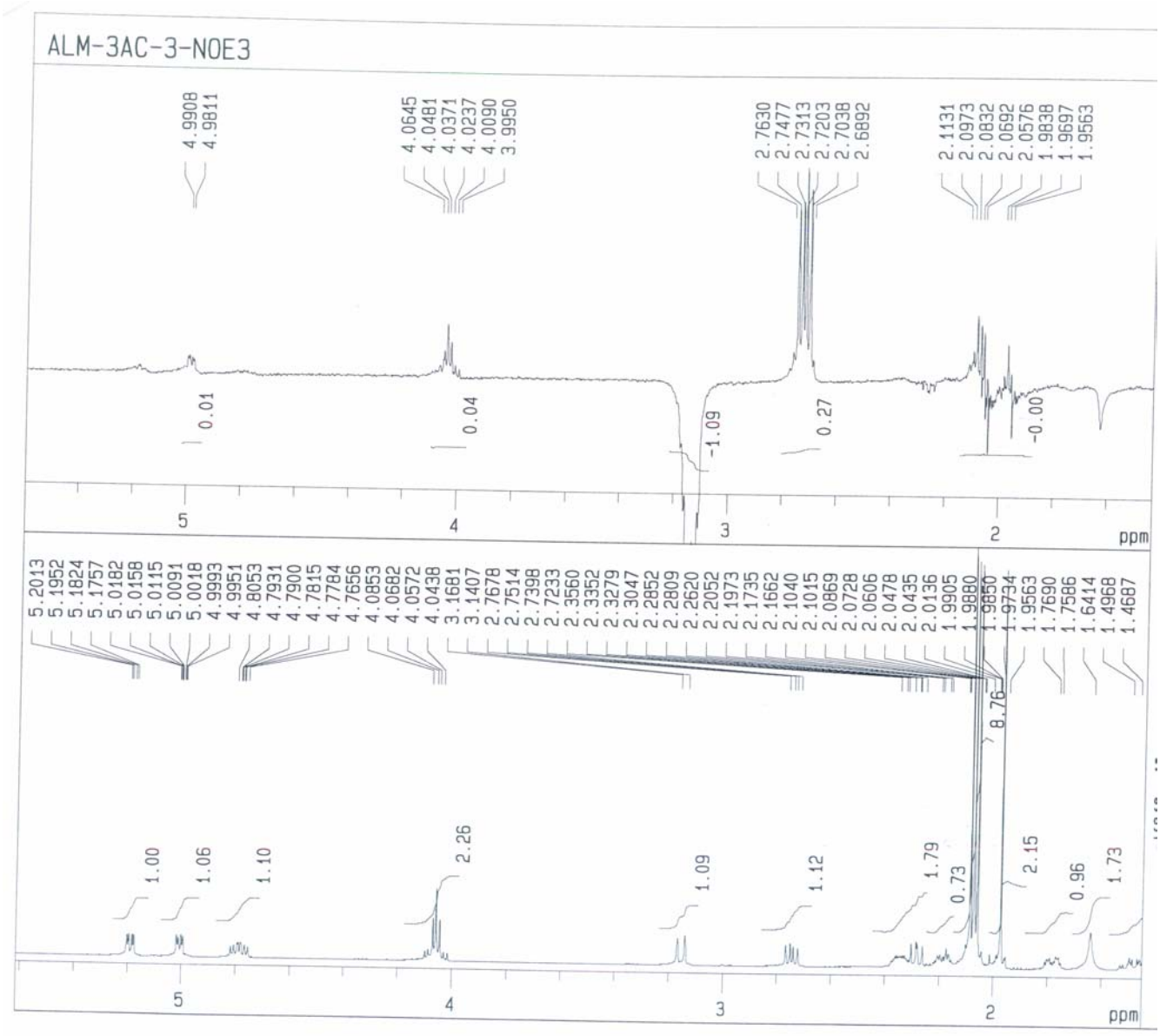
56



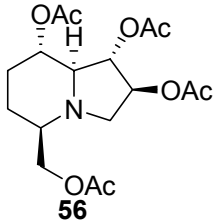
NOE spectrum of compound **56**



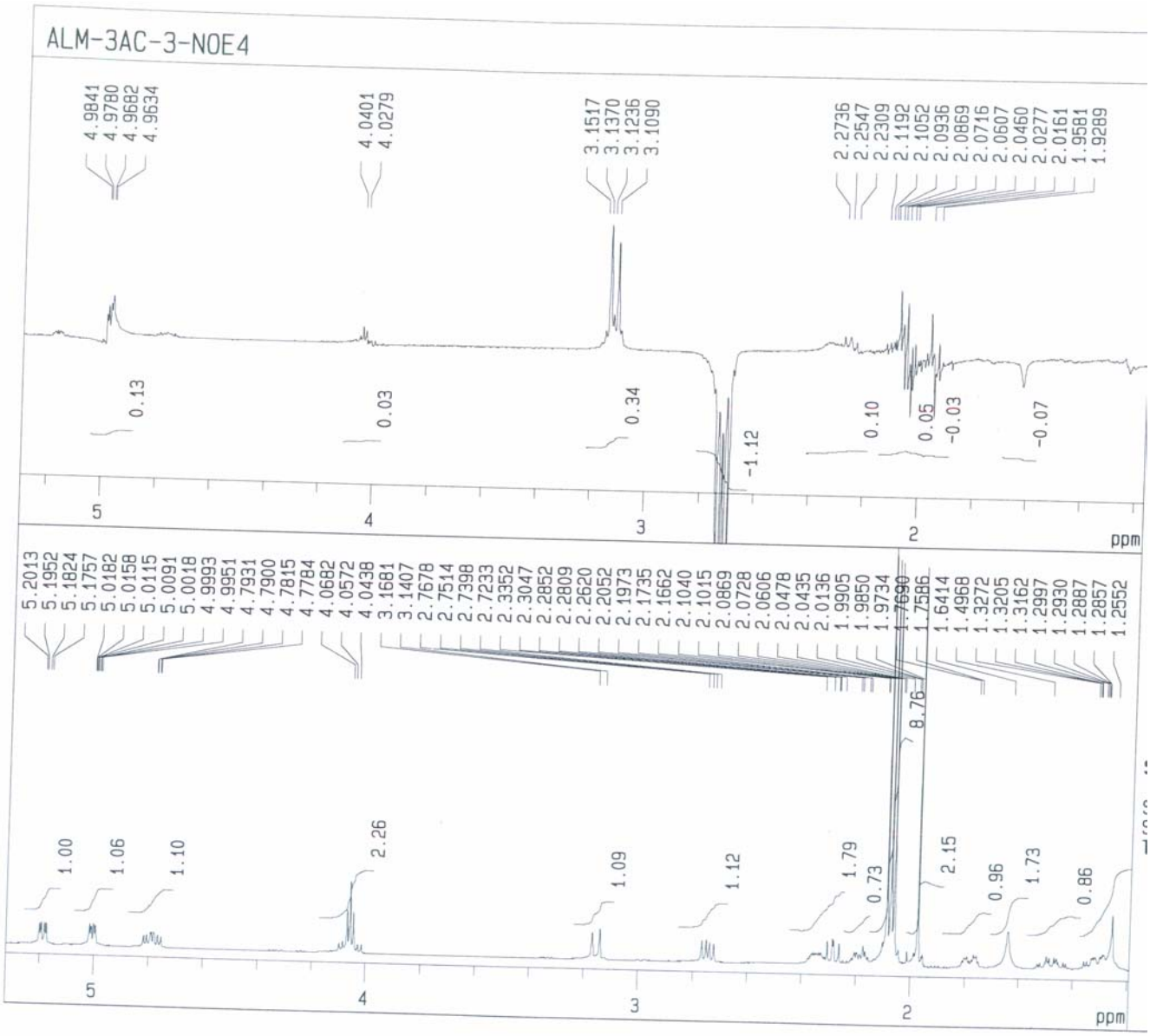
56



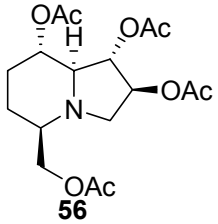
