Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supporting Information for:

New Building Blocks for Iminosugars: A Concise Synthesis of Polyhydroxylated *N*-Alkoxypiperidines through an Intramolecular Azepine Ring Contraction

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Experimental:

All reactions were carried out under an atmosphere of nitrogen in oven-dried glassware with magnetic stirring, unless otherwise specified. All reagents and solvents were purchased from Sigma-Aldrich Chemical Company and used without any further purification. TLC information was recorded on Silicycle glass 60 F_{254} plates and developed by staining with $KMnO_4$ or ceric ammonium molybdate. Purification of reaction products was carried out by flash chromatography using Silicycle Siliaflash® P60 (230-400 mesh). ^{1}H-NMR spectra were measured on Varian 400 (400 MHz) or Varian 500 (500 MHz) spectrometers and are reported in ppm (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad; integration; coupling constant(s) in Hz using TMS as an internal standard (TMS at 0.00 ppm) in $CDCl_3$, CD_3CN CD_3OD, or D_2O. ^{13}C-NMR spectra were recorded on V400 or V500 spectrometers and reported in ppm using solvent as an internal standard ($CDCl_3$ at 77.36 ppm), (CD_3CN at 118.26 ppm) or (CD_3OD at 49.86 ppm). Infrared (IR) spectra were recorded on a Nicolet 6700 FT-IR with a diamond ATR and data are reported as cm^{-1} (br = broad, s = strong). High-resolution mass spectra were obtained using an Agilent 6230 TOF LC/MS with an atmospheric pressure photo-ionization (APPI) or electrospray (ESI) source with purine and HP-0921 as internal calibrants.

Single crystal X-ray diffraction was performed at 100 K on a Bruker SMART Apex II CCD instrument using graphite-monochromated Mo K_α radiation. The crystals were covered in Paratone oil and mounted on glass fibers. Lorentz and polarization effects were corrected using SAINT[SI] and absorption corrections were applied using SADABS.[S2] The structures were solved using direct methods using OLEX2.[S3]

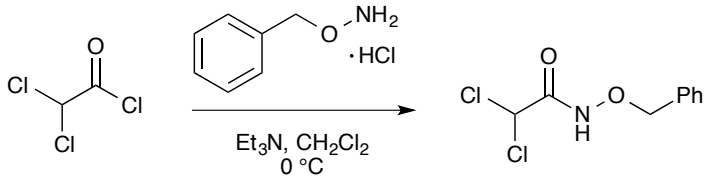
References

[S1] *SAINT: Program for data reduction, Version 7.68A; Bruker AXS: Madison, WI,* **2009**.

[S2] G. M. Sheldrick. *Acta Crystallogr., Sect. A.: Found. Crystallogr.* **2008**, *64*, 112.

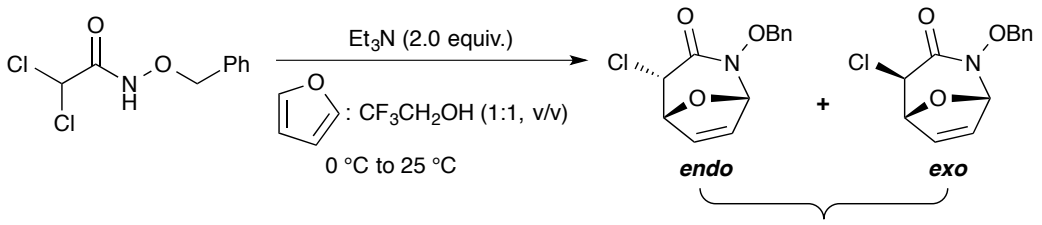
[S3] O. V. Dolomanov, L. J. Bourhis, R. J. Gildea, J. A. K. Howard, and H. Puschmann, *J. Appl. Cryst.* **2009**, *42*, 339.

(±)-2,2-dichloro-*N*-(phenylmethoxy)acetamide (7):



To a suspension of *O*-benzylhydroxylamine hydrochloride (2.15 g, 13.6 mmol) and triethylamine (2.75 g, 27.2 mmol) in CH_2Cl_2 (0.25 M) at 0 °C was added dropwise 2,2-dichloroacetyl chloride (2.0 g, 13.6 mmol) dropwise. The reaction mixture was then warmed to room temperature and stirred until TLC analysis (3:1 hexanes:ethyl acetate) indicated complete consumption of the starting material (1 hour). The solvent was then removed under reduced pressure and the crude product was purified via flash column chromatography (SiO_2, 3:1 hexanes:ethyl acetate) to provide the pure haloamide as a white crystalline solid (2.9 g, 12.4 mmol, 91% yield). R_f = 0.52 (3:1 hexanes: ethyl acetate); M.P. = 69.4 – 71.2 °C; ^{1}H NMR (400 MHz, CD_3CN) δ 9.89 (br s, 1H), 7.63 – 7.17 (m, 4H), 6.02 (s, 1H), and 4.89 (s, 2H); ^{13}C NMR (101 MHz, CD_3CN) δ 162.2, 136.1, 130.4 (2), 129.7 (2), 129.4, 78.8, and 65.6; IR (neat) 3135 (br), 2996, 2880, 2860, 1700, 1677 (st), 1531, 1468, 1454, 1367, 1341, 1214, 1200, 1046, 1027 cm^{-1}; HR-APPIMS requires for $C_9H_9Cl_2NO_2$ $(M^*)^+$ 233.0005, found 232.9976.

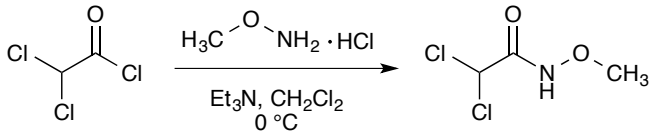
(±)-(4*S*, 5*R*, 1*S*)-4-chloro-8-oxo-2-(phenylmethoxy)-2-azabicyclo[3.2.1]oct-6-en-3-one (*endo*) and (±)-(4*R*, 5*R*, 1*S*)-4-chloro-8-oxo-2-(phenylmethoxy)-2-azabicyclo[3.2.1]oct-6-en-3-one (*exo*) (8, 9)



To a solution of 2,2-dichloro-*N*-(phenylmethoxy)acetamide (100.2 mg, 0.43 mmol) in CF_3CH_2OH and furan [1:1 (v/v) 0.25 M] at 0 °C was added triethylamine (2 equiv.) dropwise. The solution was allowed to warm to room temperature and the reaction mixture was stirred for 72 hours. After removal of the volatiles under reduced pressure, the crude mixture was purified by flash column chromatography (SiO_2, 3:1 hexanes:ethyl acetate) to afford 72 mg (0.31 mmol, 79% yield) of the pure cycloadducts (2:1 endo:exo) as yellow oils. ***Endo*-diastereoisomer:** R_f = 0.50 (3:1 hexanes:ethyl acetate); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 – 7.30 (m, 3H), 6.54 (dd, *J* = 6.0, 1.1 Hz, 1H), 6.51 (dd, *J* = 6.0, 1.7 Hz, 1H), 5.27 (d, *J* = 1.1 Hz, 1H), 5.09, (dd, *J* = 5.1, 1.6 Hz, 1H), 5.00 (d, *J* = 11.0 Hz, 1H), 4.89 (d, *J* = 11.0 Hz, 1H), 5.09 (dd, *J* = 5.1, 1.6 Hz, 1H), 5.00 (d, *J* = 11.0 Hz, 1H), 4.89 (d, *J* = 11.0 Hz, 1H), and 4.76 (d, *J* = 5.2 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.9, 136.8, 135.3, 133.1, 129.8 (2), 129.2 (2), 128.2, 92.1, 82.1, 78.3, and 56.9; IR (film) 3032, 2950, 2922, 2852, 1712 (s), 1455, 1369, 1213, 1189, 1059, 1023 cm^{-1}. HR-ESIMS requires for $C_{13}H_{12}ClNNaO_3$ $(M+Na)^+$ 288.0398, found 288.0391. ***Exo*-diastereoisomer:** R_f = 0.30 (3:1 hexanes:ethyl acetate); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.48 – 7.35 (m, 5H), 6.68 (d, *J* = 5.9 Hz, 1H), 6.34 (dd, *J* = 6.0, 1.1 Hz, 1H), 5.28 (s, 1H), 5.02 (d, *J* = 10.9 Hz, 1H), 4.98 (s, 1H), 4.92 (d, *J* = 10.9 Hz, 1H), and

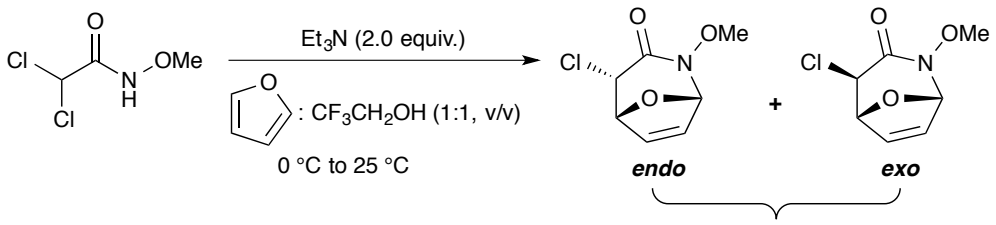
4.09 (s, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.5, 138.2, 135.0, 131.4, 129.9 (2), 129.2 (2), 128.8, 91.3, 84.2, 78.4, and 56.1; IR (neat) 3067, 3034, 2946, 2885, 1694, 1046 cm^{-1}; HR-ESIMS requires for $C_{13}H_{12}ClNNaO_3$ $(M+Na)^+$ 288.0398, found 288.0399.

(±)-2,2-dichloro-*N*-(methoxy)acetamide (10):



To a suspension of methoxyamine hydrochloride (2.26 g, 27.1 mmol) and triethylamine (5.48 g, 54.2 mmol) in CH_2Cl_2 (0.25 M) at 0 °C was added dropwise 2,2-dichloroacetyl chloride (4.0 g, 27.1 mmol) dropwise. The reaction mixture was then warmed to room temperature and stirred until TLC analysis (3:1 hexanes:ethyl acetate) indicated complete consumption of the starting material (1 hour). The solvent was then removed under reduced pressure and the crude product was purified via flash column chromatography (SiO_2, 2:1 hexanes:ethyl acetate) to provide the pure haloamide as a white crystalline solid (3.5 g, 22.2 mmol, 82% yield). R_f = 0.3 (2:1 hexanes: ethyl acetate); M.P. = 40.5 – 42.8 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 11.38 (br s, 1H), 6.28 (s, 1H), and 3.90 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.51, 64.17, and 63.95; IR (neat) 3172 (br), 2998, 2940, 1674 (st), 1500, 1439, 1335, 1210, 1057, and 974 cm^{-1}; HR-ESIMS requires for $C_3H_5ClNO_2$ $(M+H)^+$ 158.9798, found 158.9784.

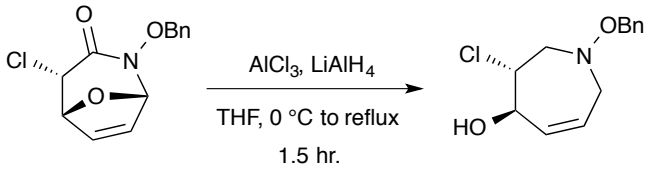
(±)-(4*S*, 5*R*, 1*S*)-4-chloro-8-oxo-2-(methoxy)-2-azabicyclo[3.2.1]oct-6-en-3-one (*endo*) and (±)-(4*R*, 5*R*, 1*S*)-4-chloro-8-oxo-2-(methoxy)-2-azabicyclo[3.2.1]oct-6-en-3-one (*exo*) (11, 12)



To a solution of 2,2-dichloro-*N*-(phenylmethoxy)acetamide (3.5 g, 22.2 mmol) in CF_3CH_2OH and furan [1:1 (v/v) 0.25 M] at 0 °C was added triethylamine (2 equiv.) dropwise. The solution was allowed to warm to room temperature and the reaction mixture was stirred for 24 hours. After removal of the volatiles under reduced pressure, the crude mixture was purified by flash column chromatography (SiO_2, 3:1 hexanes:ethyl acetate) to afford 3.4 g (17.9 mmol, 80 % yield) of the pure cycloadduct endo isomer as a yellow solid and exo isomer as a yellow oil (2:1 endo:exo). ***Endo*-diastereoisomer:** R_f = 0.4 (2:1 hexanes:ethyl acetate); M.P. = 87.8 °C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 6.81 (dd, *J* = 6.0, 1.3 Hz, 1H), 6.60 (dd, *J* = 6.0, 1.8 Hz, 1H), 5.63 (d, *J* = 1.4 Hz, 1H), 5.18 (dd, *J* = 5.1, 1.9 Hz, 1H), 4.80 (d, *J* = 5.1 Hz, 1H), 3.82 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 165.53, 136.79, 133.22, 90.80, 82.05, 63.56, and 56.67; IR (neat) 3101, 3015, 3091, 2990, 2942, 1679 (st), 1442, 1394, 1325, 1242, 1062, 1030, 926, and 834 cm^{-1}; HR-ESIMS requires for $C_7H_8ClNO_3$ $(M+Na)^+$ 212.0085, found 212.0083. ***Exo*-diastereoisomer:** R_f = 0.3 (2:1 hexanes:ethyl acetate); ^{1}H NMR (500 MHz, $CDCl_3$): δ 6.87 (dd, *J* = 6.1, 1.4 Hz, 1H), 6.50 (dd, *J* = 5.9, 2.0 Hz, 1H), 5.70 (d, *J* = 1.5 Hz, 1H), 5.08 (d, *J* = 2.1 Hz, 1H), 4.16 (d, *J* = 1.0 Hz, 1H), and 3.84 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 165.16, 137.88, 131.70, 89.90, 84.06, 63.41, and 55.69; IR (neat) 3094, 2987,

2939, 2901, 1692 (st), 1439, 1363, 1274, 1236, 1157, 1046 (st), 986, 903, and 834 cm^{-1}; HR-ESIMS requires for $C_7H_8ClNO_3$ $(M+Na)^+$ 212.0085, found 212.0087.

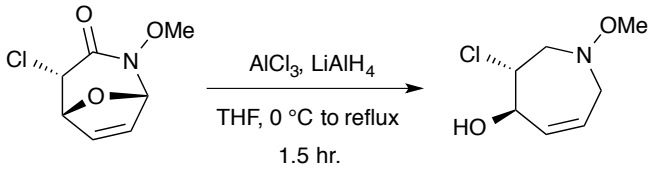
(±)-(3*S*, 4*R*)-*N*-phenylmethoxy-3-chloro-4-hydroxy-2,3,4,7-tetrahydro-1*H*-azepine (13)



To an oven dried 100 mL Schlenk flask equipped with a magnetic stir bar was added dry THF (19 mL) under an atmosphere of nitrogen. The flask was placed in an ice bath and aluminum chloride (7.57 mmol, 1.01 g) was added in portions over a period of 5 minutes. Upon complete dissolution of the aluminum chloride, a solution of lithium aluminum hydride in dry THF (11.4 mmol, 5.7 mL) was added dropwise at that same temperature over a period of 15 minutes and the resulting solution was stirred at 0 °C for 20 minutes. The cycloadduct **8** (3.79 mmol, 1.01 g) was then added in THF (25 mL) dropwise over a period of 20 minutes and the reaction mixture was refluxed under nitrogen for 1.5 hours. The reaction flask was cooled to 0 °C and quenched with water followed by 10% NaOH. The aluminum salts were filtered off and the filtrate was dried over Na_2SO_4 and concentrated under reduced pressure. The crude residue was purified by column chromatography (10% - 33% Hex:EtOAc) to afford **13** as a white crystalline solid (0.67 g, 2.64 mmol, 70% yield). R_f = 0.54 (2:1 hexanes:ethyl acetate); M.P. 59.5 – 62.0 °C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.35 – 7.30 (m, 5H), 5.81 (dt, *J* = 11.9, 3.1 Hz, 1H), 5.67 (dt, *J* = 12.0, 6.0 Hz, 1H), 4.69 (s, 2H), 4.36 (d, *J* = 8.2 Hz, 1H), 4.18 (td, *J* =

8.3, 4.7 Hz, 1H), 3.77 (dd, *J* = 14.1, 4.7 Hz, 1H), 3.62 (dd, *J* = 15.9, 6.2 Hz, 1H), 3.44 – 3.39 (m, 1H), 3.22 (dd, *J* = 14.0, 8.0 Hz, 1H), and 2.86 – 2.83 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 137.20, 132.20, 128.71, 128.38 (2), 128.03 (2), 126.27, 74.64, 73.34, 64.26, 61.87, and 57.41; IR (neat) 3556, 3105 (br), 3006, 2987, 2965, 1464, 1376, 1055 (s), and 1037 cm^{-1}; HR-ESIMS requires for $C_{13}H_{17}ClNO_2$ $(M+H)^+$ 254.0948, found 254.0950.

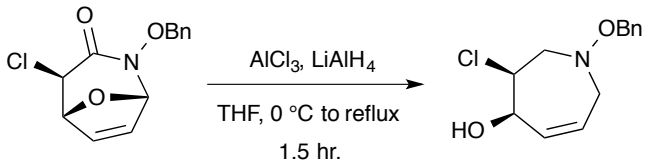
(±)-(3*S*, 4*R*)-*N*-methoxy-3-chloro-4-hydroxy-2,3,4,7-tetrahydro-1*H*-azepine (14)



To an oven dried 100 mL Schlenk flask equipped with a magnetic stir bar was added dry THF (19 mL) under an atmosphere of nitrogen. The flask was placed in an ice bath and aluminum chloride (12.1 mmol, 1.61 g) was added in portions over a period of 5 minutes. Upon complete dissolution of the aluminum chloride, a solution of lithium aluminum hydride in dry THF (18.1 mmol, 9.1 mL) was added dropwise at that same temperature over a period of 15 minutes and the resulting solution was stirred at 0 °C for 20 minutes. The cycloadduct **11** (6.03 mmol, 1.14 g) was then added in THF (40 mL) dropwise over a period of 20 minutes and the reaction mixture was refluxed under nitrogen for 1.5 hours. The reaction flask was cooled to 0 °C and quenched with water followed by 10% NaOH. The aluminum salts were filtered off and the filtrate was dried over Na_2SO_4 and concentrated under reduced pressure. The crude residue was purified by column chromatography (25% - 33% Hex:EtOAc) to afford **14** as a white crystalline

solid (0.75 g, 4.22 mmol, 70% yield). X-ray quality crystals were grown by slow evaporation of a dichloromethane/hexanes solution of **14**. R_f = 0.55 (1:1 hexanes:ethyl acetate); M.P. = 63.9 – 65.4 °C; ^{1}H NMR (500 MHz, $CDCl_3$): δ 5.84 (dt, *J* = 11.9, 2.9 Hz, 1H), 5.75 – 5.70 (m, 1H), 4.39 (d, *J* = 7.2 Hz, 1H), 4.19 (td, *J* = 8.6, 4.5 Hz, 1H), 3.82 (ddd, *J* = 13.9, 4.5, 1.5 Hz, 1H), 3.68 (ddd, *J* = 15.9, 6.5, 1.2 Hz, 1H), 3.53 (s, 3H), 3.42 (d, *J* = 16.2 Hz, 1H), 3.19 (dd, *J* = 13.8, 8.4 Hz, 1H), and 2.86 (br s, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 132.97, 125.91, 73.42, 63.72, 62.07, 59.68, and 56.50; IR (neat) 3326 (br), 3031, 2949, 2810, 1458, 1385, 1350, 1283, 1198, 1062, 1024 (st), 897, and 774 cm^{-1}; HR-ESIMS requires for $C_7H_{12}ClNO_2$ $(M+H)^+$ 178.0629, found 178.0627.