NOE spectrum of compound **56**



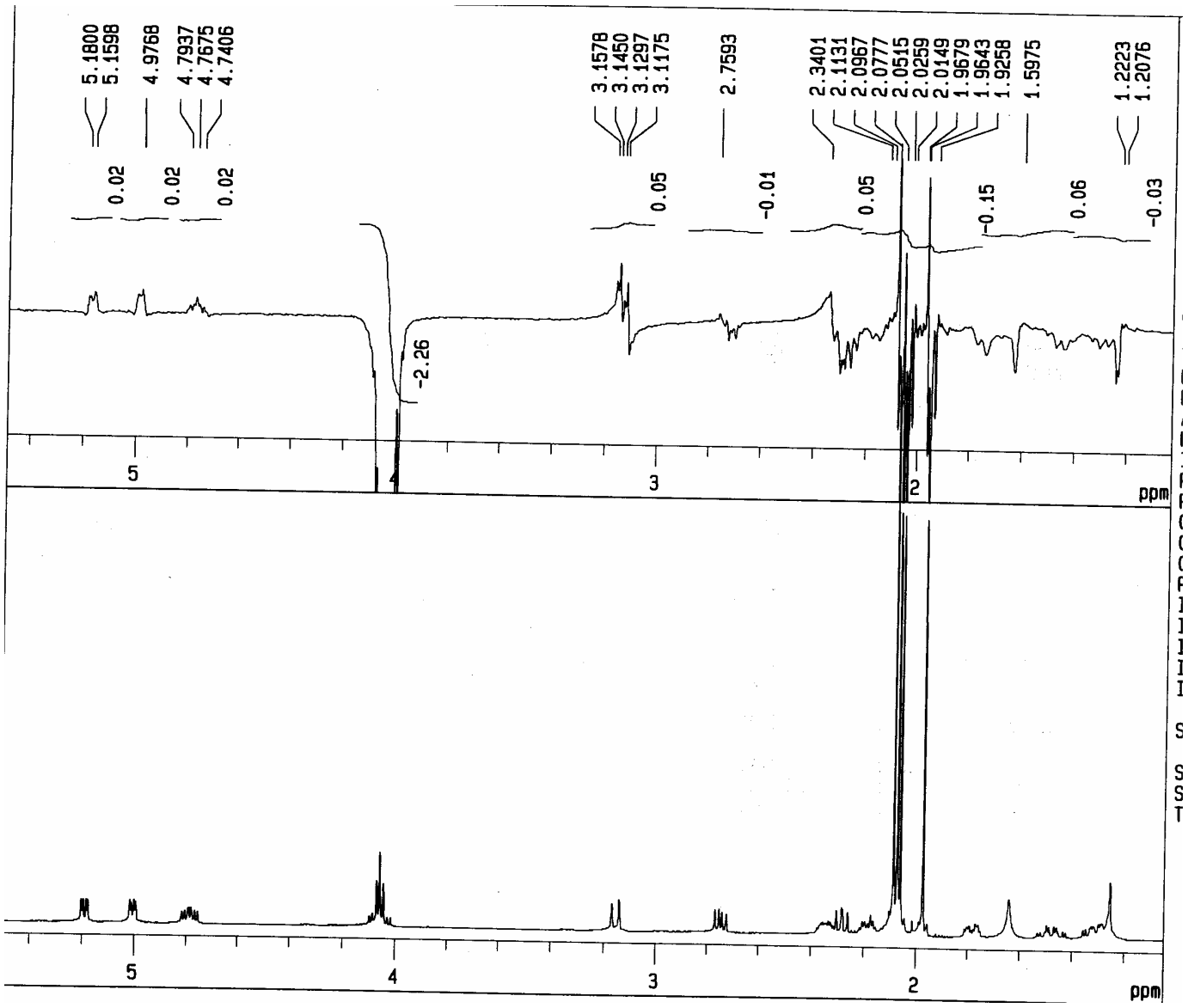
56

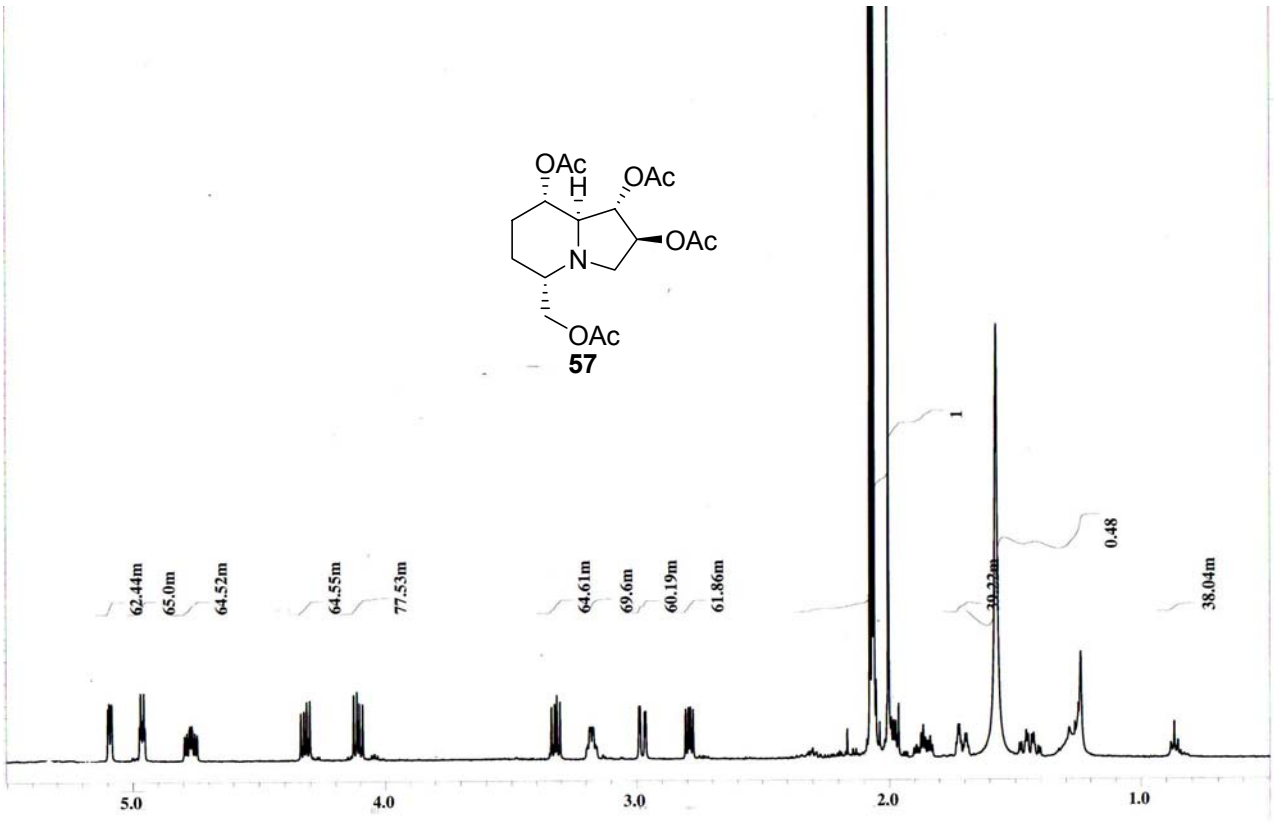


NOE spectrum of compound **56**

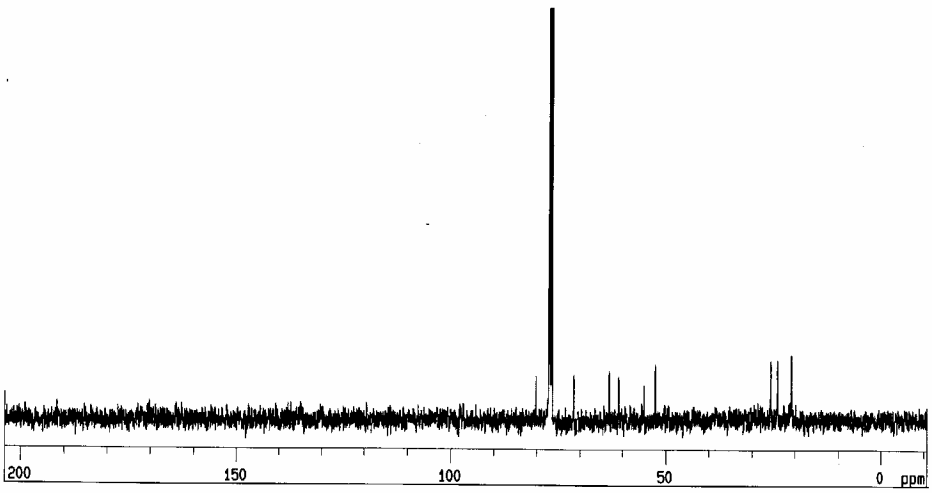


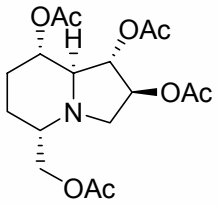
56


5.1800
5.1598
4.9768
4.7937
4.7675
4.7406
3.1578
3.1450
3.1297
3.1175
2.7593
2.3401
2.1131
2.0967
2.0777
2.0515
2.0259
2.0149
1.9679
1.9643
1.9258
1.5975
1.2223
1.2076
0.02
0.02
0.02
0.05
-0.01
0.05
-0.15
0.06
-0.03
-2.26
5
4
3
2
ppm


OAc
H
OAc
OAc
N
OAc
62.44m
65.0m
64.52m
64.55m
77.53m
64.61m
69.6m
60.19m
61.86m
1
0.48
38.04m
5.0
4.0
3.0
2.0
1.0