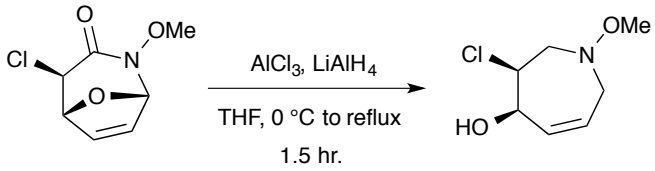
(±)-(3*R*, 4*R*)-*N*-phenylmethoxy-3-chloro-4-hydroxy-2,3,4,7-tetrahydro-1*H*-azepine (15)



To an oven dried 250 mL Schlenk flask equipped with a magnetic stir bar was added dry THF (55 mL) under an atmosphere of nitrogen. The flask was placed in an ice bath and aluminum chloride (21.8 mmol, 2.91 g) was added in portions over a period of 5 minutes. Upon complete dissolution of the aluminum chloride, a solution of lithium aluminum hydride in dry THF (32.7 mmol, 16.4 mL) was added dropwise at that same temperature over a period of 15 minutes and the resulting solution was stirred at 0 °C for 20 minutes. The cycloadduct **9** (10.9 mmol, 2.89 g) was then added in THF (72 mL) dropwise over a period of 20 minutes and the reaction mixture was refluxed under

nitrogen for 1.5 hours. The reaction flask was cooled to 0 °C and quenched with water followed by 10% NaOH. The aluminum salts were filtered off and the filtrate was dried over Na_2SO_4 and concentrated under reduced pressure. The crude residue was purified by column chromatography (10% - 33% Hex:EtOAc) to afford **15** as a colorless oil (1.96 g, 7.72 mmol, 71% yield). R_f = 0.36 (3:1 hexanes:ethyl acetate); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.35 – 7.31 (m, 5H), 5.86 (dd, *J* = 11.7, 6.2 Hz, 1H), 5.72 (dt, *J* = 11.6, 4.7 Hz, 1H), 4.69 (s, 2H), 4.45 (td, *J* = 8.0, 1.3 Hz, 1H), 4.32 (ddd, *J* = 8.0, 6.0, 2.2 Hz, 1H), 3.70 (dd, *J* = 16.5, 5.0 Hz, 1H), 3.59 (dd, *J* = 13.8, 7.8 Hz, 1H), 3.55 – 3.49 (m, 2H), 2.91 (d, *J* = 8.9 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 137.01, 131.06, 129.20, 128.77 (2), 128.46 (2), 128.17, 74.74, 71.45, 62.00, 60.19, and 57.05; IR (neat) 3498 (br), 3150, 2976, 2865, 2852, 1489, 1424, 1176, and 1054 cm^{-1}; HR-ESIMS requires for $C_{13}H_{17}ClNO_2$ $(M+H)^+$ 254.0948, found 254.0940.

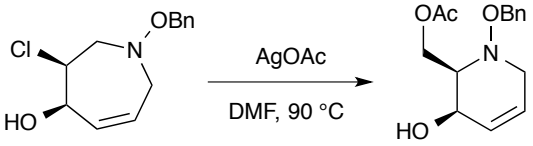
(±)-(3*R*, 4*R*)-*N*-methoxy-3-chloro-4-hydroxy-2,3,4,7-tetrahydro-1*H*-azepine (16)



To an oven dried 100 mL Schlenk flask equipped with a magnetic stir bar was added dry THF (19 mL) under an atmosphere of nitrogen. The flask was placed in an ice bath and aluminum chloride (7.48 mmol, 0.997 g) was added in portions over a period of 5 minutes. Upon complete dissolution of the aluminum chloride, a solution of lithium aluminum hydride in dry THF (11.2 mmol, 5.6 mL) was added dropwise at that same temperature over a period of 15 minutes and the resulting solution was stirred at 0 °C for

20 minutes. The cycloadduct **12** (3.74 mmol, 1.01 g) was then added in THF (25 mL) dropwise over a period of 20 minutes and the reaction mixture was refluxed under nitrogen for 1.5 hours. The reaction flask was cooled to 0 °C and quenched with water followed by 10% NaOH. The aluminum salts were filtered off and the filtrate was dried over Na_2SO_4 and concentrated under reduced pressure. The crude residue was purified by column chromatography (10% - 33% Hex:EtOAc) to afford **16** as a colorless oil (2.59 mmol, 0.46 g, 69% yield). R_f = (2:1 hexanes:ethyl acetate); ^{1}H NMR (500 MHz, $CDCl_3$): δ 5.94 – 5.89 (m, 1H), 5.78 (dt, *J* = 11.4, 4.8 Hz, 1H), 4.49, (ddd, *J* = 8.7, 6.6, 2.4 Hz, 1H), 4.41 – 4.35 (m, 1H), 3.75 (dd, *J* = 16.3, 5.0 Hz, 1H), 3.66 – 3.60 (m, 1H), 3.58 – 3.55 (m, 1H), and 3.55 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$): δ 131.40, 129.12, 71.47, 61.17, 60.21, 59.75, and 55.96; IR (neat) 3405 (br), 2971, 2939, 2860, 2825, 1458, 1435, 1369, 1312, 1052 (st), 1033, 1017, 926, and 745 cm^{-1}; HR-ESIMS requires for $C_7H_{12}ClNO_2$ $(M+Na)^+$ 200.0449, found 200.0447.

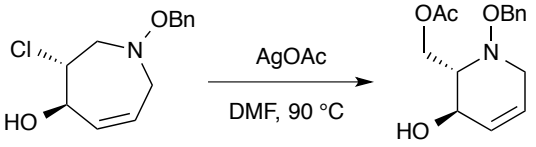
(±)-(2*R*, 3*R*)-*N*-phenylmethoxy-2-acetoxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (17)



To a stirred solution of **15** (0.9 mmol, 229 mg,) in DMF (11 mL) was added AgOAc (1.81 mmol, 302 mg,) all at once and the resulting suspension was heated in a sealed flask at 90 °C for 72 hours. The crude reaction mixture was filtered through a pad of celite and the pad was washed with ethyl acetate (2 x 10 mL) followed by methanol (10 mL). The filtrate was concentrated under reduced pressure at 65 °C to remove DMF

and the crude residue was purified by column chromatography (20% to 33% hexanes:ethyl acetate) to afford **17** as a pale yellow oil (0.63 mmol, 174 mg, 69% yield). R_f = 0.36 (2:1 hexanes:ethyl acetate); ^{1}H NMR (500 MHz, CD_3OD): δ 7.37 – 7.25 (m, 5H), 5.88 – 5.81 (m, 1H), 5.74 (dd, *J* = 10.0, 4.9 Hz, 1H), 4.81 (d, *J* = 1.8 Hz, 1H), 4.73 – 4.69 (m, 1H), 4.65 (dd, *J* = 11.0, 1.6 Hz, 1H), 4.56 (dd, *J* = 10.8, 5.5 Hz, 1H), 4.32 (ddd, *J* = 11.2, 7.3, 1.7 Hz, 1H), 4.12 (d, *J* = 4.1 Hz, 1H), 3.74 (dd, *J* = 16.6, 4.5 Hz, 1H), 3.28 – 3.22 (m, 1H), 3.04 (s, 1H), and 2.00 (d, *J* = 1.7 Hz, 3H); ^{13}C NMR (101 MHz, CD_3OD): δ 171.42, 137.22, 128.67, 127.95 (2), 127.66 (2), 126.71, 125.74, 75.32, 64.99, 62.20, 58.72, 54.23, and 19.56; IR (neat) 3467 (br), 3028, 2922, 2860, 2816, 1728 (st), 1454, 1366, 1236, 1086, 1039, and 735 cm^{-1}; HR-ESIMS requires for $C_{15}H_{19}NO_4$ $(M+H)^+$ 278.1387, found 278.1388.

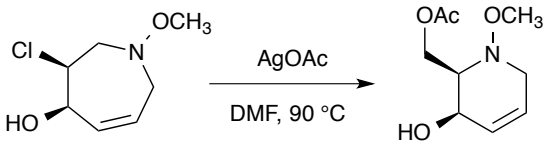
(±)-(2*S*, 3*R*)-*N*-phenylmethoxy-2-acetoxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (18)



To a stirred solution of **13** (1.0 mmol, 250 mg,) in DMF (12 mL) was added AgOAc (2.0 mmol, 334 mg,) all at once and the resulting suspension was heated in a sealed flask at 90 °C for 72 hours. The crude reaction mixture was filtered through a pad of celite and the pad was washed with ethyl acetate (2 x 15 mL) followed by methanol (15 mL). The filtrate was concentrated under reduced pressure at 65 °C to remove DMF and the crude residue was purified by column chromatography (33% to 50% hexanes:ethyl acetate) to afford **18** as a pale yellow oil (0.81 mmol, 224 mg, 60% yield).

R_f = 0.33 (1:1 hexanes:ethyl acetate); ^{1}H NMR (500 MHz, CD_3OD): δ 7.34 – 7.24 (m, 5H), 5.74 – 5.66 (m, 2H), 4.83 (s, 1H), 4.70 (d, *J* = 10.7 Hz, 1H), 4.65 (d, *J* = 10.6 Hz, 1H), 4.48 (d, *J* = 12.7 Hz, 1H), 4.40 (dd, *J* = 11.5, 5.0 Hz, 1H), 4.24 (dd, *J* = 8.3, 3.6 Hz, 1H), 3.66 (d, *J* = 15.8 Hz, 1H), 3.39 – 3.32 (m, 1H), 2.81 (s, 1H), and 2.05 (s, 3H); ^{13}C NMR (101 MHz, CD_3OD): δ 171.54, 137.13, 128.78, 128.60, 127.90 (2), 127.60 (2), 123.97, 74.88, 66.99, 64.61, 60.89, 53.67, and 19.49; IR (neat) 3405 (br), 3034, 2917, 2860, 1736, 1451, 1363, 1236, 1024, and 698 cm^{-1}; HR-ESIMS requires for $C_{15}H_{19}NO_4$ $(M+H)^+$ 278.1387, found 278.1384.

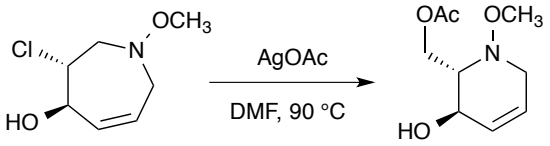
(±)-(2*R*, 3*R*)-*N*-methoxy-2-acetoxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (19)



To a stirred solution of **16** (1.4 mmol, 252 mg,) in DMF (13 mL) was added AgOAc (2.8 mmol, 467 mg,) all at once and the resulting suspension was heated in a sealed flask at 90 °C for 72 hours. The crude reaction mixture was filtered through a pad of celite and the pad was washed with ethyl acetate (2 x 15 mL) followed by methanol (15 mL). The filtrate was concentrated under reduced pressure at 65 °C to remove DMF and the crude residue was purified by column chromatography (33% to 50% hexanes:ethyl acetate) to afford **19** as a pale yellow oil (0.92 mmol, 186 mg, 65% yield). R_f = 0.23 (1:1 hexanes:ethyl acetate); ^{1}H NMR (400 MHz, CD_3OD): δ 5.89 – 5.83 (m, 1H), 5.79 (ddd, *J* = 10.0, 4.5, 1.9 Hz, 1H), 4.55 (dd, *J* = 10.9, 5.7 Hz, 1H), 4.34 (dd, *J* = 10.9, 7.5 Hz, 1H), 4.11 (d, *J* = 7.2 Hz, 1H), 3.82 (dd, *J* = 16.6, 4.6 Hz, 1H), 3.52 (s, 3H), 3.26 – 3.20 (m, 1H), 3.02 (t, *J* = 5.8 Hz, 1H), and 2.07 (s, 3H); ^{13}C NMR (101 MHz,

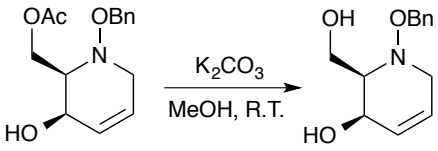
CD_3OD): δ 171.37, 126.71, 125.56, 64.55, 61.95, 59.72, 58.65, 53.46, and 19.49; IR (neat) 3443, 3003, 2967, 2939, 2920, 2860, 2844, 1727 (st), 1454, 1369, 1236, 1052 (st), 1012, and 748 cm^{-1}; HR-ESIMS requires for $C_9H_{15}NO_4$ $(M+Na)^+$ 224.0893, found 224.0893.

(±)-(2*S*, 3*R*)-*N*-methoxy-2-acetoxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (20)



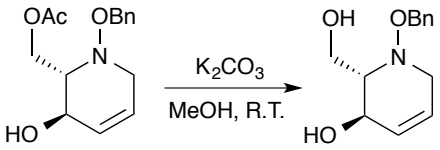
To a stirred solution of **14** (1.1 mmol, 200 mg,) in DMF (15 mL) was added AgOAc (2.2 mmol, 367 mg,) all at once and the resulting suspension was heated in a sealed flask at 90 °C for 72 hours. The crude reaction mixture was filtered through a pad of celite and the pad was washed with ethyl acetate (2 x 15 mL) followed by methanol (15 mL). The filtrate was concentrated under reduced pressure at 65 °C to remove DMF and the crude residue was purified by column chromatography (33% to 50% hexanes:ethyl acetate) to afford **20** as a pale yellow oil (0.71 mmol, 143 mg, 64% yield). R_f = 0.23 (1:1 hexanes:ethyl acetate); ^1H NMR (500 MHz, $CDCl_3$): δ 5.81 – 5.77 (m, 1H), 5.73 (dddd, *J* = 10.1, 3.8, 2.3, 1.3 Hz, 1H), 4.55 (dd, *J* = 11.7, 4.3 Hz, 1H), 4.35 (dd, *J* = 11.7, 4.2 Hz, 1H), 4.23 (d, *J* = 7.6 Hz, 1H), 3.70 – 3.64 (m, 1H), 3.57 (s, 3H), 3.43 – 3.38 (m, 1H), 2.97 – 2.93 (m, 1H), 2.56 (d, *J* = 11.3 Hz, 1H), and 2.12 (s, 3H); ^{13}C NMR (101 MHz, CD_3OD): δ 170.92, 126.54, 124.31, 75.52, 68.85, 60.70, 59.39, 58.22, and 19.65; IR (neat) 3444 (br), 2937, 2891, 2845, 2811, 1729 (st), 1454, 1439, 1372, 1228 (st), 1029, 965, and 901 cm^{-1}; HR-ESIMS requires for $C_9H_{15}NO_4$ $(M+Na)^+$ 224.0893, found 224.0890.

(±)-(2*R*, 3*R*)-*N*-phenylmethoxy-2-hydroxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (21)



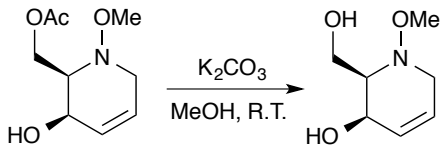
To a solution of **17** (0.958 mmol, 266 mg) in methanol (19 mL) was added potassium carbonate (20.0 mmol, 2.75 g) all at once and the resulting suspension was stirred for 16 hours at room temperature. After concentration under reduced pressure, the crude residue was taken up in 25 mL of water and extracted with $CHCl_3$:*i*-PrOH (3:1 v:v, 3 x 15 mL). The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated to afford diol **21** as an off-white solid that was used without further purification (0.95 mmol, 224 mg, 99% yield). X-ray quality crystals were grown by slow evaporation of a benzene solution of **21**. R_f = 0.15 (1:1 hexanes:ethyl acetate); M.P. = 89.5 – 91.8 °C; ^{1}H NMR (500 MHz, CD_3OD): δ 7.41 – 7.25 (m, 5H), 5.87 – 5.81 (m, 1H), 5.73 (ddd, *J* = 9.9, 4.8, 1.9 Hz, 1H), 4.84 (s, 2H), 4.71 (q, *J* = 10.9 Hz, 2H), 4.20 (br s, 1H), 4.01 (dd, *J* = 10.9, 5.3 Hz, 1H), 3.92 (dd, *J* = 10.9, 7.0 Hz, 1H), 3.73 (dd, *J* = 16.8, 4.6 Hz, 1H), 3.24 (d, *J* = 16.8 Hz, 1H), and 2.85 (br s, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 137.31, 128.63, 127.95, 127.64 (2), 127.00 (2), 125.71, 75.32, 67.82, 65.48, 59.83, and 54.55; IR (neat) 3322 (br), 3034, 2872, 2813, 1454, 1401, 1369, 1124, 1089, 1045, 998, and 953 cm^{-1}; HR-ESIMS requires for $C_{13}H_{17}NO_3$ $(M+H)^+$ 236.1281, found 236.1283.

(±)-(2*S*, 3*R*)-*N*-phenylmethoxy-2-hydroxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (22)



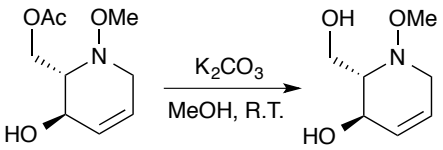
To a solution of **18** (2.24 mmol, 620 mg) in methanol (45 mL) was added potassium carbonate (46.6 mmol, 6.44 g) all at once and the resulting suspension was stirred for 16 hours at room temperature. After concentration under reduced pressure, the crude residue was taken up in 45 mL of water and extracted with $CHCl_3$:*i*-PrOH (3:1 v:v, 3 x 25 mL). The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated to afford the crude diol. The crude product was then ran through a short plug of silica gel (eluent 1:1 hexanes:ethyl acetate) to give the pure diol **22** as a colorless oil (1.87 mmol, 440 mg, 83% yield). R_f = 0.14 (1:1 hexanes:ethyl acetate); ^{1}H NMR (400 MHz, CD_3OD): δ 7.39 – 7.21 (m, 5H), 5.72 – 5.61 (m, 2H), 4.76 (s, 2H), 4.24 (d, *J* = 8.2 Hz, 1H), 3.94 (dd, *J* = 10.94, 2.55 Hz, 1H), 3.85 (dd, *J* = 11.1, 5.2 Hz, 1H), 3.66 – 3.59 (m, 1H), 3.37 – 3.30 (m, 1H), and 2.65 (s, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 137.35, 128.79, 128.51, 127.87 (2), 127.53 (2), 123.95, 74.83, 69.62, 65.12, 58.89, and 53.49; IR (neat) 3364, 3063, 3028, 2930, 2879, 2825, 1496, 1451, 1366, 1264, 1242, 1030, 1002, 913, and 736 cm^{-1}; HR-ESIMS requires for $C_{13}H_{17}NO_3$ $(M+Na)^+$ 258.1101, found 258.1097.

(±)-(2*R*, 3*R*)-*N*-methoxy-2-hydroxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (23)



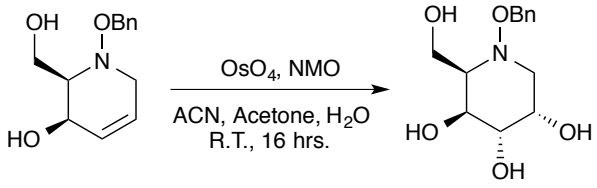
To a solution of **19** (0.82 mmol, 165 mg) in methanol (16 mL) was added potassium carbonate (17.1 mmol, 2.36 g) all at once and the resulting suspension was stirred for 16 hours at room temperature. After concentration under reduced pressure, the crude residue was taken up in 10 mL of water and extracted with $CHCl_3$:*i*-PrOH (3:1 v:v, 3 x 15 mL). The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated to afford diol **23** as an off-white solid that was used without further purification (0.73 mmol, 117 mg, 89% yield). R_f = 0.3 (5% DCM:MeOH); M.P. = 67.4 – 70.1 °C; ^{1}H NMR (400 MHz, CD_3OD): δ 5.85 – 5.79 (m, 1H), 5.74 (dd, *J* = 9.7, 4.2 Hz, 1H), 4.15 (s, 1H), 3.96 (ddd, *J* = 10.9, 5.6, 1.0 Hz, 1H), 3.88 (ddd, *J* = 10.9, 6.7, 1.0 Hz, 1H), 3.77 (ddd, *J* = 16.5, 4.5, 1.2 Hz, 1H), 3.51 (s, 3H), 3.18 (d, *J* = 16.6 Hz, 1H), and 2.78 (s, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 127.01, 125.51, 67.74, 65.12, 59.82, 59.63, and 53.75; IR (neat) 3303, 2980, 2930, 2885, 2816, 1470, 1451, 1388, 1337, 1299, 1223, 1125, 1078, 1049, 1008, 986, 935, and 751 cm^{-1}; HR-ESIMS requires for $C_7H_{13}NO_3$ $(M+Na)^+$ 182.0788, found 182.0788.

(±)-(2*S*, 3*R*)-*N*-methoxy-2-hydroxymethyl-3-hydroxy-1,2,3,6-tetrahydropyridine (24)



To a solution of **20** (1.36 mmol, 273 mg) in methanol (27 mL) was added potassium carbonate (28.3 mmol, 3.9 g) all at once and the resulting suspension was stirred for 16 hours at room temperature. After concentration under reduced pressure, the crude residue was taken up in 10 mL of water and extracted with $CHCl_3$:*i*-PrOH (3:1 v:v, 3 x 15 mL). The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated to afford diol **24** as a white solid that was used without further purification (1.19 mmol, 190 mg, 88% yield). R_f = 0.4 (5% DCM:MeOH); M.P. = 121.2 – 123.4 °C; IR (neat) 3352 (br), 3245 (br), 2921, 2851, 2808, 1457, 1384, 1265, 1243, 1225, 1121, 1026, 947, 895, 870, and 846 cm^{-1}; HR-ESIMS requires for $C_7H_{13}NO_3$ $(M+Na)^+$ 182.0788, found 182.0785.

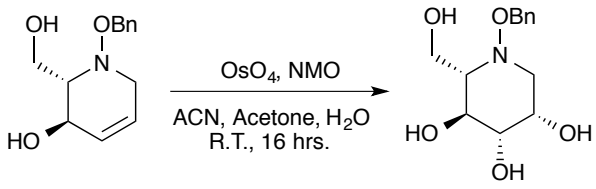
(±)-(2*R*, 3*R*, 4*S*, 5*S*)-*N*-phenylmethoxy-2-hydroxymethyl-3,4,5-trihydroxypiperidine (25)



To a solution of **21** (0.992 mmol, 233.3 mg) in acetonitrile, acetone, and deionized water (6 mL, 1:1:1 v/v) was added NMO (1.98 mmol, 0.21 mL) followed by 1.3 mL of a 1 wt. % solution of osmium tetroxide in deionized water and the resulting

solution was stirred overnight at room temperature. The reaction mixture was then filtered through a pad of celite and the pad washed with methanol (3 x 10 mL). After concentration under reduced pressure, the crude residue was purified by column chromatography (5% - 10% DCM:MeOH) to afford the pure piperidine **25** as a white solid (0.82 mmol, 220 mg). X-ray quality crystals were grown by vapor diffusion of pentane into an ethanol solution of **25**. R_f = 0.2 (10% DCM:MeOH); M.P. = 130.7 – 133.5 °C; ^{1}H NMR (400 MHz, CD_3OD): δ 7.40 – 7.21 (m, 5H), 4.83 (s, 2H), 4.70 (d, *J* = 10.7 Hz, 1H), 4.63 (d, *J* = 10.6 Hz, 1H), 3.97 (d, *J* = 8.9 Hz, 1H), 3.95 – 3.92 (m, 1H), 3.89 (d, *J* = 10.8 Hz, 1H), 3.76 (s, 1H), 3.23 (ddd, *J* = 9.6, 4.6, 1.0 Hz, 1H), 2.84 (s, 1H), and 2.76 (d, *J* = 10.4 Hz, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 137.17, 128.56 (2), 127.94 (2), 127.60, 74.87, 70.61, 70.15, 65.51, 64.32, 59.72, and 55.90; IR (neat) 3225 (br), 3031, 2978, 2951, 2919, 2842, 1460, 1451, 1437, 1366, 1319, 1210, 1101, 1062, 1042, 974, 909, and 856 cm^{-1}; HR-ESIMS requires for $C_{13}H_{19}NO_5$ $(M+H)^+$ 270.1336, found 270.1337.

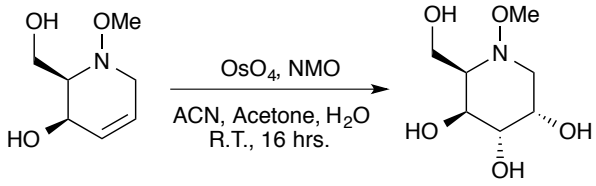
(±)-(2*S*, 3*R*, 4*S*, 5*S*)-*N*-phenylmethoxy-2-hydroxymethyl-3,4,5-trihydroxypiperidine (26)



To a solution of **22** (1.83 mmol, 430 mg) in acetonitrile, acetone, and deionized water (11 mL, 1:1:1 v/v) was added NMO (3.66 mmol, 0.4 mL) followed by 2.4 mL of a 1 wt. % solution of osmium tetroxide in deionized water and the resulting solution was

stirred overnight at room temperature. The reaction mixture was then filtered through a pad of celite and the pad washed with methanol (3 x 15 mL). After concentration under reduced pressure, the crude residue was purified by column chromatography (5% - 10% DCM:MeOH) to afford the pure piperidine **26** as an off white (1.6 mmol, 431 mg). R_f = 0.3 (10% DCM:MeOH); M.P. = 98.6 – 100.8 °C; ^{1}H NMR (400 MHz, CD_3OD): δ 7.38 – 7.22 (m, 5H), 4.73 (d, *J* = 1.0 Hz, 1H), 4.00 (ddd, *J* = 11.2, 2.8, 1.0 Hz, 1H), 3.91 – 3.88 (m, 1H), 3.79 (td, *J* = 9.7, 1.0 Hz, 1H), 3.54 (ddd, *J* = 11.4, 3.5, 1.0 Hz, 1H), 3.35 (ddd, *J* = 9.6, 3.6, 1.0 Hz, 1H), 3.29 (dq, *J* = 3.0, 1.5 Hz, 1H), 2.67 (dd, *J* = 11.6, 1.8 Hz, 1H), and 2.34 (d, *J* = 9.7 Hz, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 136.94, 128.54 (2), 127.93 (2), 127.61, 74.77, 74.61, 70.91, 68.18, 67.40, 58.50, and 58.25; IR (neat) 3225 (br), 3031, 2978, 2951, 2919, 2842, 1460, 1451, 1437, 1366, 1319, 1210, 1101, 1062, 1042, 974, 909, and 856 cm^{-1}; HR-ESIMS requires for $C_{13}H_{19}NO_5$ $(M+Na)^+$ 292.1155, found 292.1155.

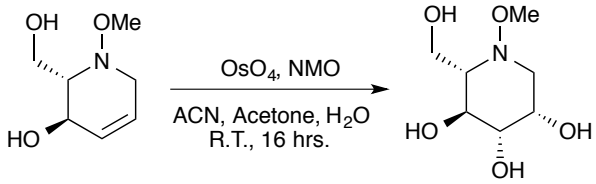
(±)-(2*R*, 3*R*, 4*S*, 5*S*)-*N*-methoxy-2-hydroxymethyl-3,4,5-trihydroxypiperidine (27)



To a solution of **23** (0.63 mmol, 100 mg) in acetonitrile, acetone, and deionized water (3.75 mL, 1:1:1 v/v) was added NMO (1.26 mmol, 0.13 mL) followed by 0.8 mL of a 1 wt. % solution of osmium tetroxide in deionized water and the resulting solution was stirred overnight at room temperature. The reaction mixture was then filtered through a pad of celite and the pad washed with methanol (3 x 10 mL). After concentration under

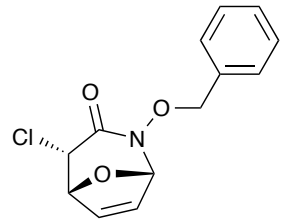
reduced pressure, the crude residue was purified by column chromatography (5% - 20% DCM:MeOH) to afford the pure piperidine **27** as an off white gum (0.5 mmol, 97.3 mg, 80%). R_f = 0.4 (20% DCM:MeOH); ^{1}H NMR (500 MHz, CD_3OD): δ 4.03 – 3.93 (m, 2H), 3.89 (dt, *J* = 12.1, 6.0 Hz, 2H), 3.80 – 3.72 (m, 1H), 3.48 (s, 3H), 3.23 (dd, *J* = 9.7, 4.6 Hz, 1H), 2.77 (s, 1H), and 2.69 (s, 1H); ^{13}C NMR (500 MHz, CD_3OD): δ 70.42, 70.18, 65.37, 64.36, 59.68, 59.15, and 55.04; IR (neat) 3297, (br), 2961, 2940, 2918, 2891, 2845, 1454, 1369, 1228, 1103, 1072, 1051, 1039, 1014, 974, and 950 cm^{-1}; HR-ESIMS requires for $C_7H_{15}NO_5$ $(M+Na)^+$ 216.0842, found 216.0840.

(2*S*, 3*R*, 4*S*, 5*S*)-*N*-methoxy-2-hydroxymethyl-3,4,5-trihydroxypiperidine (28)



To a solution of **24** (0.69 mmol, 109 mg) in acetonitrile, acetone, and deionized water (4.05 mL, 1:1:1 v/v) was added NMO (1.37 mmol, 0.2 mL) followed by 0.9 mL of a 1 wt. % solution of osmium tetroxide in deionized water and the resulting solution was stirred overnight at room temperature. The reaction mixture was then filtered through a pad of celite and the pad washed with methanol (3 x 10 mL). After concentration under reduced pressure, the crude residue was purified by column chromatography (5% - 20% DCM:MeOH) to afford the pure piperidine **28** as a colorless gum (0.6 mmol, 122.2 mg, 92%). R_f = 0.5 (20% DCM:MeOH); ^{1}H NMR (400 MHz, CD_3OD): δ 3.99 (ddd, *J* = 7.0, 3.7, 1.8 Hz, 1H), 3.73 (td, *J* = 7.6, 3.2 Hz, 1H), 3.66 (ddd, *J* = 5.9, 1.8, 0.5 Hz, 1H), 3.47 (s, 3H), 3.33 (s, 1H), 3.23 – 3.16 (m, 1H), 3.11 (dd, *J* = 3.2, 0.9 Hz, 1H), 3.09 – 3.07 (m,

1H), and 3.06 – 3.03 (m, 1H); ^{13}C NMR (101 MHz, CD_3OD): δ 76.42, 75.11, 70.78, 67.43, 59.86, 58.99, and 58.00; IR (film) 3346 (br), 2952, 2921, 2903, 2851, 2072, 1463, 1375, 1225, 1118, 1087, 1057, 1042, 971, 898, and 818 cm^{-1}; HR-ESIMS requires for $C_7H_{15}NO_5$ $(M+Na)^+$ 216.0842, found 216.0840.


O
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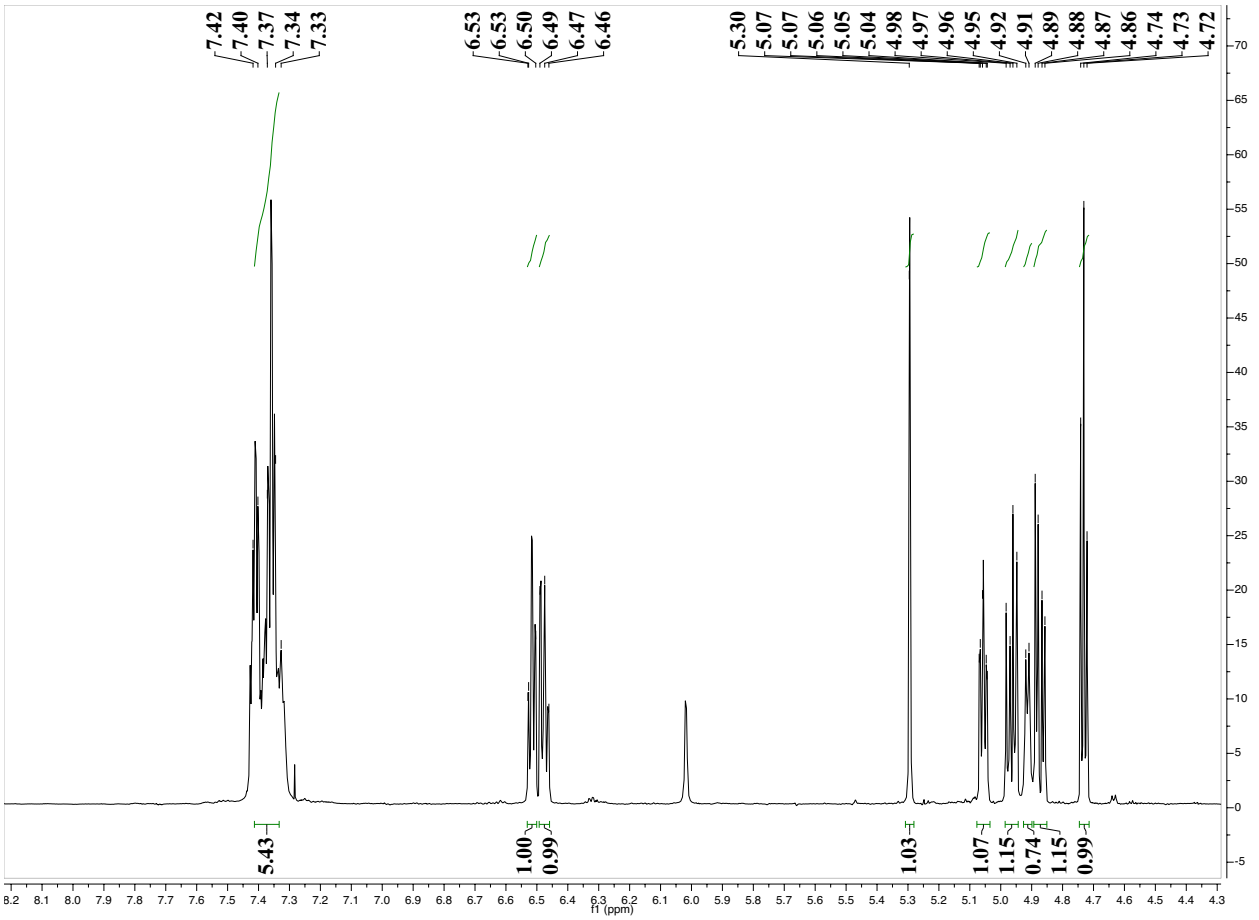
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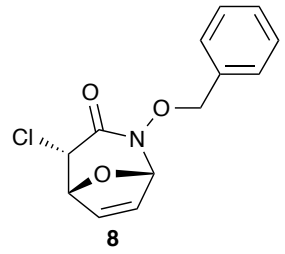
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Cl
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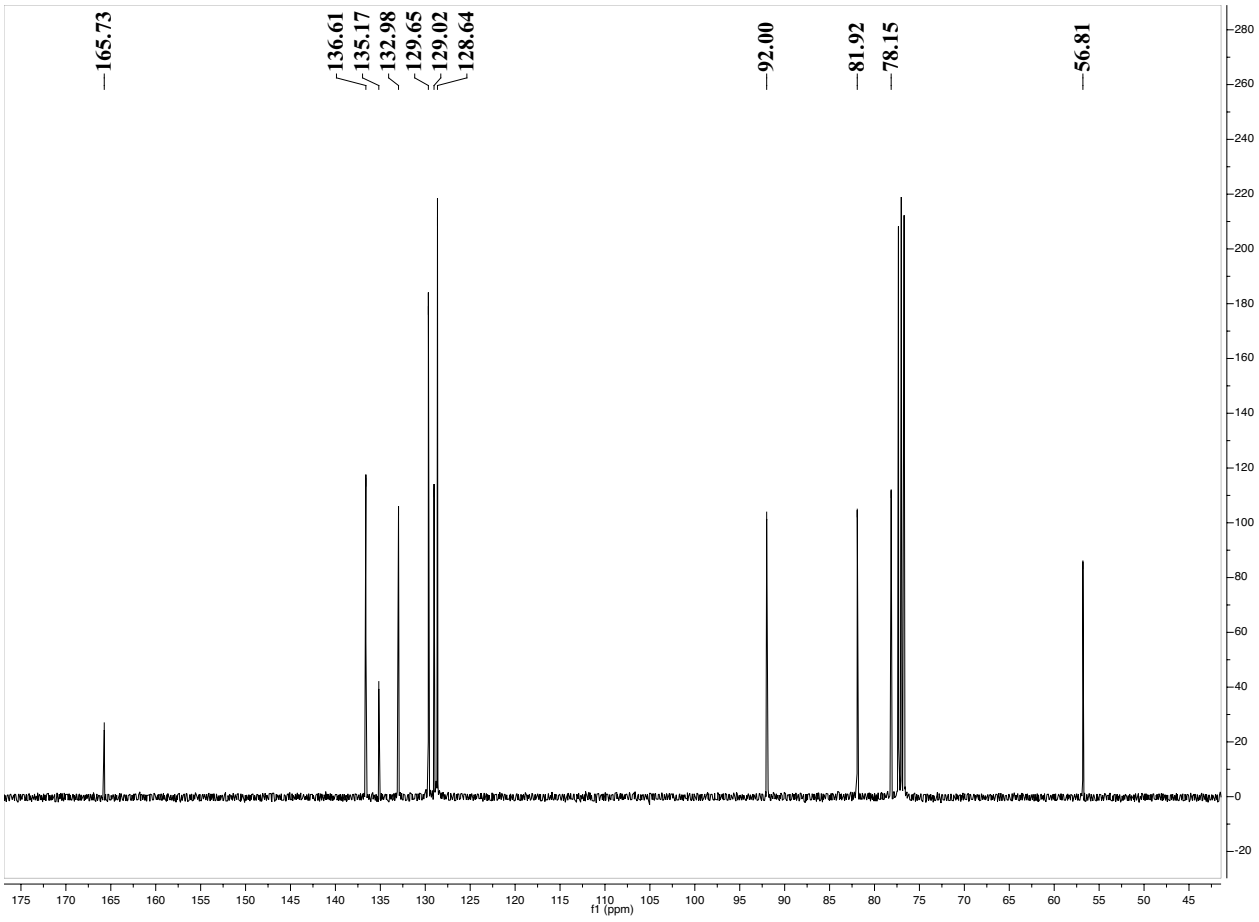
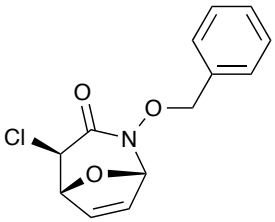
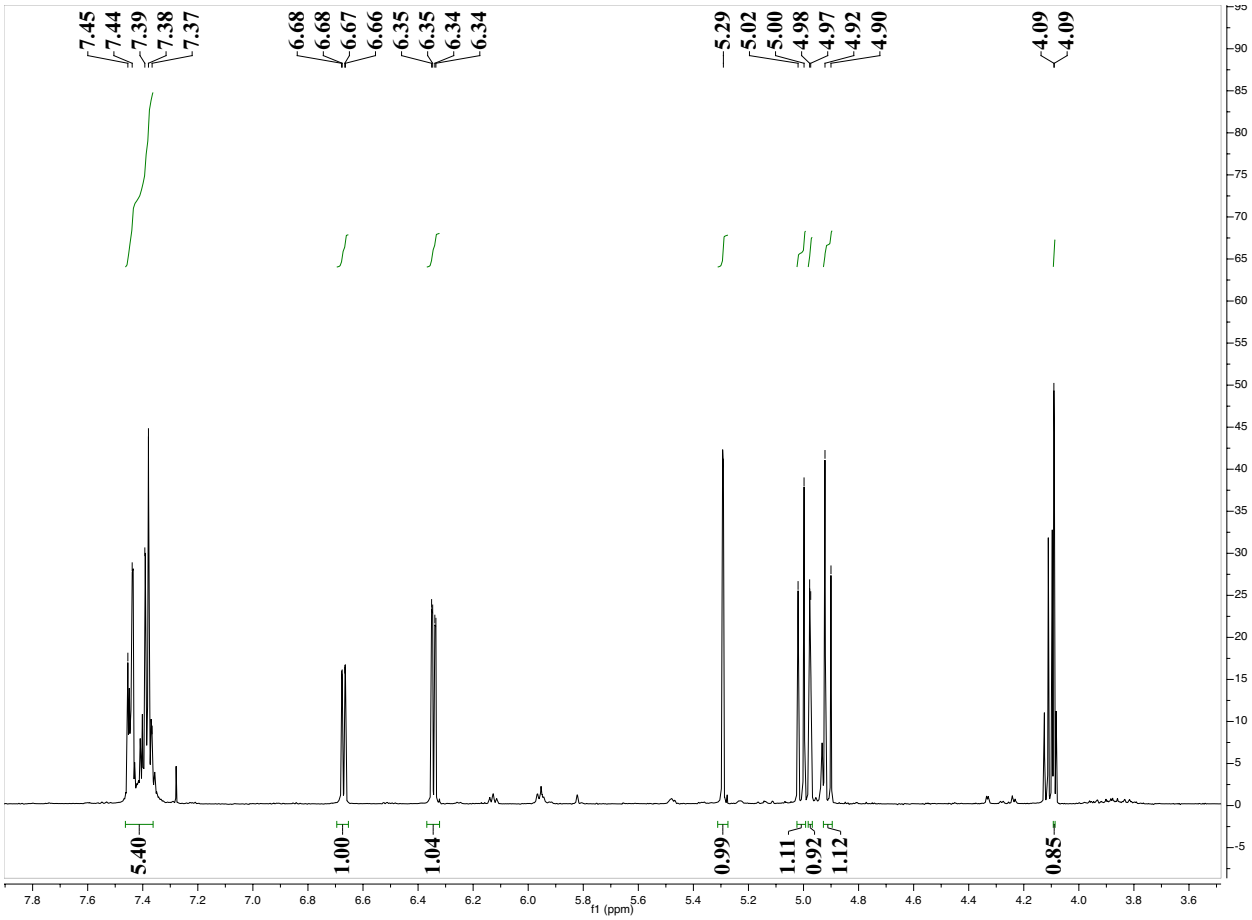
O