57



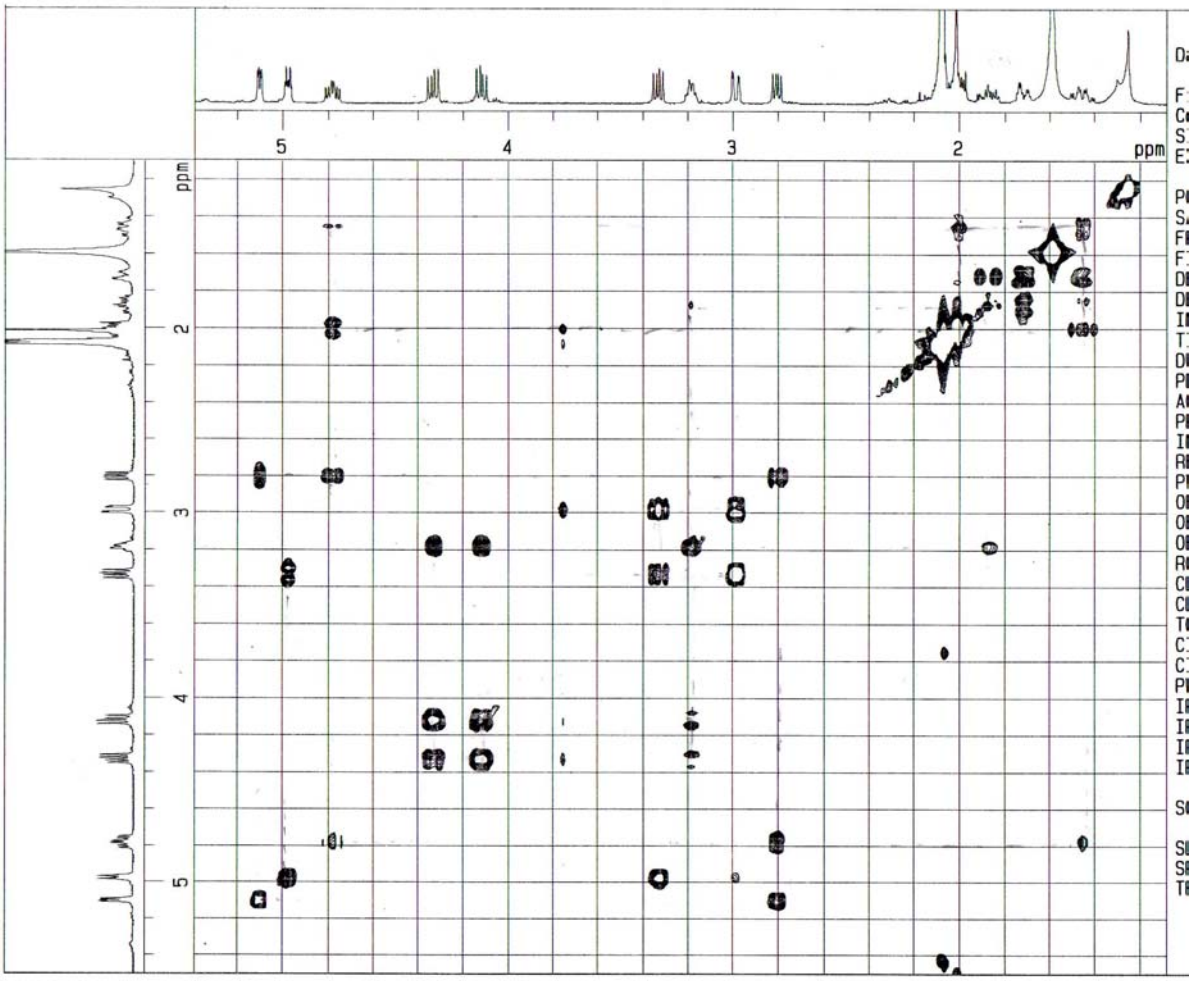


57

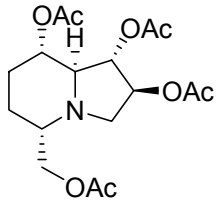
OAc
H
OAc
OAc
N
OAc

57

COSY spectrum of compound **57**



NOE spectrum of compound **57**



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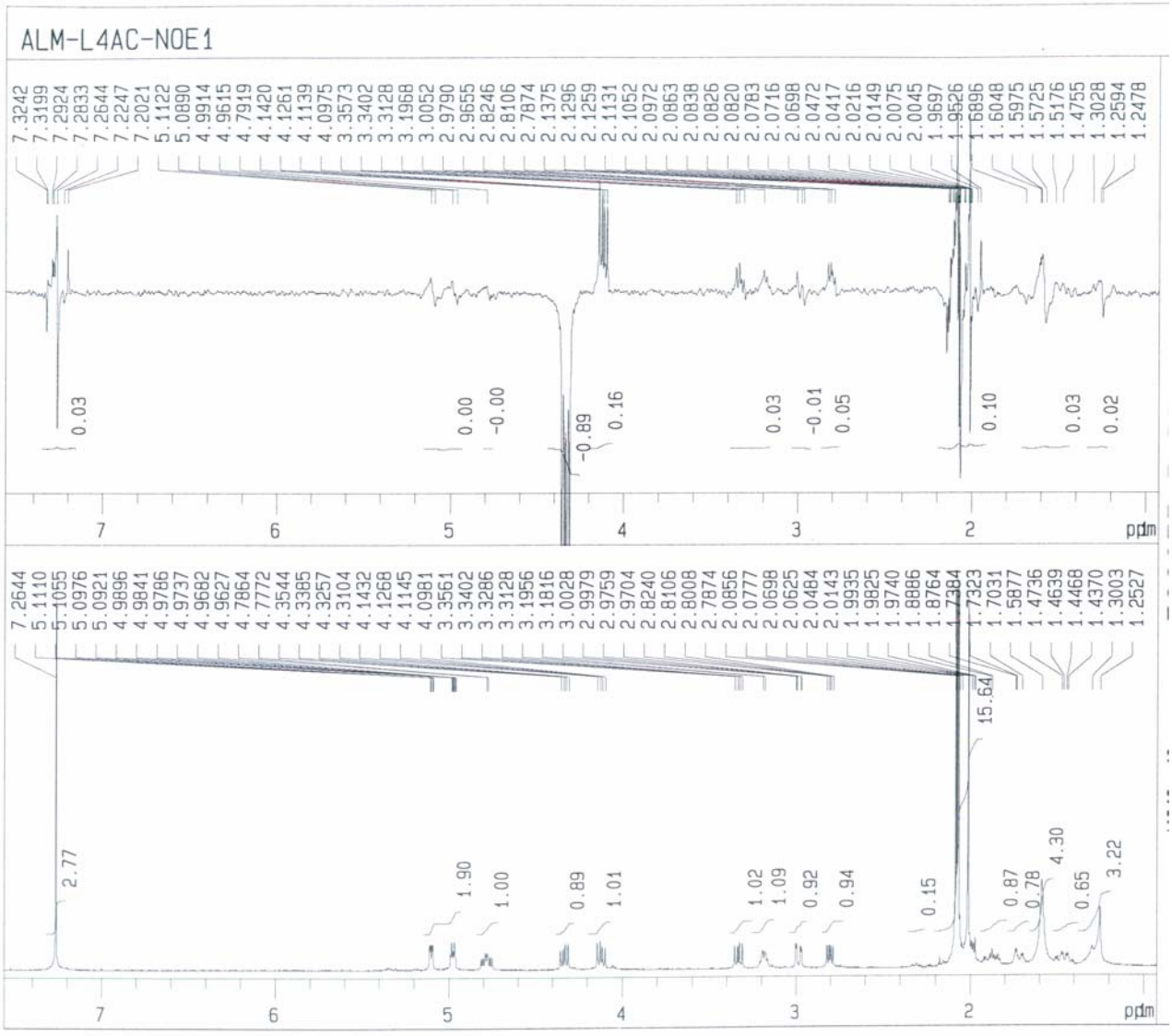
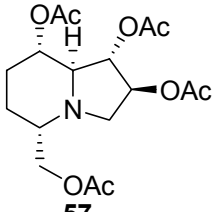