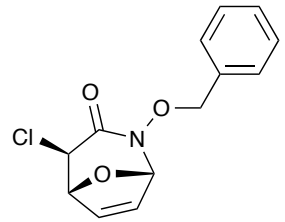
8


165.73
136.61
135.17
132.98
129.65
129.02
128.64
92.00
81.92
78.15
56.81
f1 (ppm)

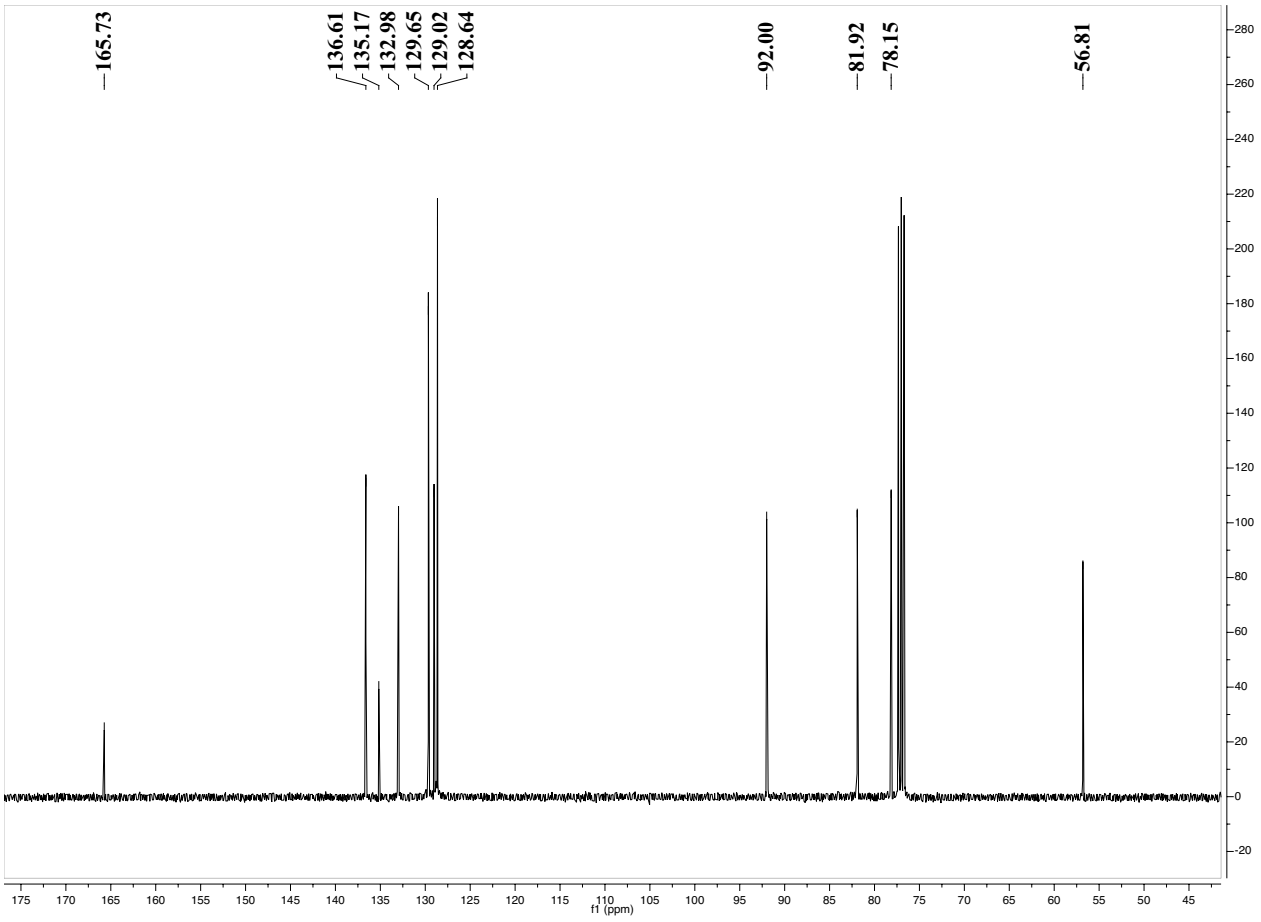

O
Cl
N
O
O

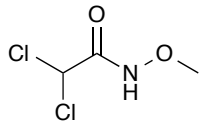
9


7.45
7.44
7.39
7.38
7.37
6.68
6.68
6.67
6.66
6.35
6.35
6.34
6.34
5.29
5.02
5.00
4.98
4.97
4.92
4.90
4.09
4.09
5.40
1.00
1.04
0.99
1.11
0.92
1.12
0.85
f1 (ppm)

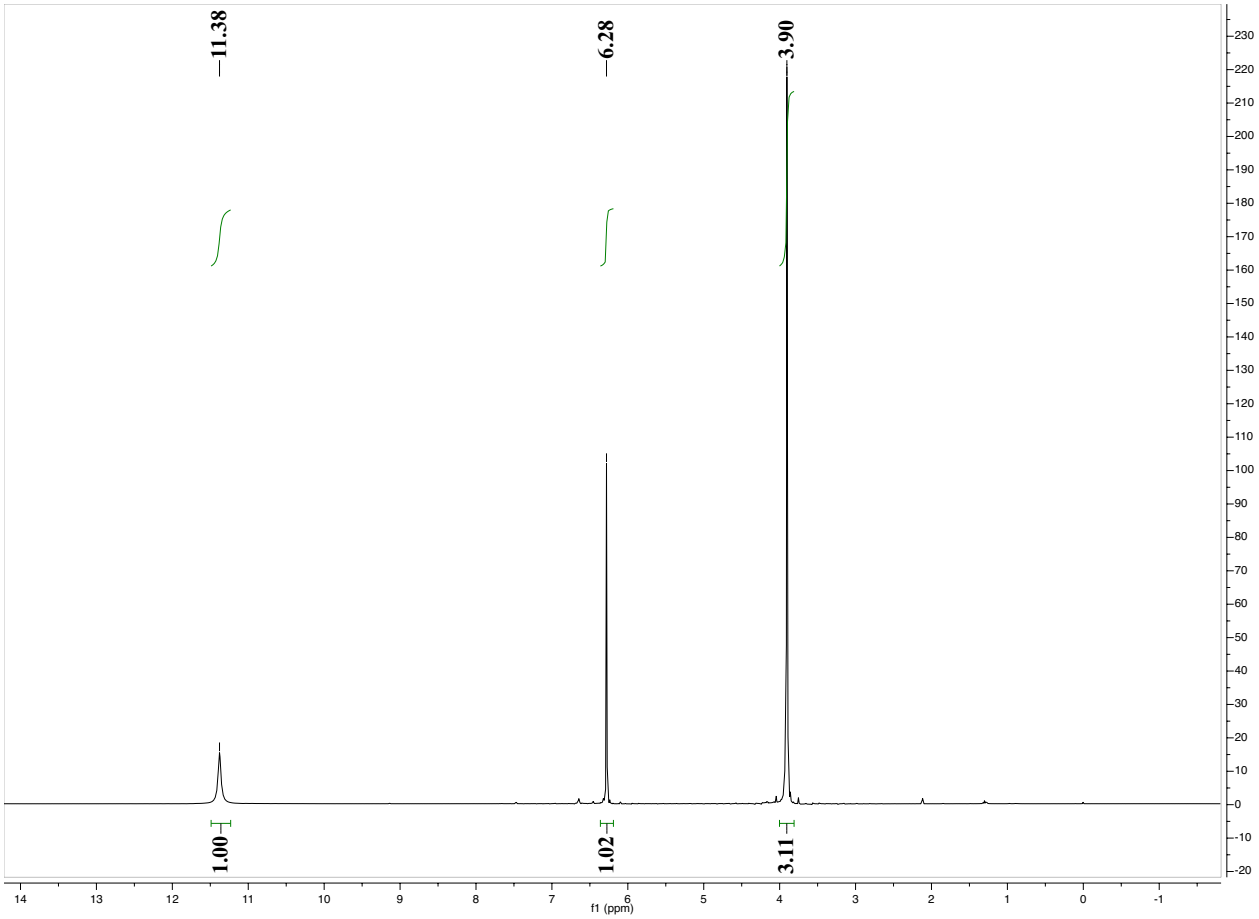

O
Cl
N
O
O

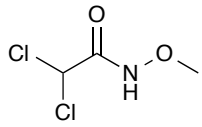
9


165.73
136.61
135.17
132.98
129.65
129.02
128.64
92.00
81.92
78.15
56.81
f1 (ppm)

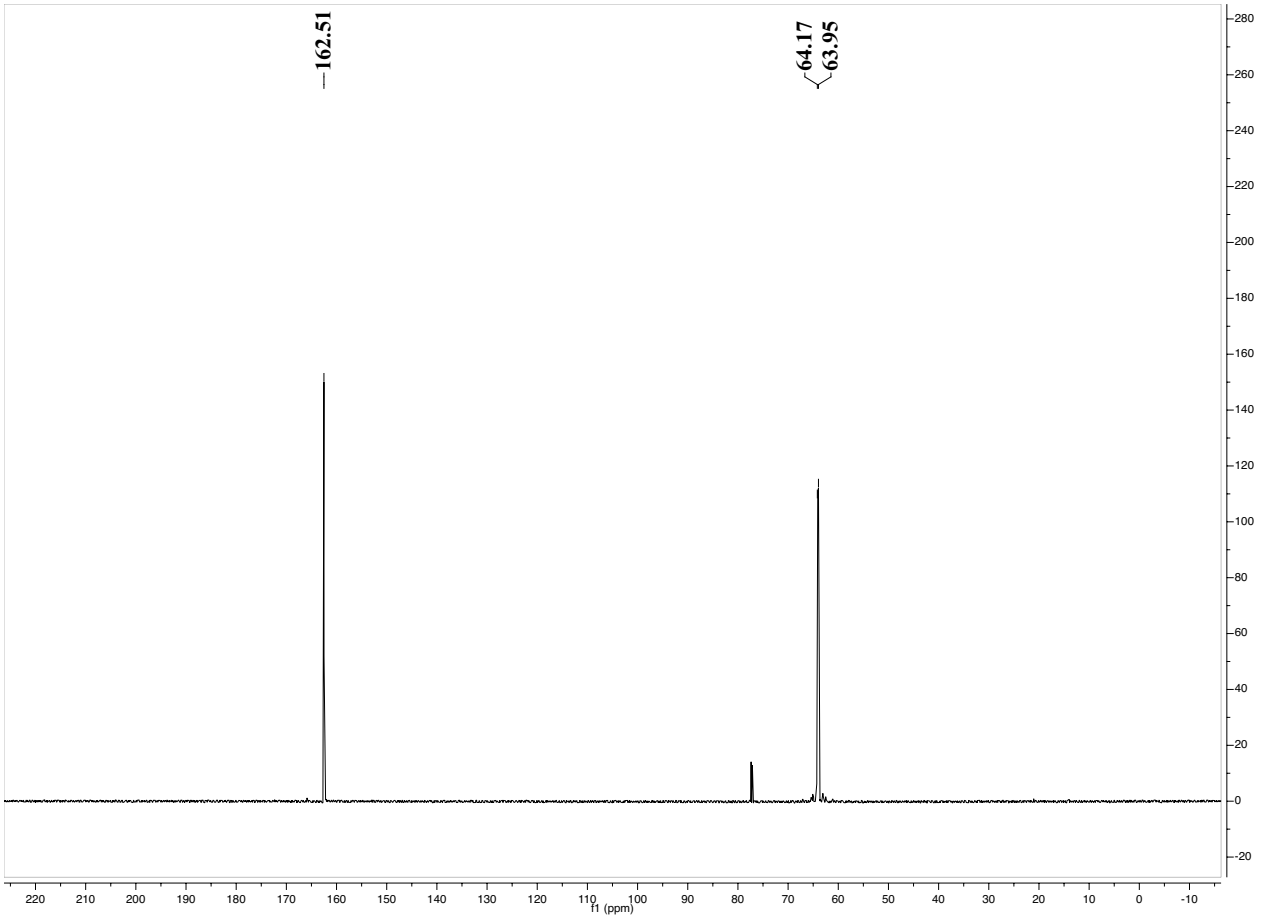


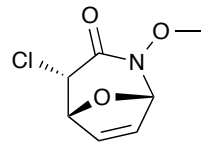
10



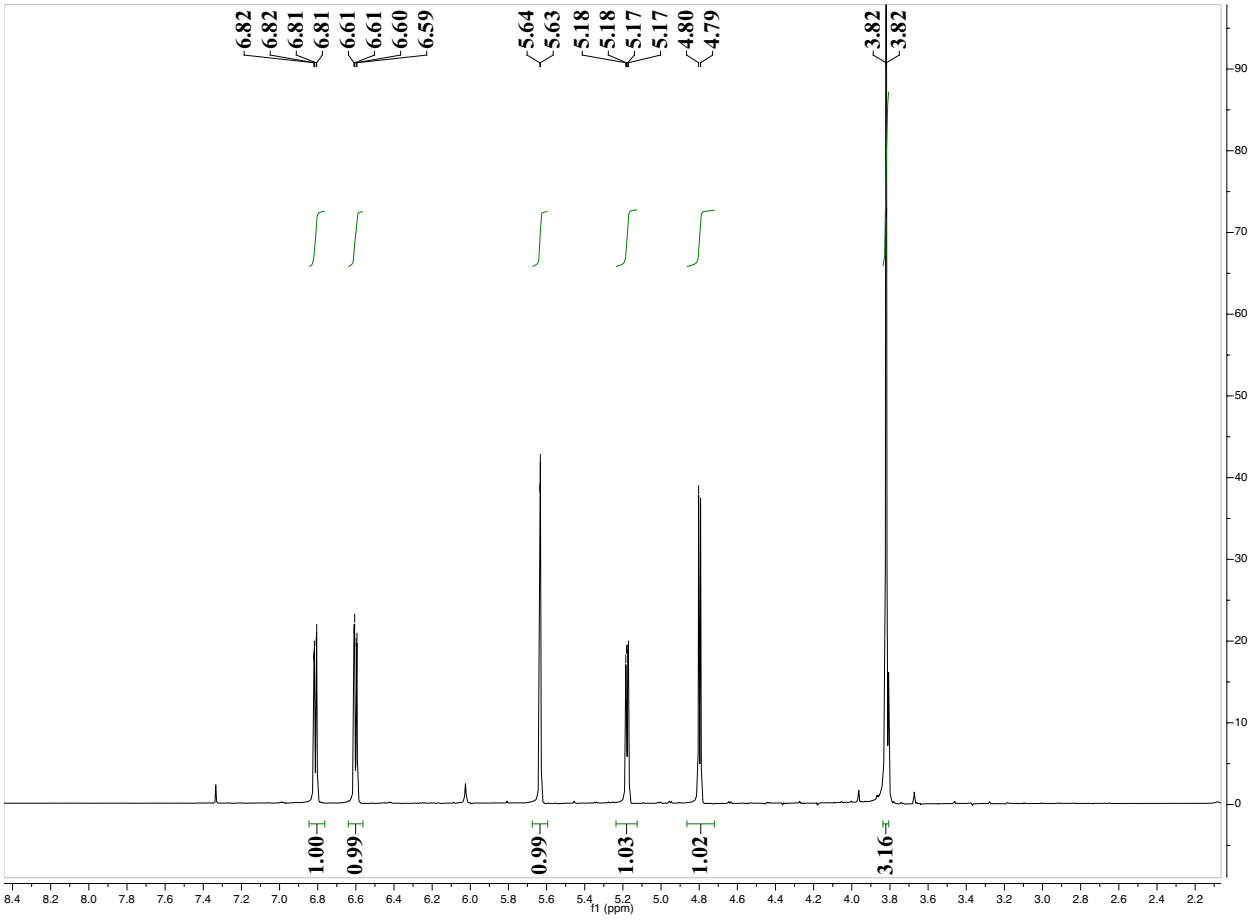

O
Cl
N
O
H
Cl

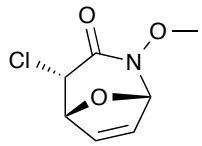
10


162.51
64.17
63.95
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

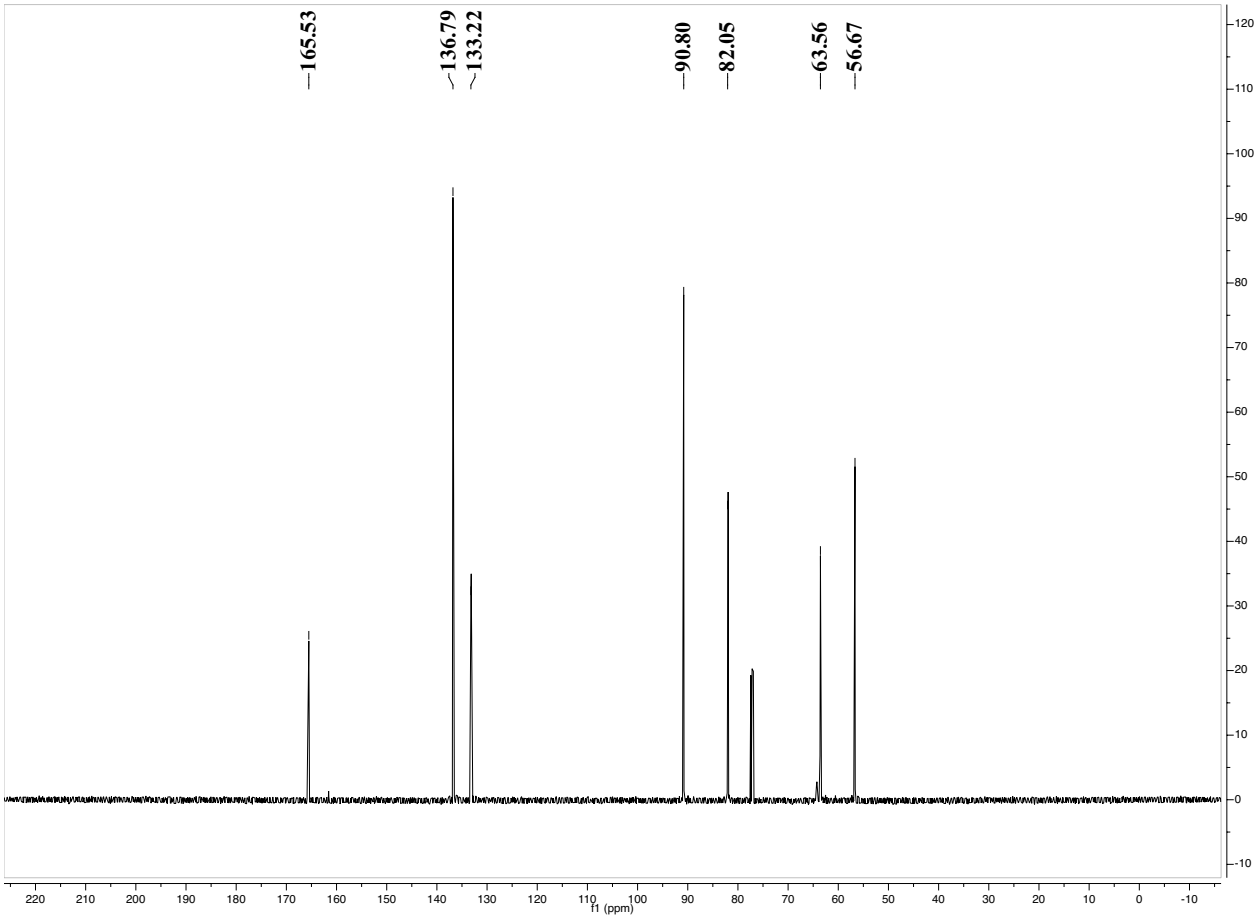

O
Cl
N
O
O

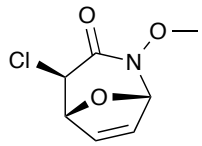
11


6.82
6.82
6.81
6.81
6.61
6.61
6.60
6.59
5.64
5.63
5.18
5.18
5.17
5.17
4.80
4.79
3.82
3.82
1.00
0.99
0.99
1.03
1.02
3.16
f1 (ppm)

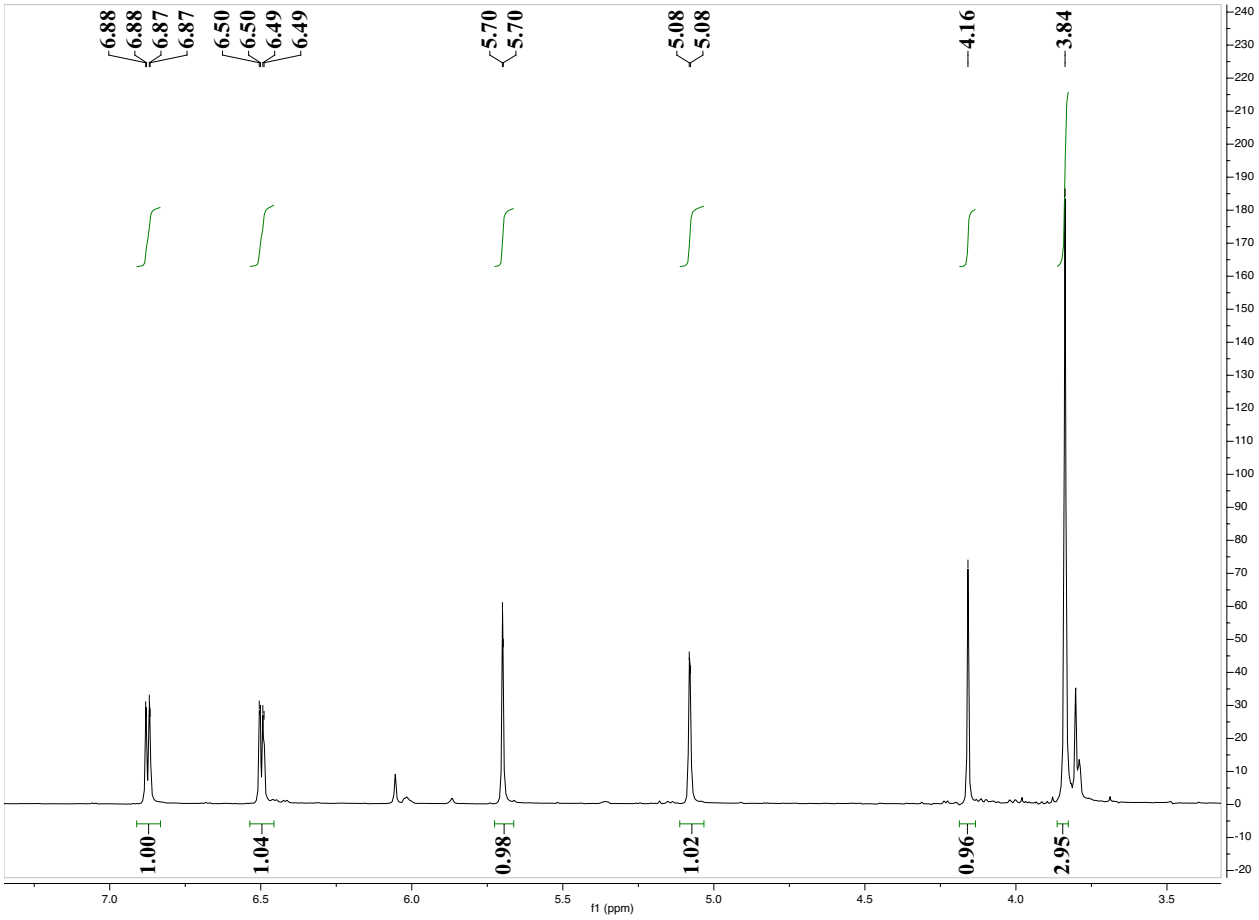


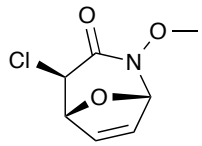
11



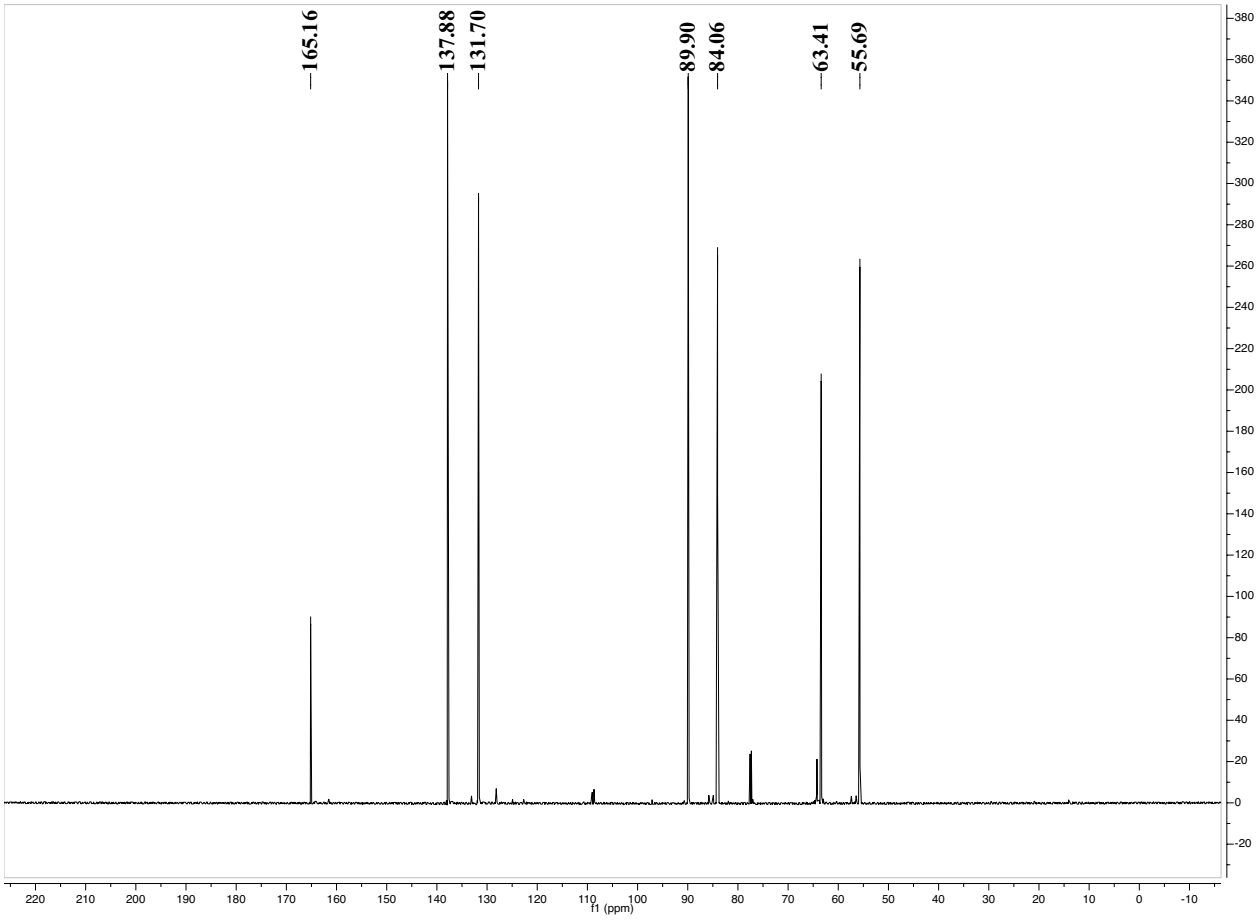

O
Cl
N
O
O

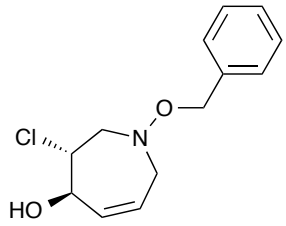
12


6.88
6.88
6.87
6.87
6.50
6.50
6.49
6.49
5.70
5.70
5.08
5.08
4.16
3.84
1.00
1.04
0.98
1.02
0.96
2.95
f1 (ppm)

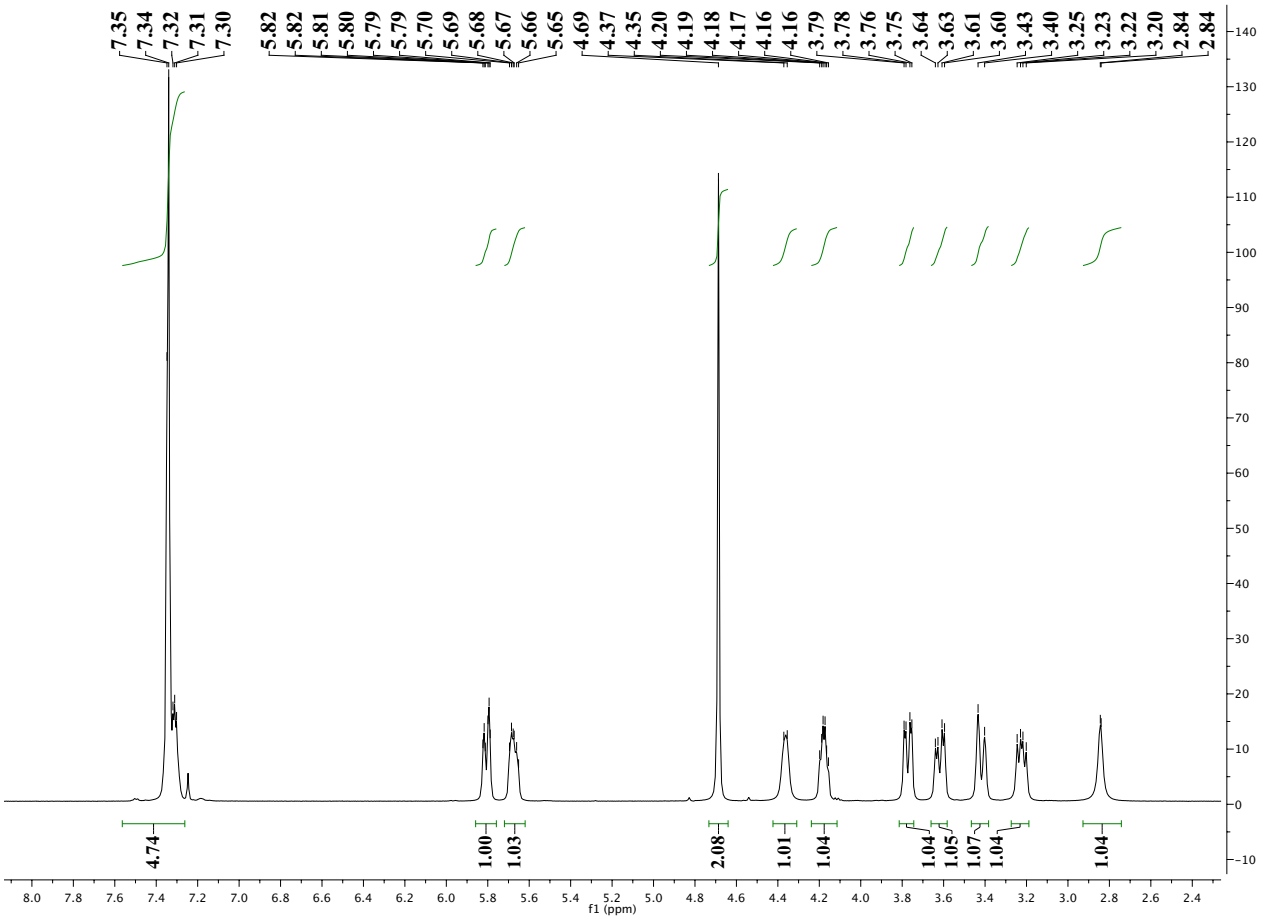


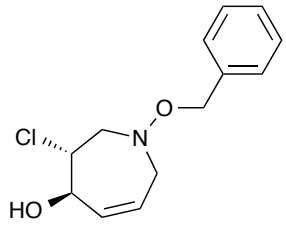
12



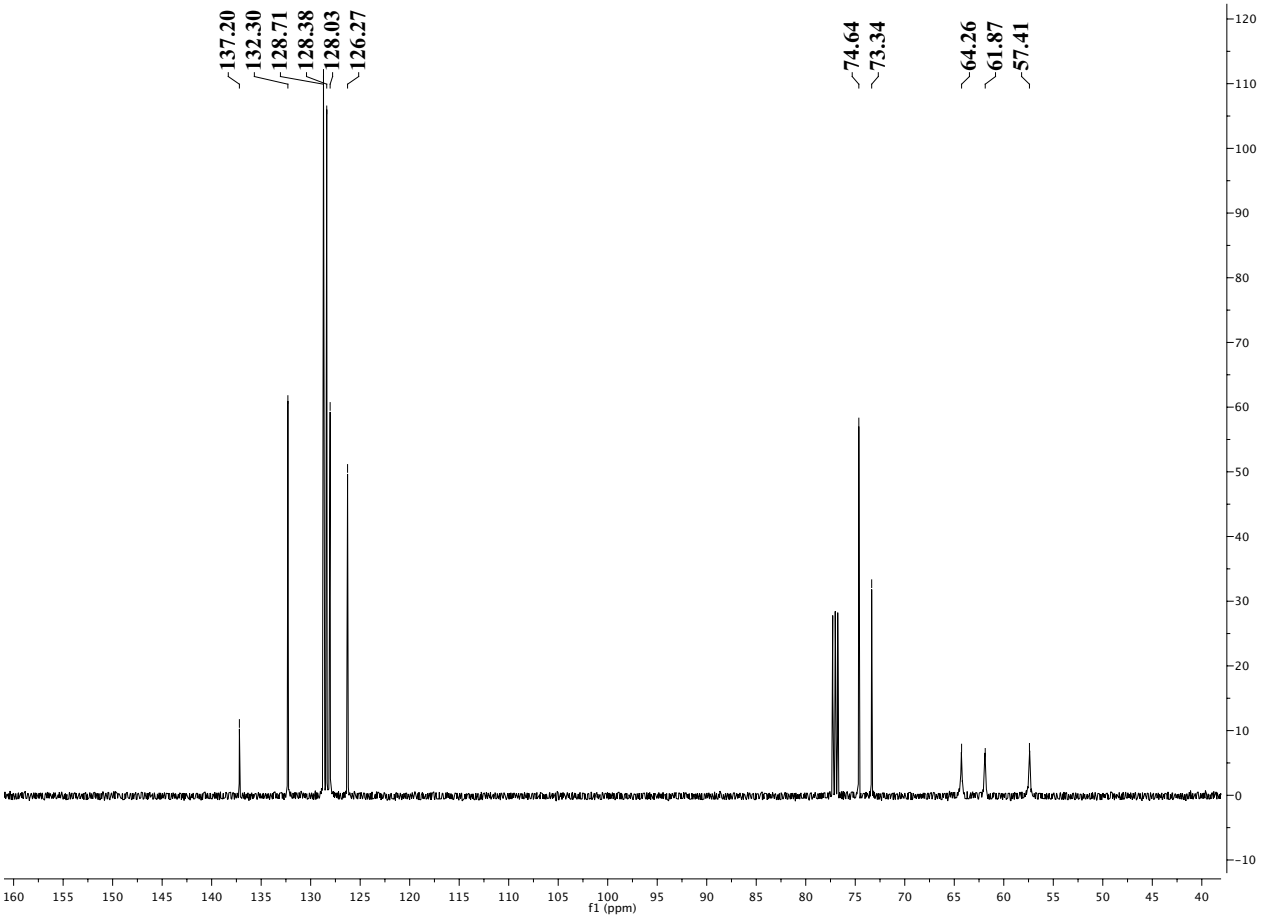

Cl
N
O
HO

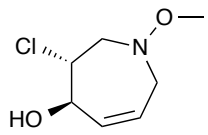
13


7.35 7.34 7.32 7.31 7.30 5.82 5.82 5.81 5.80 5.79 5.79 5.70 5.69 5.68 5.67 5.66 5.65 4.69 4.37 4.35 4.20 4.19 4.18 4.17 4.16 4.16 3.79 3.78 3.76 3.75 3.64 3.63 3.61 3.60 3.43 3.40 3.25 3.23 3.22 3.20 2.84 2.84
4.74 1.00 1.03 2.08 1.01 1.04 1.04 1.05 1.07 1.04 1.04
f1 (ppm)

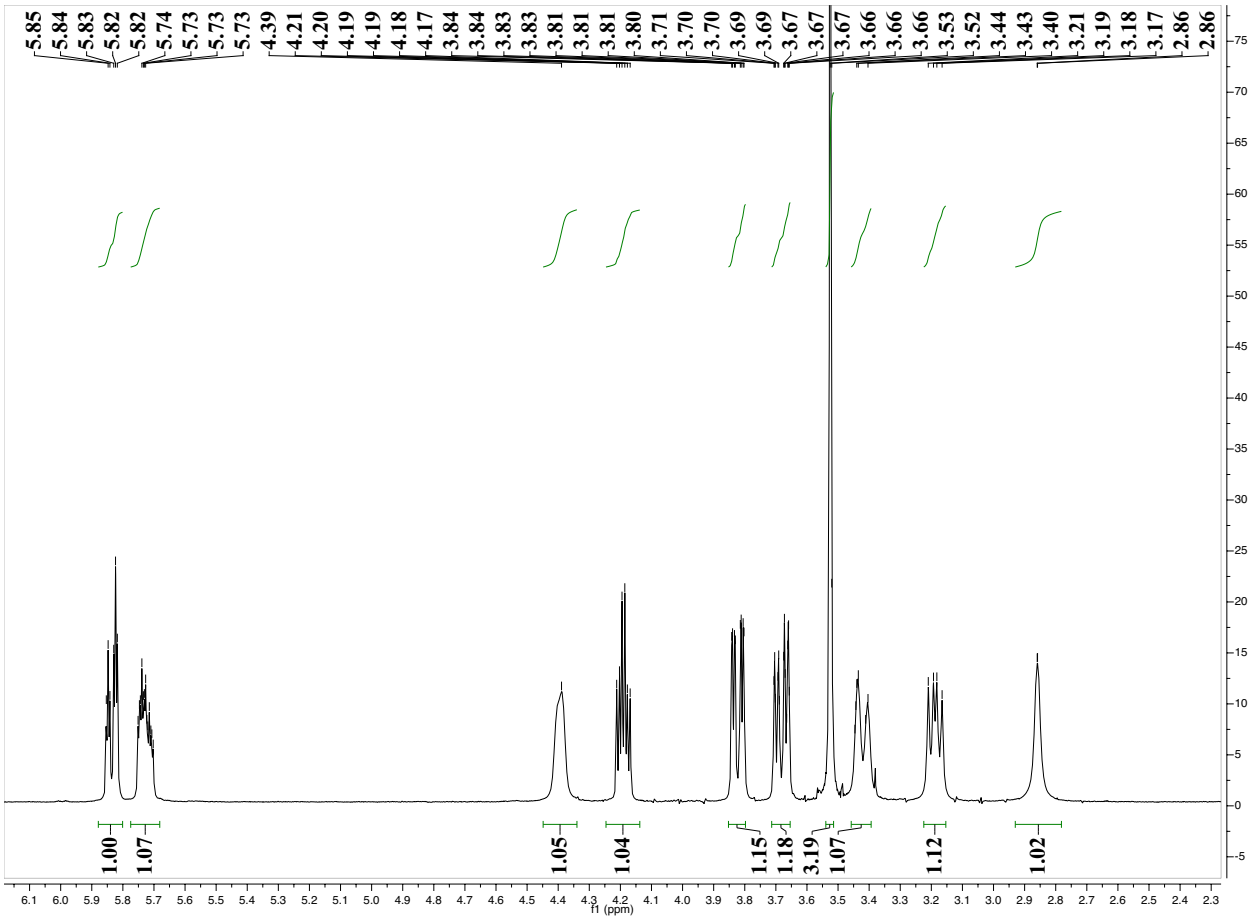

Cl
O
N
HO

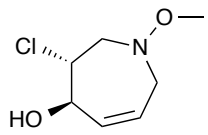
13


137.20
132.30
128.71
128.38
128.03
126.27
74.64
73.34
64.26
61.87
57.41
f1 (ppm)