NOE spectrum of compound **57**



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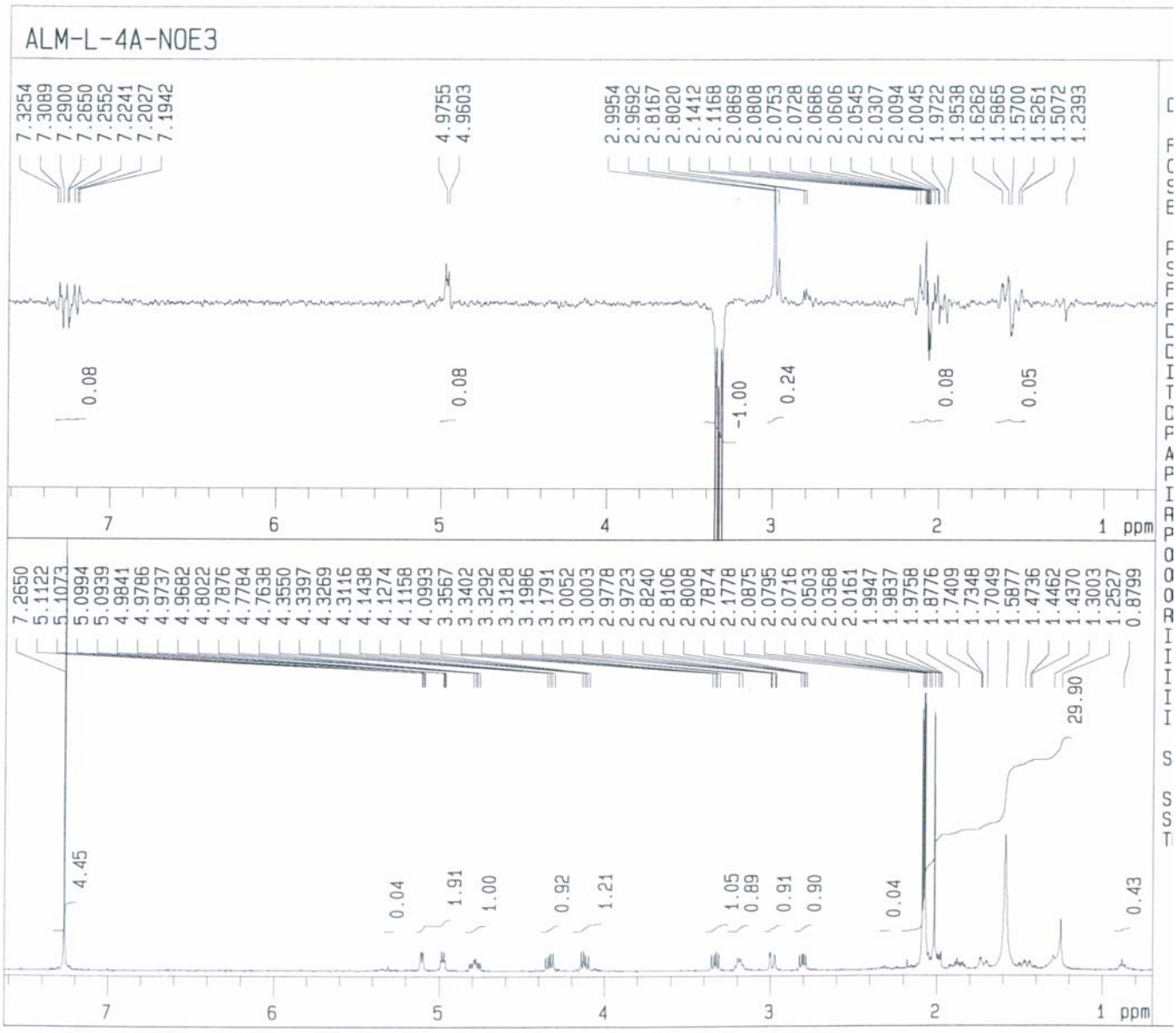
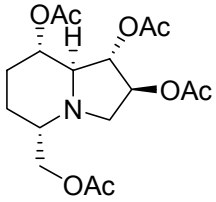


NOE spectrum of compound **57**



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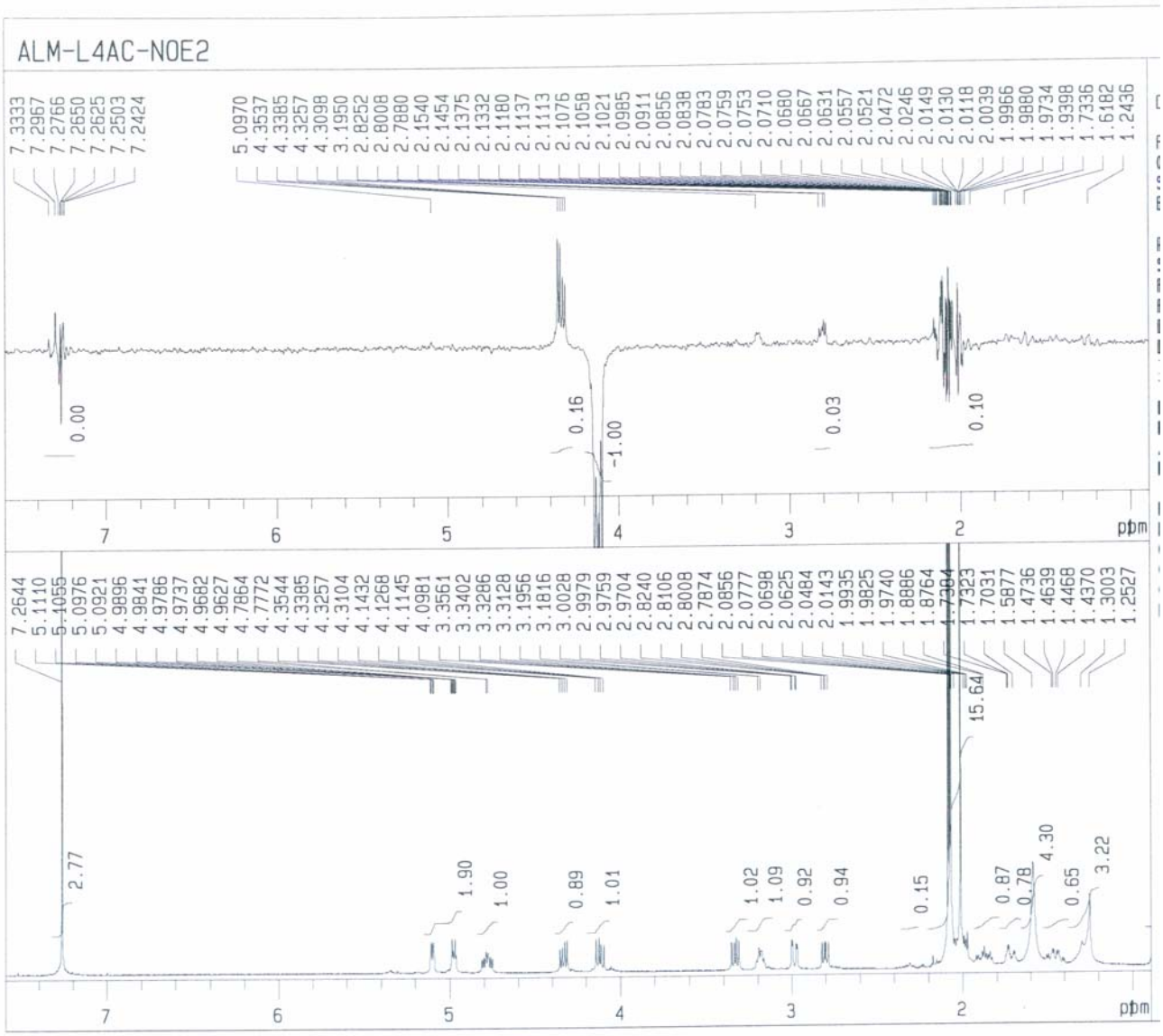
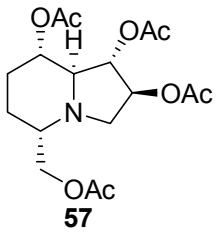