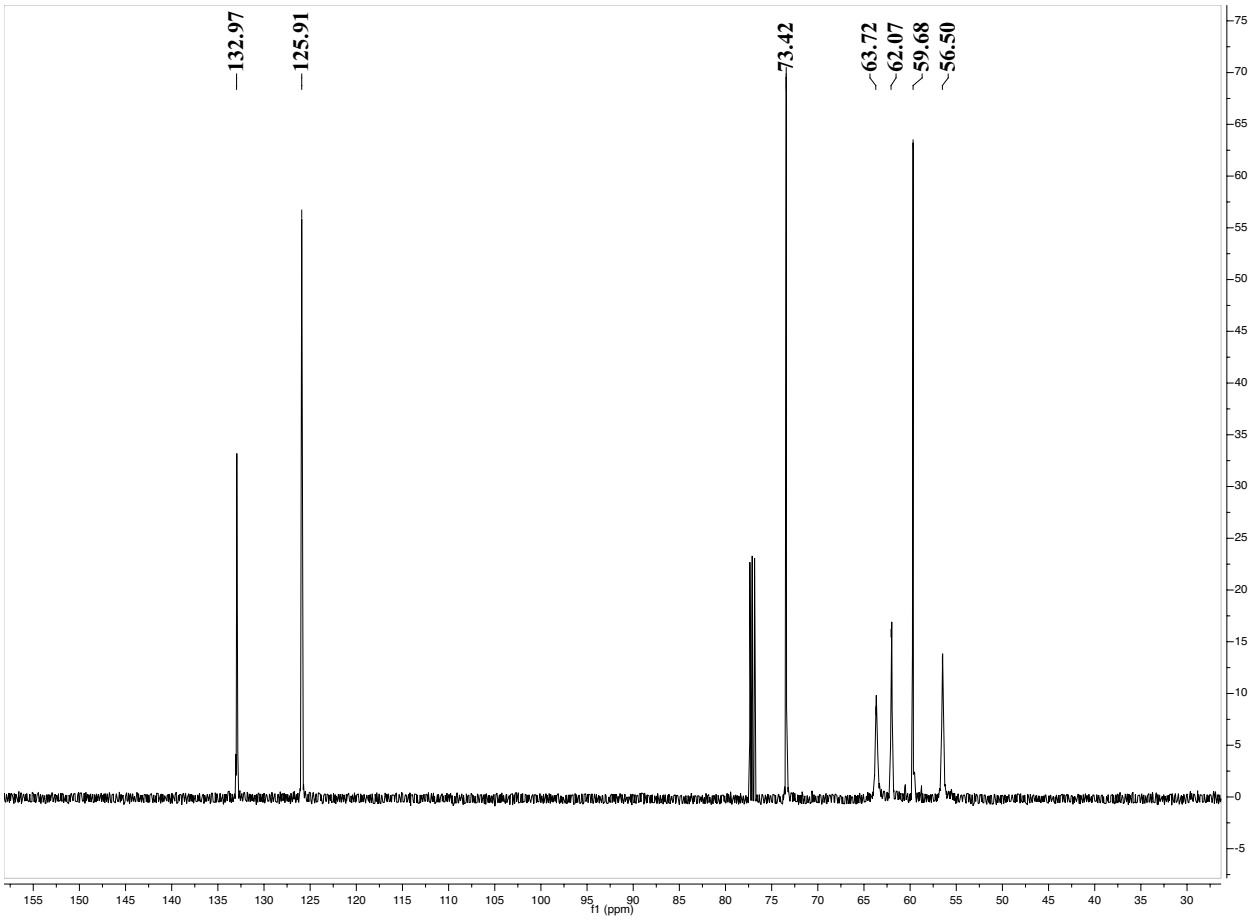

Cl
N
O
HO

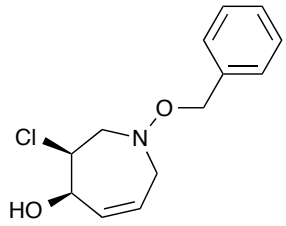
14


5.85 5.84 5.83 5.82 5.82 5.74 5.73 5.73 5.73 4.39 4.21 4.20 4.19 4.19 4.18 4.17 3.84 3.84 3.83 3.83 3.81 3.81 3.81 3.80 3.71 3.70 3.70 3.69 3.69 3.67 3.67 3.67 3.66 3.66 3.66 3.53 3.52 3.44 3.43 3.40 3.21 3.19 3.18 3.17 2.86 2.86
1.00 1.07 1.05 1.04 1.15 1.18 3.19 1.07 1.12 1.02
f1 (ppm)

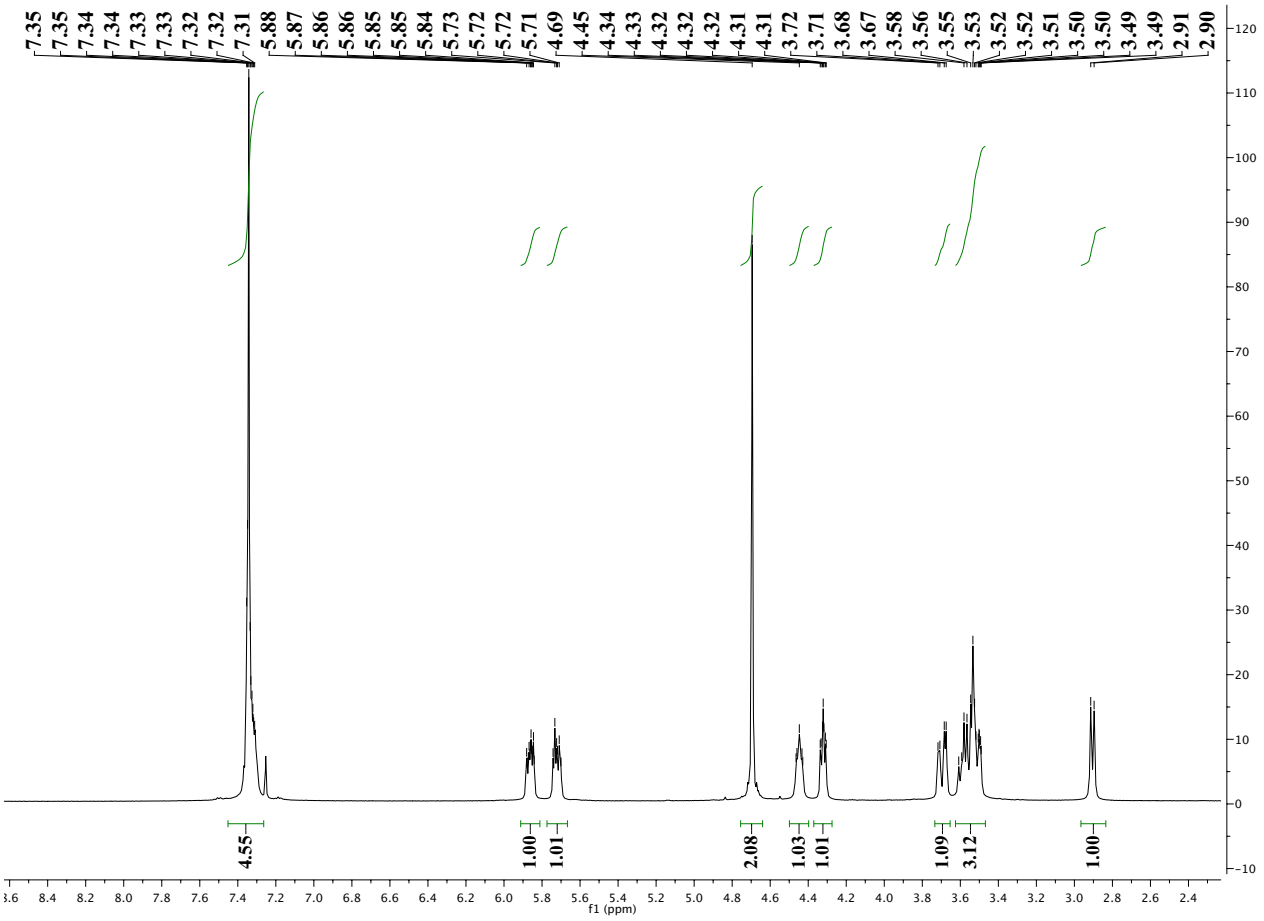


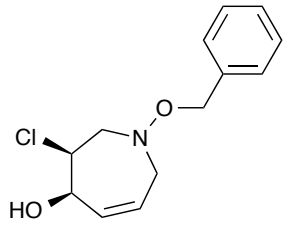
14



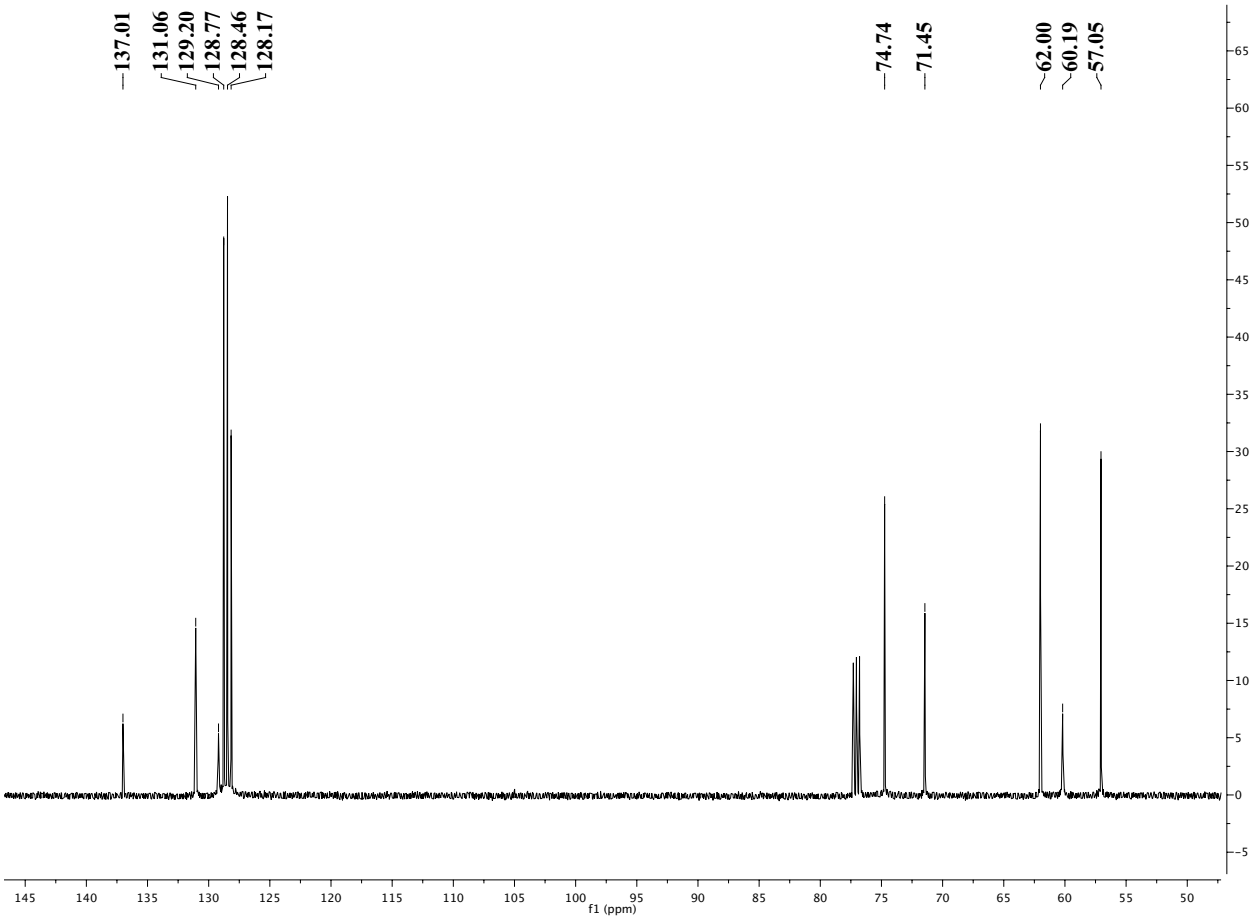

Cl
N
O
HO

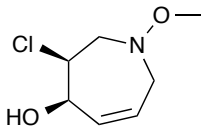
15


7.35 7.35 7.34 7.34 7.33 7.33 7.32 7.32 7.31 5.88 5.87 5.86 5.86 5.85 5.85 5.84 5.73 5.72 5.72 5.71 4.69 4.45 4.34 4.33 4.32 4.32 4.32 4.31 4.31 3.72 3.71 3.68 3.67 3.58 3.56 3.55 3.53 3.52 3.52 3.51 3.50 3.50 3.49 3.49 2.91 2.90
4.55 1.00 1.01 2.08 1.03 1.01 1.09 3.12 1.00
f1 (ppm)

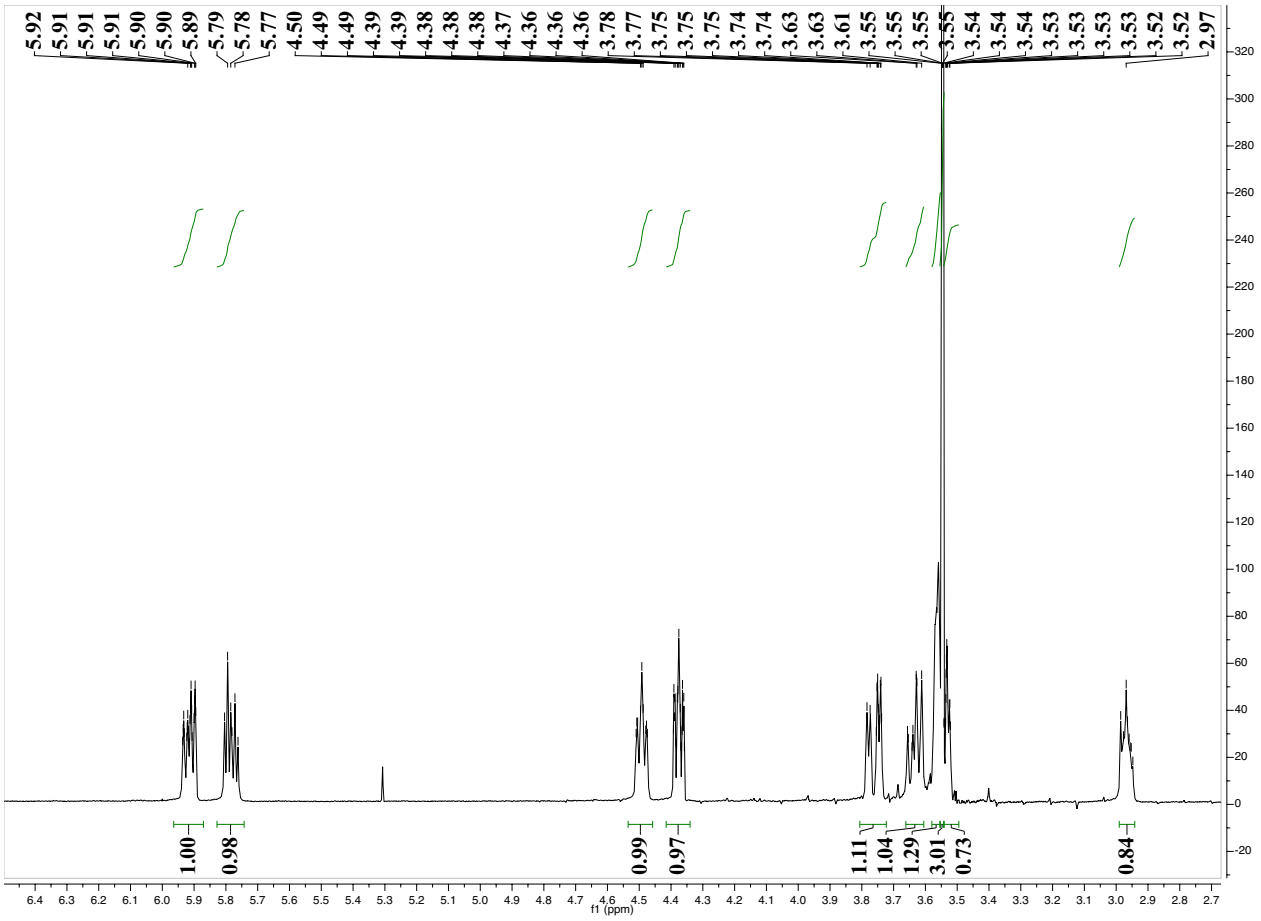

Cl
O
N
HO

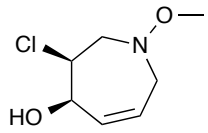
15


137.01
131.06
129.20
128.77
128.46
128.17
74.74
71.45
62.00
60.19
57.05
f1 (ppm)

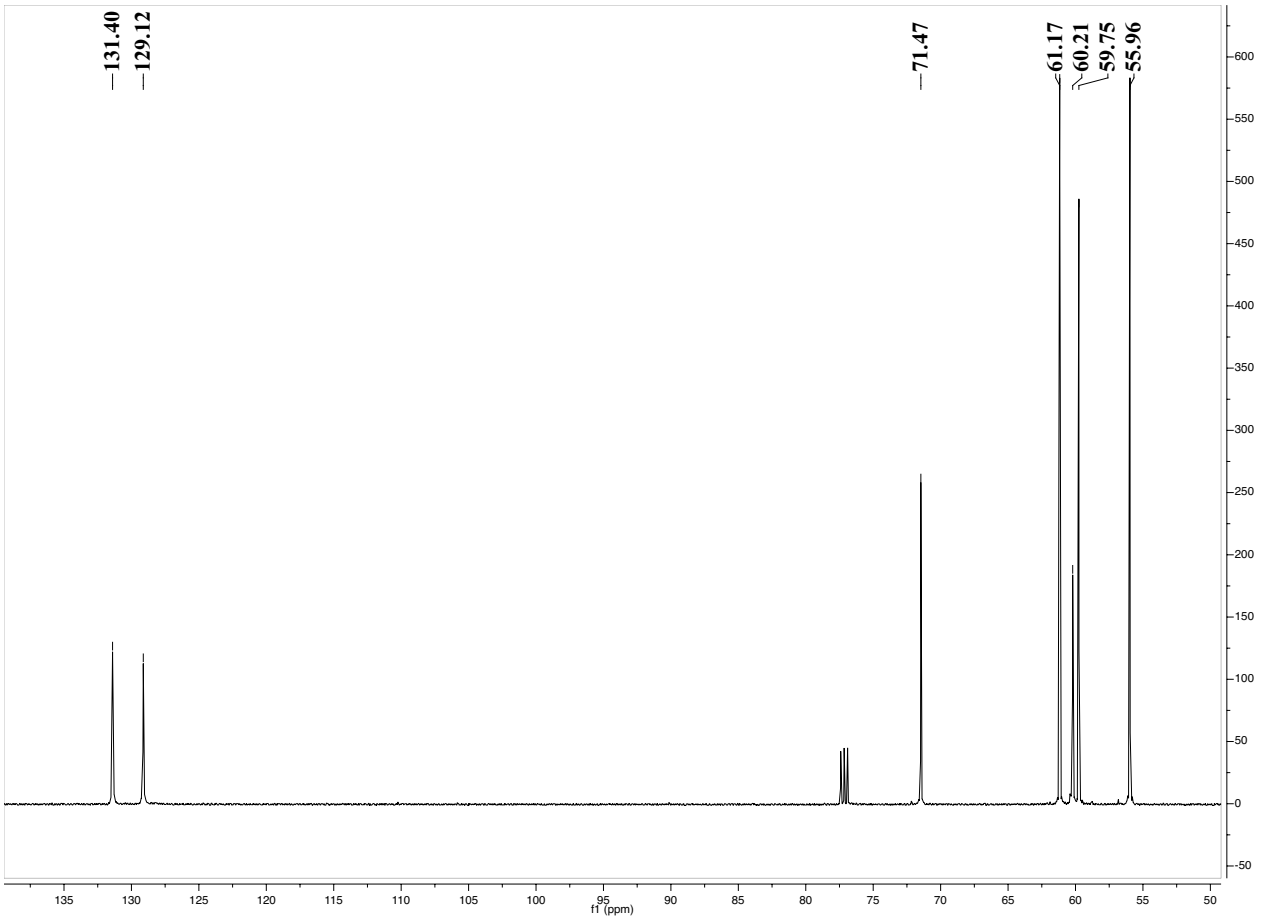

Cl
N
O
HO

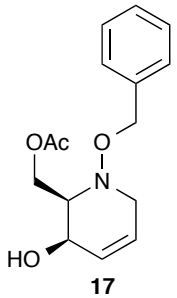
16


5.92 5.91 5.91 5.91 5.90 5.90 5.89 5.79 5.78 5.77 4.50 4.49 4.49 4.39 4.39 4.38 4.38 4.38 4.37 4.36 4.36 4.36 3.78 3.77 3.75 3.75 3.75 3.74 3.74 3.63 3.63 3.61 3.55 3.55 3.55 3.55 3.54 3.54 3.54 3.53 3.53 3.53 3.53 3.52 3.52 2.97
1.00 0.98 0.99 0.97 1.11 1.04 1.29 3.01 0.73 0.84
f1 (ppm)