NOE spectrum of compound **57**



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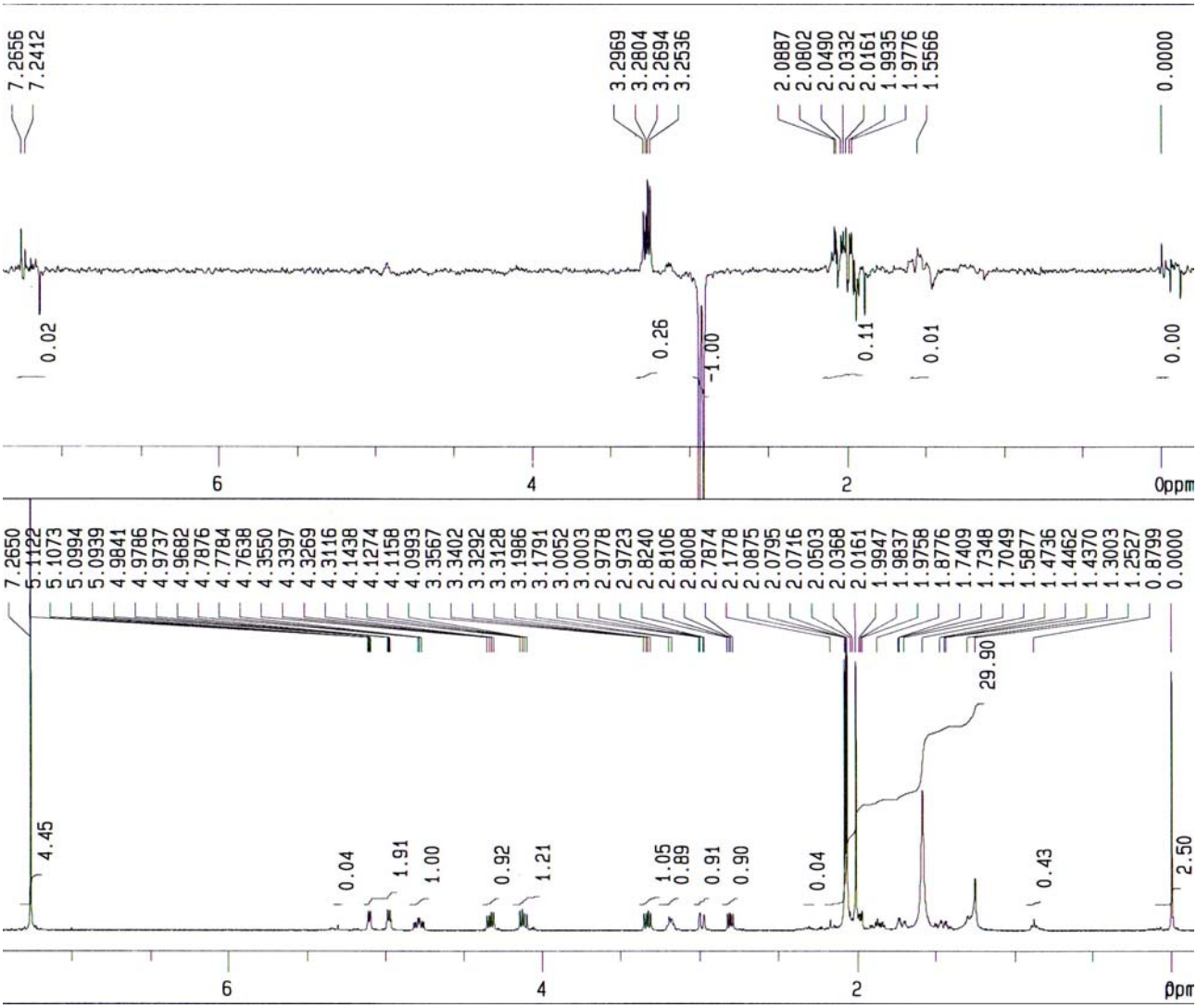
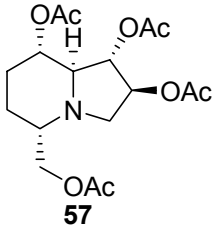


NOE spectrum of compound **57**



57

0.03
0.03
0.03
0.00
-1.00
-0.05
-0.06
-0.02
6
4
2
0 ppm
4.45
0.04
1.91
1.00
0.92
1.21
1.76
0.91
0.90
0.04
29.90
0.43
2.50
6
4
2
0 ppm