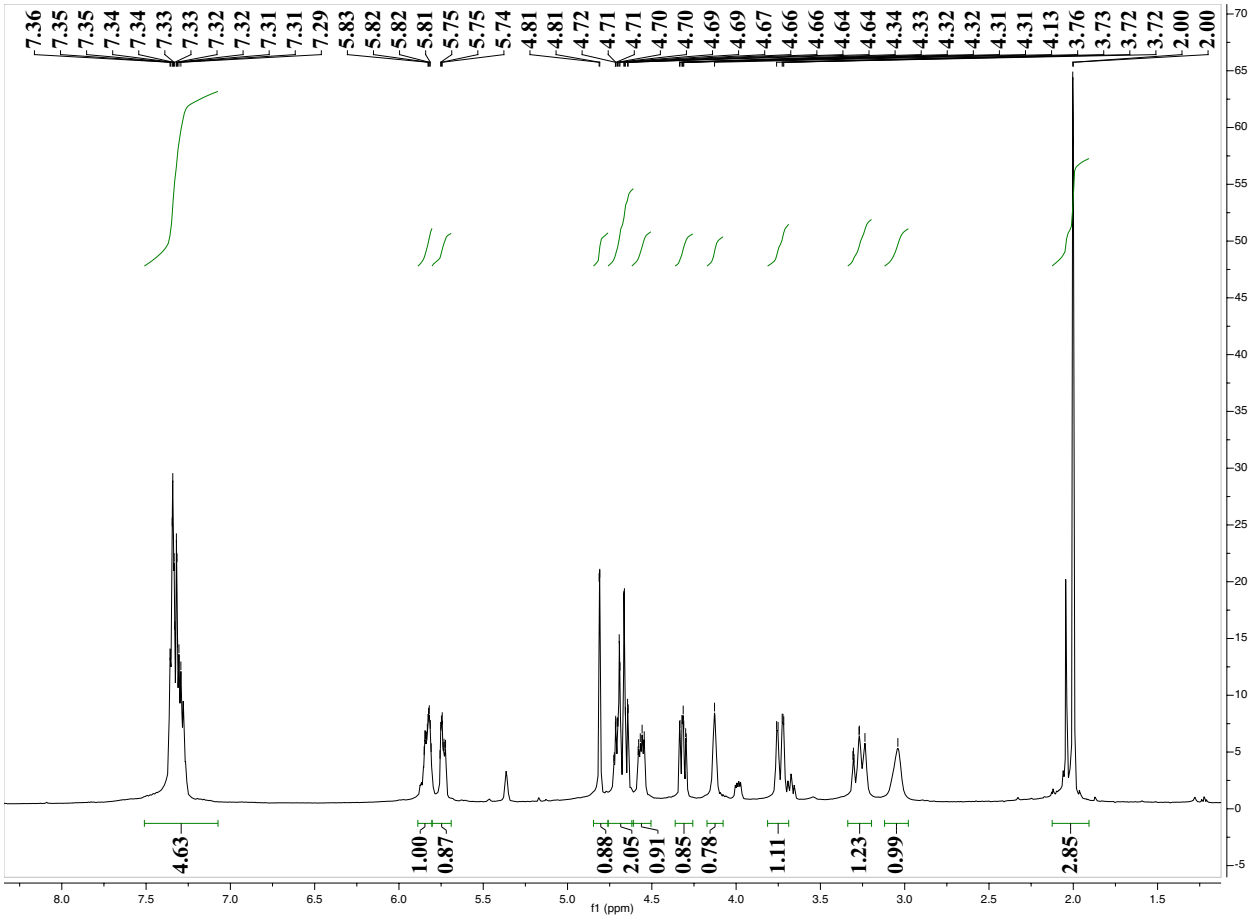


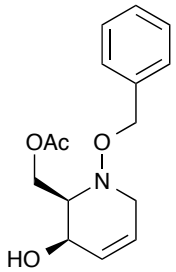
16



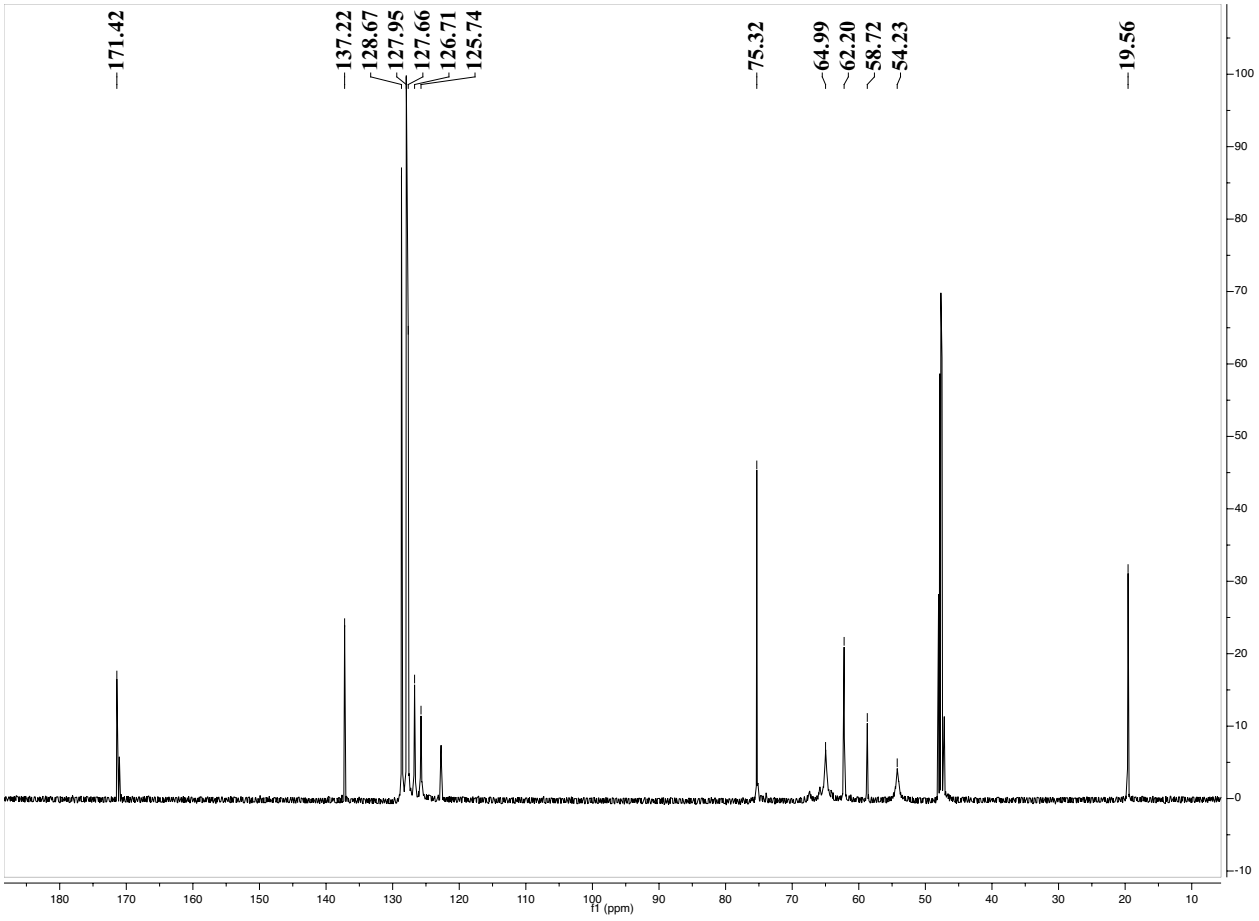

OAc
O
N
HO

17


7.36 7.35 7.35 7.34 7.34 7.33 7.33 7.32 7.32 7.31 7.31 7.29
5.83 5.82 5.82 5.81 5.75 5.75 5.74
4.81 4.81 4.72 4.71 4.71 4.70 4.70 4.69 4.69 4.67 4.66 4.66 4.64 4.64 4.34 4.33 4.32 4.32 4.31 4.31 4.13
3.76 3.73 3.72 3.72 2.00 2.00
4.63 1.00 0.87 0.88 2.05 0.91 0.85 0.78 1.11 1.23 0.99 2.85
f1 (ppm)


OAc
O
N
HO

17


171.42
137.22
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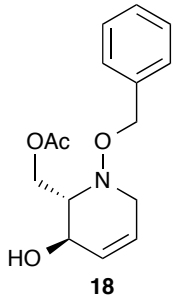
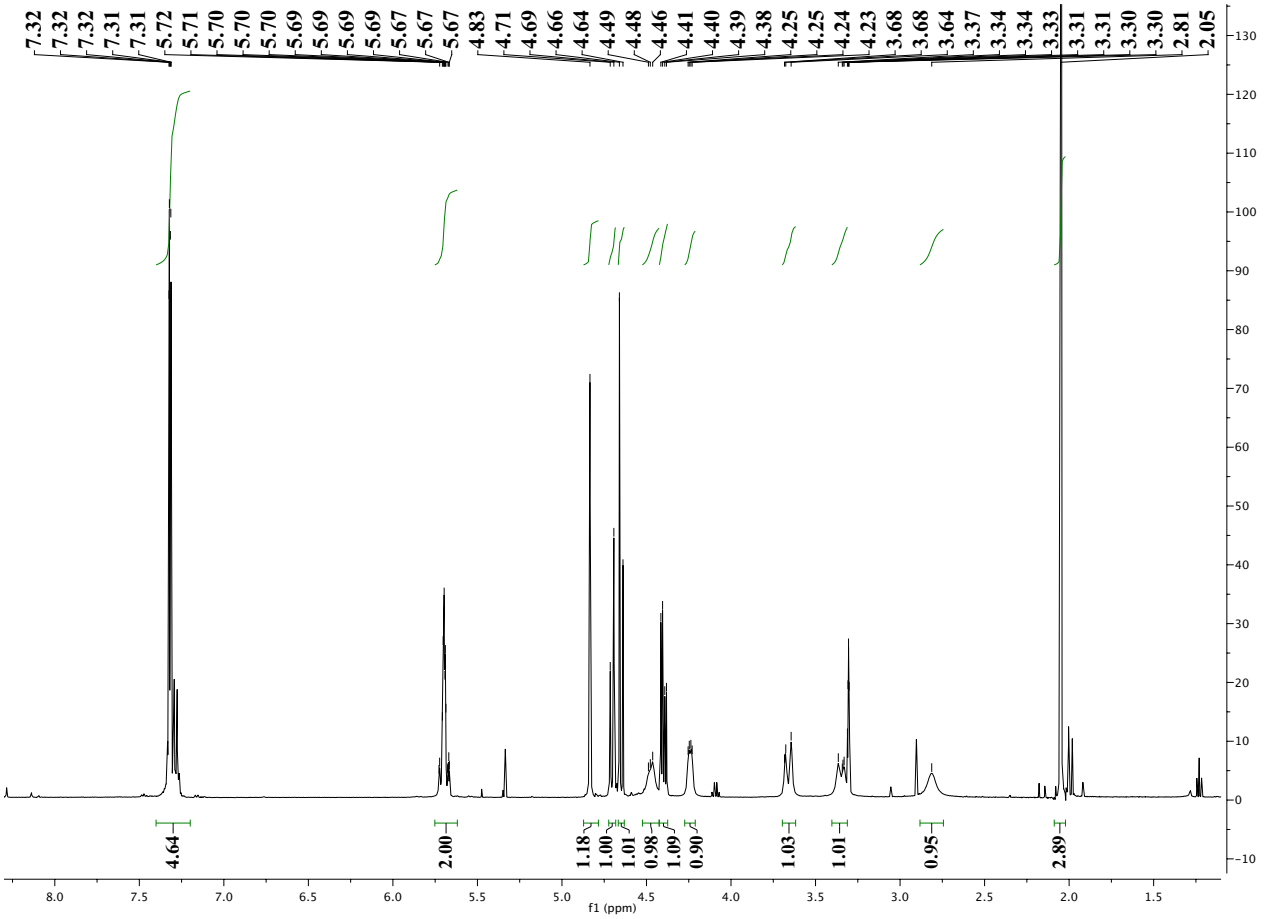
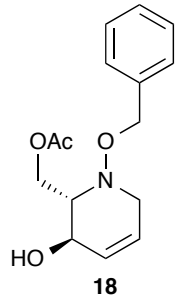
127.95
127.66
126.71
125.74
75.32
64.99
62.20
58.72
54.23
19.56
f1 (ppm)

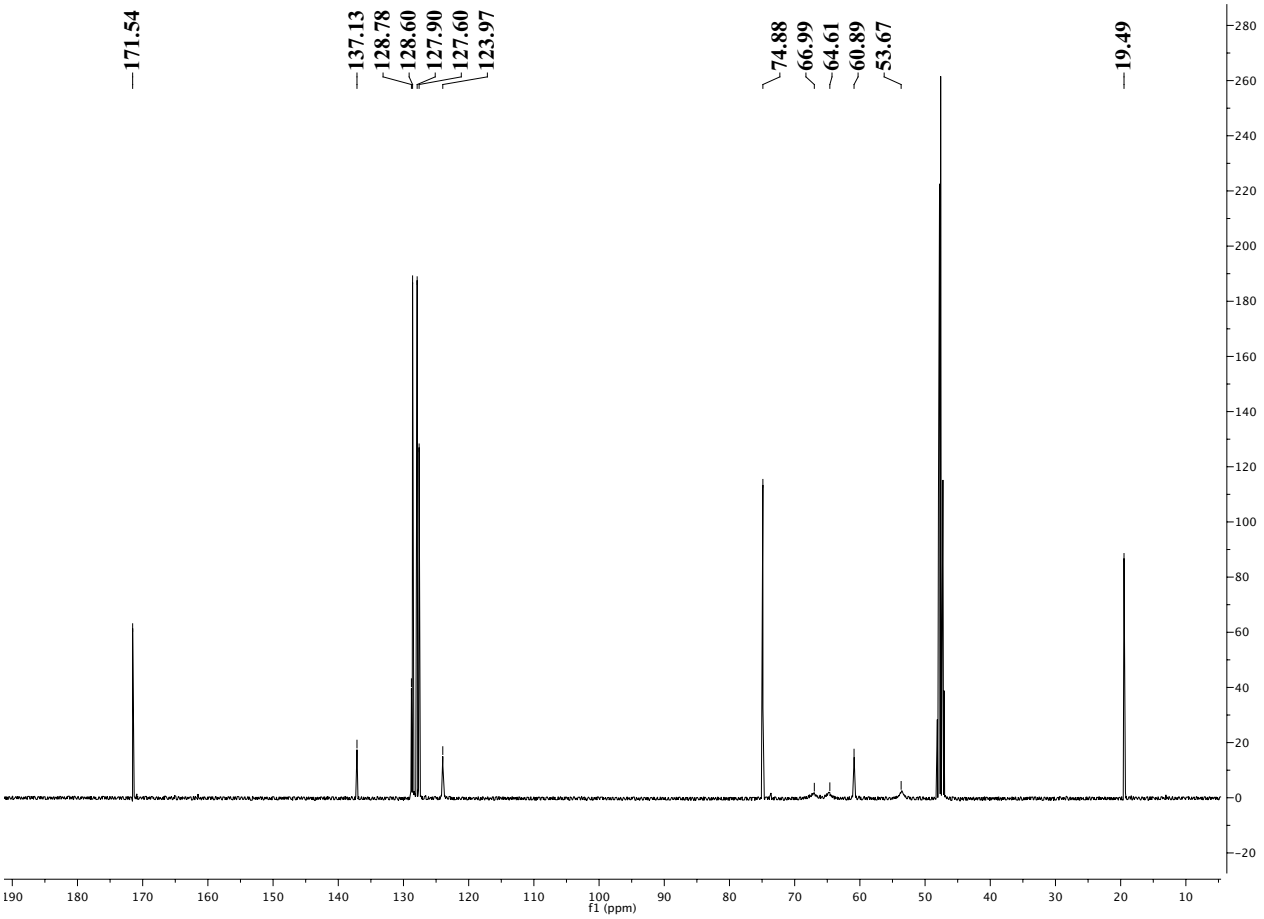

OAc
O
N
HO

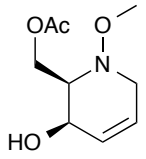
18


7.32 7.32 7.32 7.31 7.31 5.72 5.71 5.70 5.70 5.70 5.69 5.69 5.69 5.69 5.67 5.67 5.67
4.83 4.71 4.69 4.66 4.64 4.49 4.48 4.46 4.41 4.40 4.39 4.38 4.25 4.25 4.24 4.23 3.68 3.68 3.64 3.37 3.34 3.34 3.33 3.31 3.31 3.30 3.30 2.81 2.05
4.64 2.00 1.18 1.00 1.01 0.98 1.09 0.90 1.03 1.01 0.95 2.89
f1 (ppm)

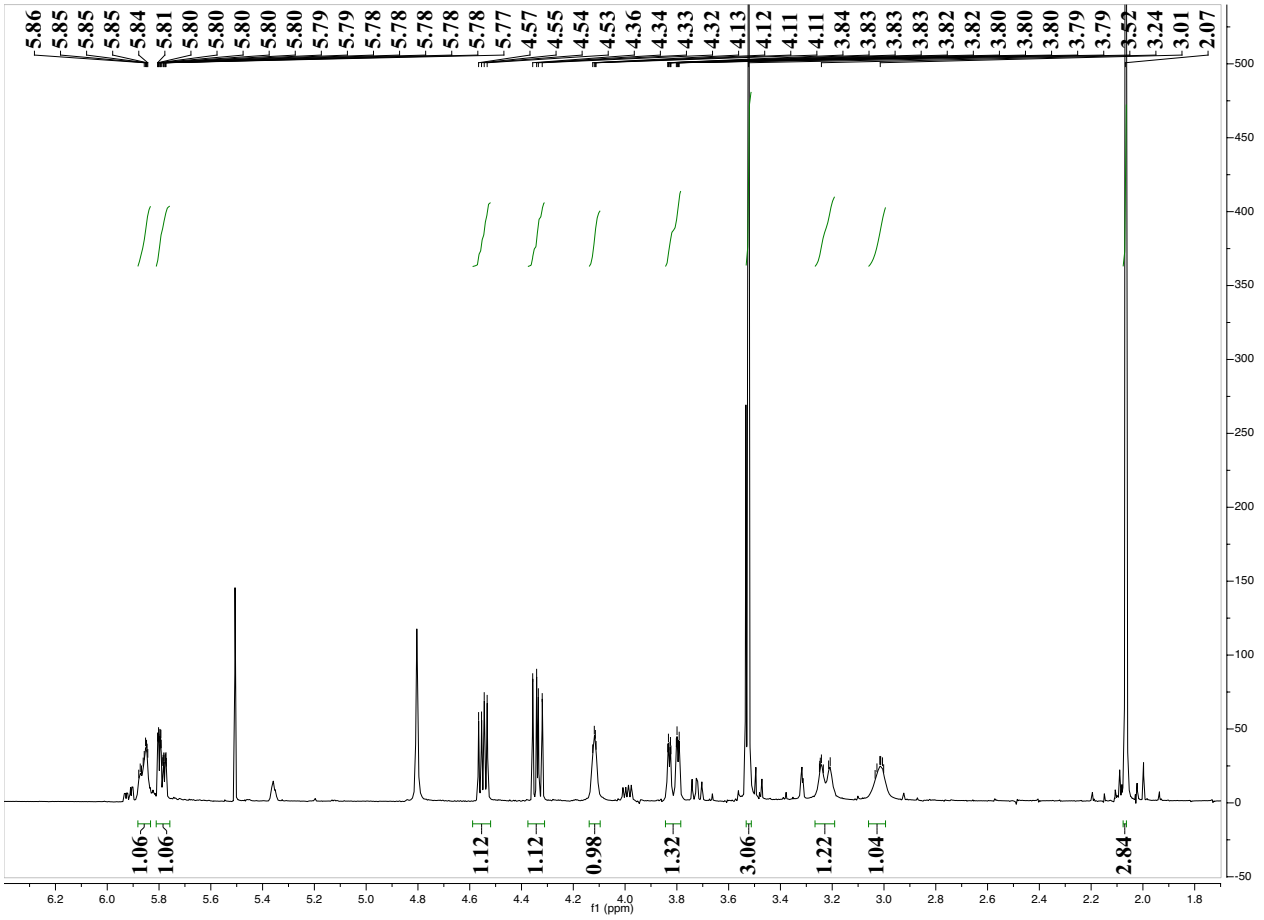

OAc
O
N
HO

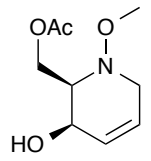
18


171.54
137.13
128.78
128.60
127.90
127.60
123.97
74.88
66.99
64.61
60.89
53.67
19.49
f1 (ppm)

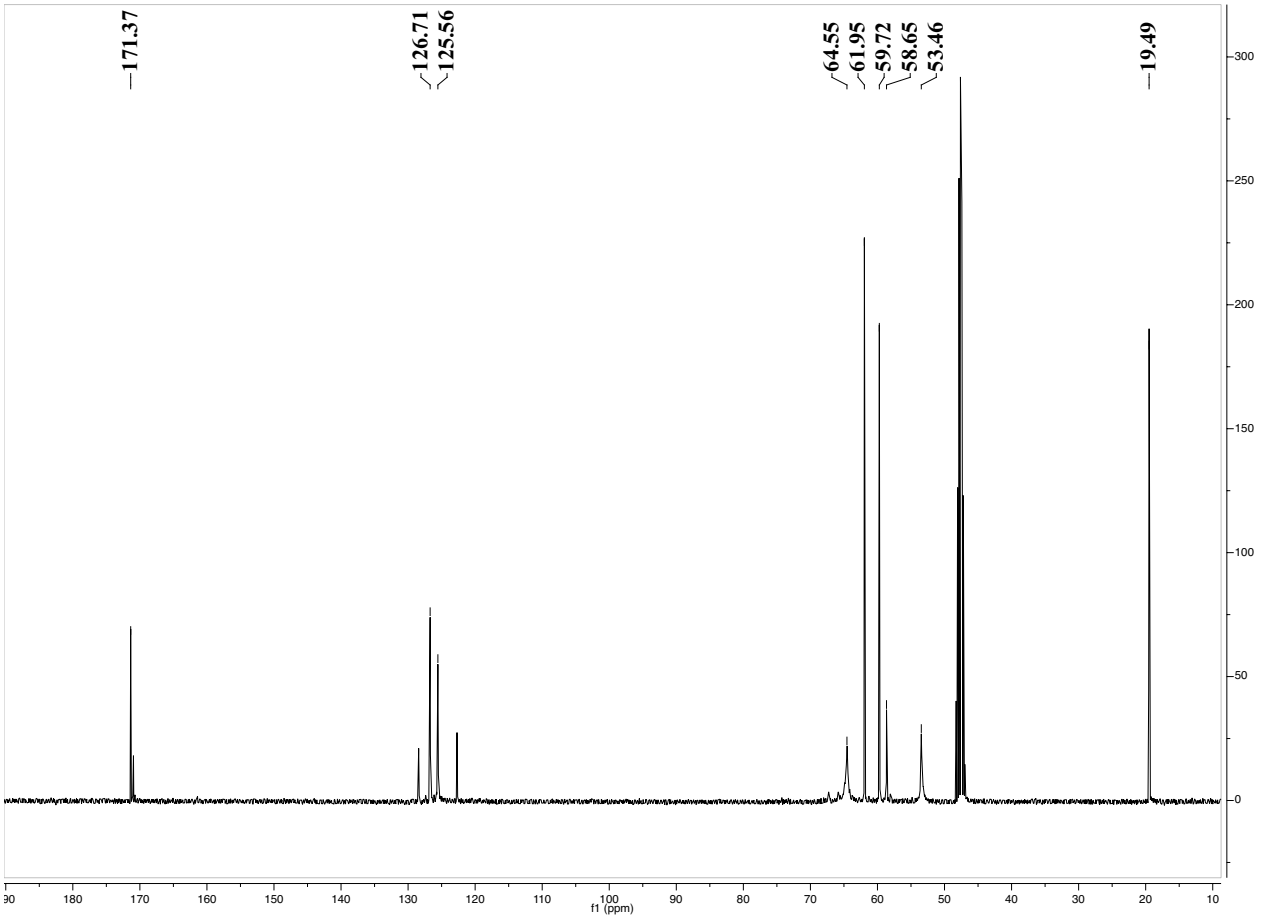

OAc
O
N
HO

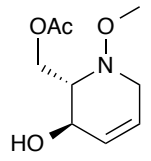
19


5.86 5.85 5.85 5.85 5.84 5.81 5.80 5.80 5.80 5.80 5.80 5.79 5.79 5.78 5.78 5.78 5.78 5.78 5.77 4.57 4.55 4.54 4.53 4.36 4.34 4.33 4.32 4.13 4.12 4.11 4.11 3.84 3.83 3.83 3.83 3.82 3.82 3.80 3.80 3.80 3.79 3.79 3.52 3.24 3.01 2.07
1.06 1.06 1.12 1.12 0.98 1.32 3.06 1.22 1.04 2.84
f1 (ppm)

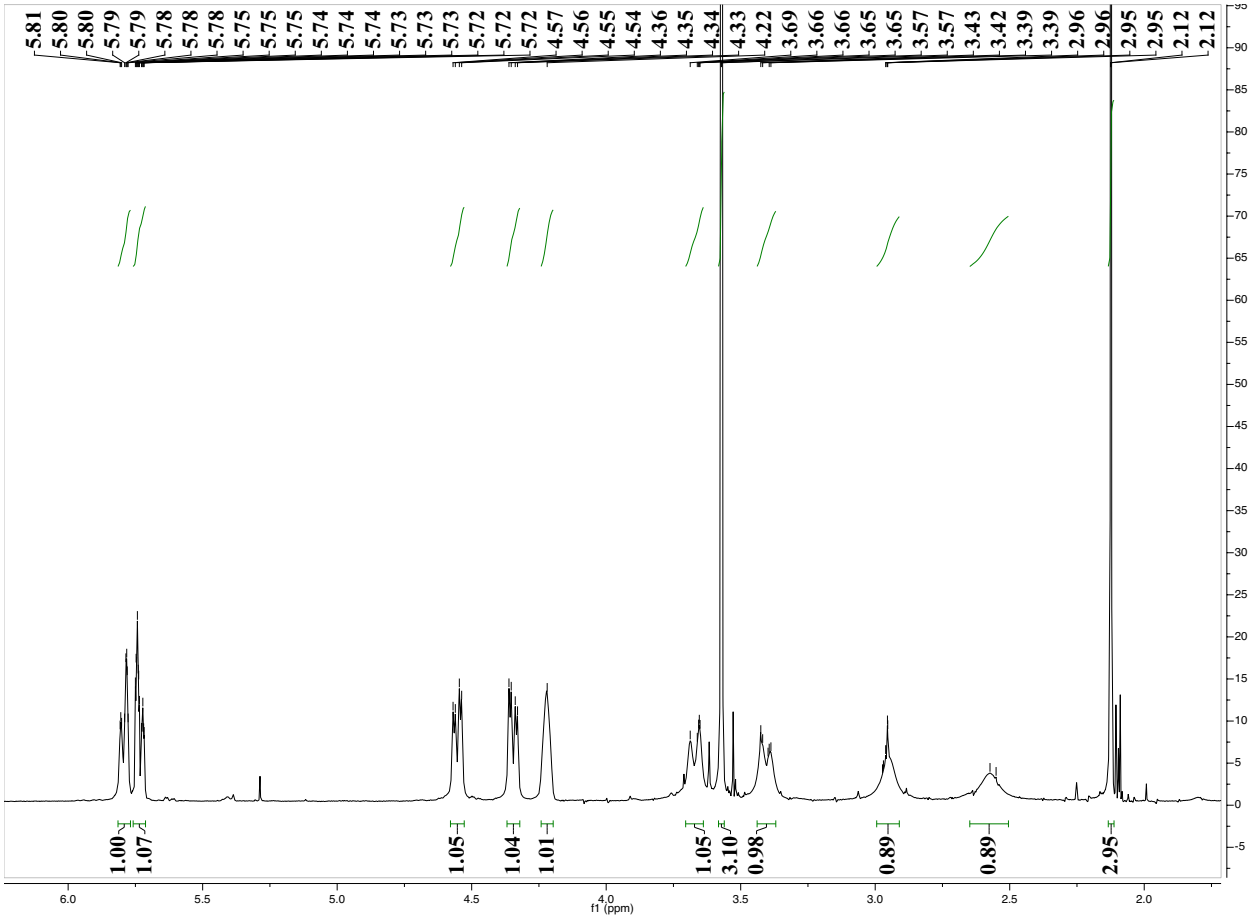

OAc
O
N
HO

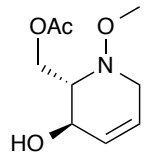
19


171.37
126.71
125.56
64.55
61.95
59.72
58.65
53.46
19.49
300
250
200
150
100
50
0
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

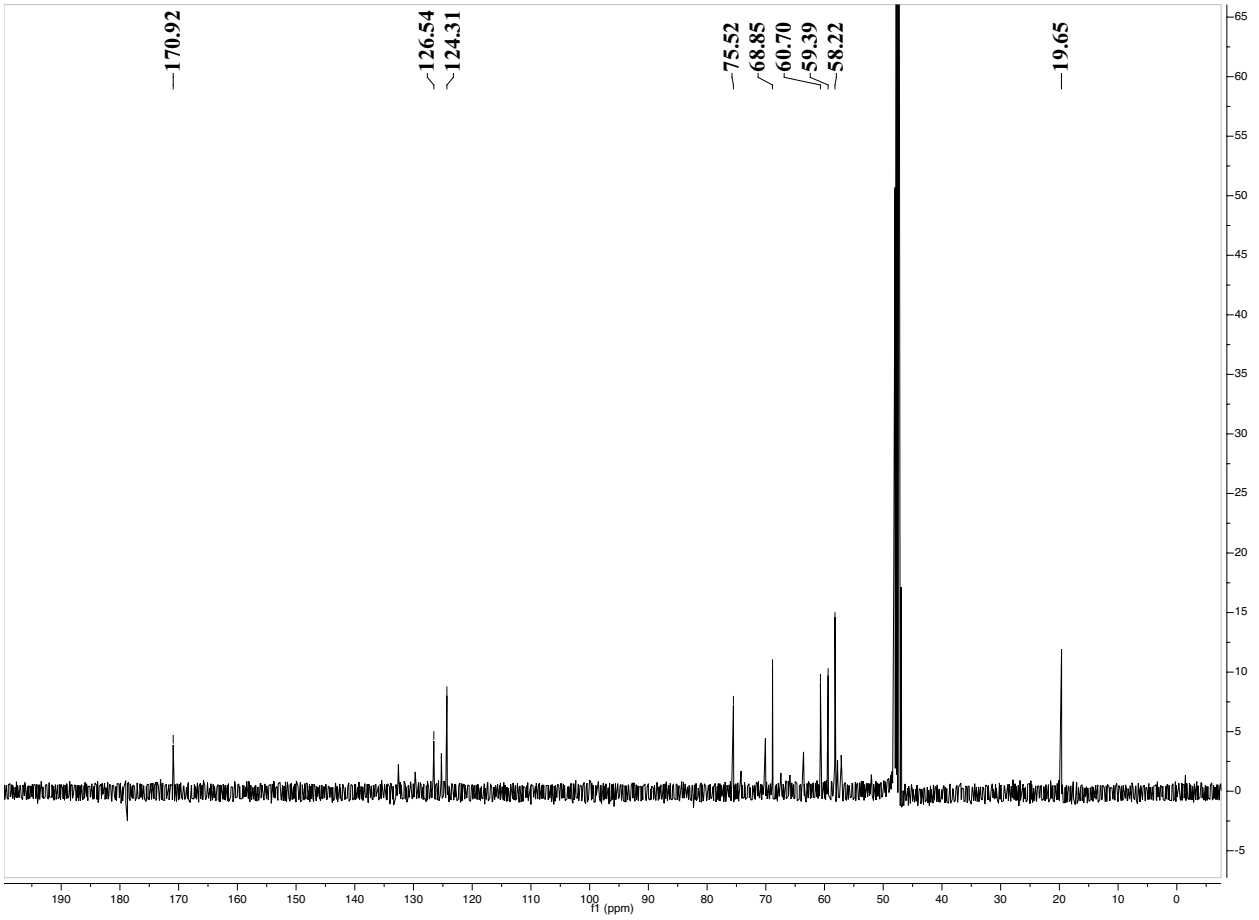

OAc
O
N
HO

20


5.81 5.80 5.80 5.79 5.79 5.78 5.78 5.78 5.75 5.75 5.75 5.74 5.74 5.74 5.73 5.73 5.73 5.72 5.72 5.72 4.57 4.56 4.55 4.54 4.36 4.35 4.34 4.33 4.22 3.69 3.66 3.66 3.65 3.65 3.57 3.57 3.43 3.42 3.39 3.39 2.96 2.96 2.95 2.95 2.12 2.12
1.00 1.07 1.05 1.04 1.01 1.05 3.10 0.98 0.89 0.89 2.95
f1 (ppm)


OAc
O
N
HO

20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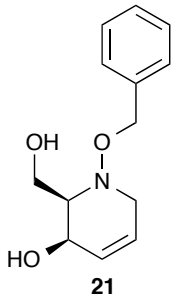
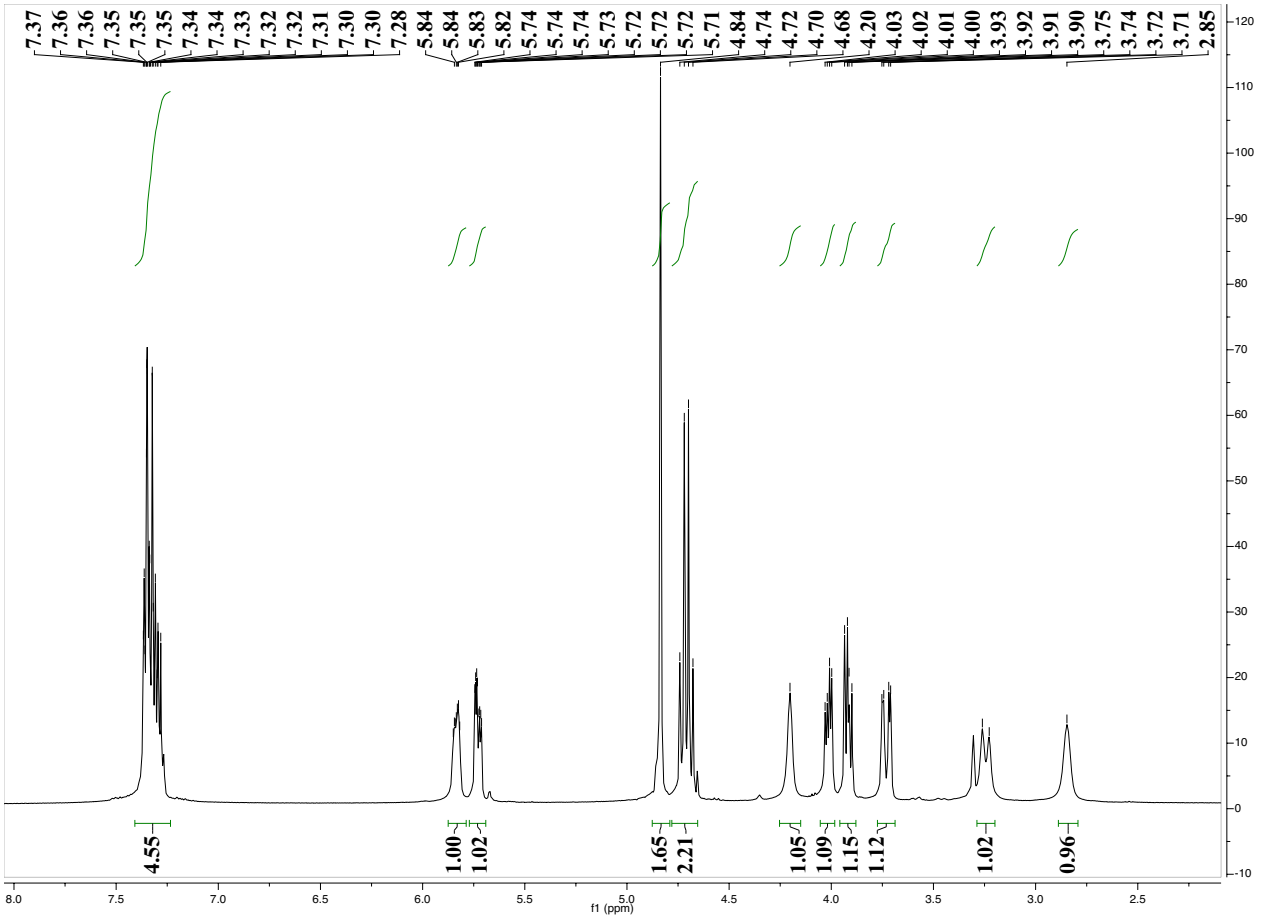
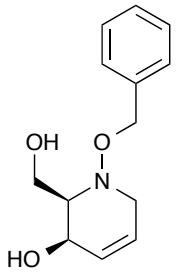
126.54
124.31
75.52
68.85
60.70
59.39
58.22
19.65
f1 (ppm)

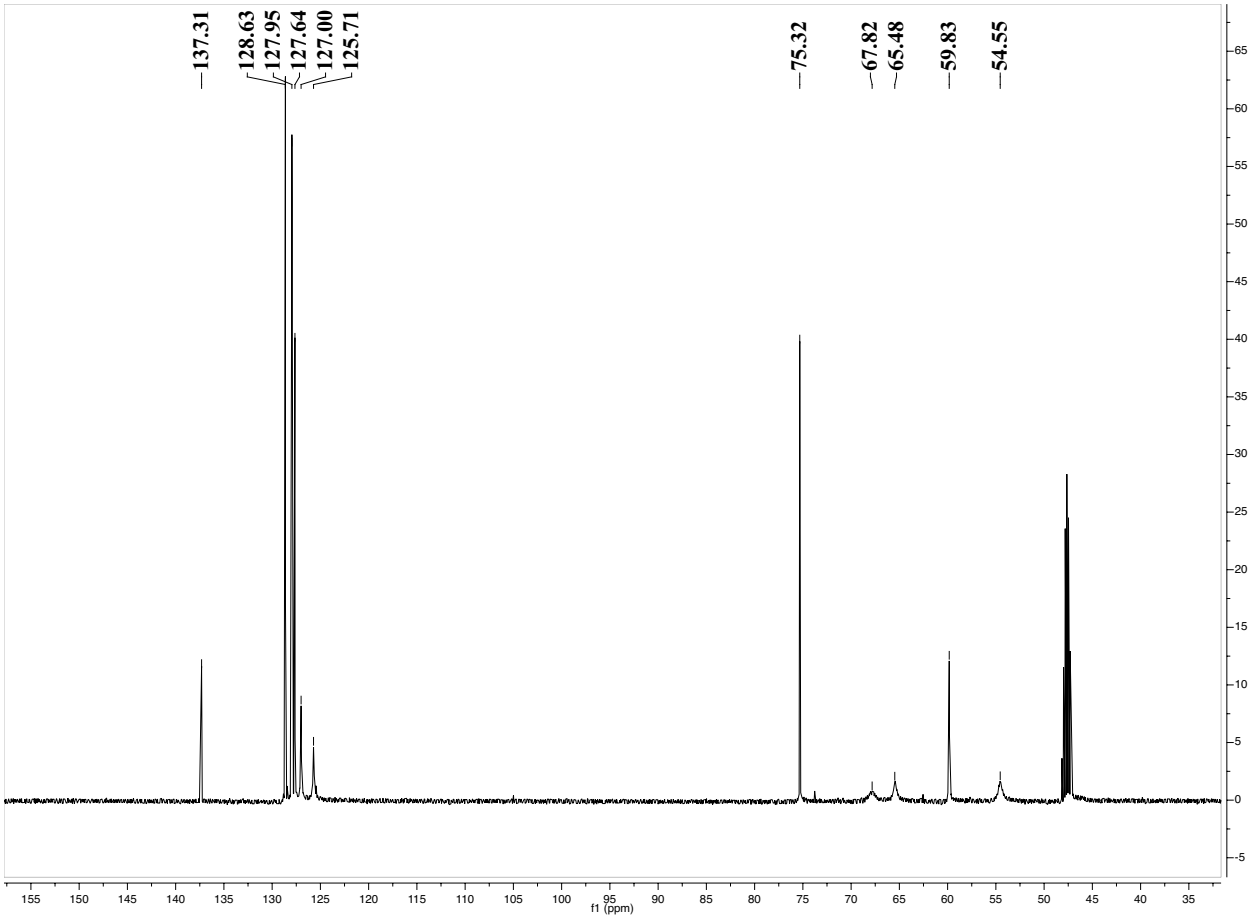

OH
O
N
HO

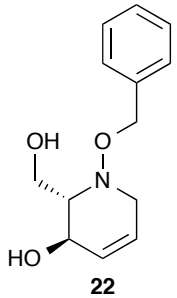
21


7.37 7.36 7.36 7.35 7.35 7.35 7.34 7.34 7.33 7.32 7.32 7.31 7.30 7.30 7.28
5.84 5.84 5.83 5.82 5.74 5.74 5.74 5.73 5.72 5.72 5.72 5.71
4.84 4.74 4.72 4.70 4.68 4.20 4.03 4.02 4.01 4.00 3.93 3.92 3.91 3.90 3.75 3.74 3.72 3.71 2.85
4.55
1.00
1.02
1.65
2.21
1.05
1.09
1.15
1.12
1.02
0.96
f1 (ppm)

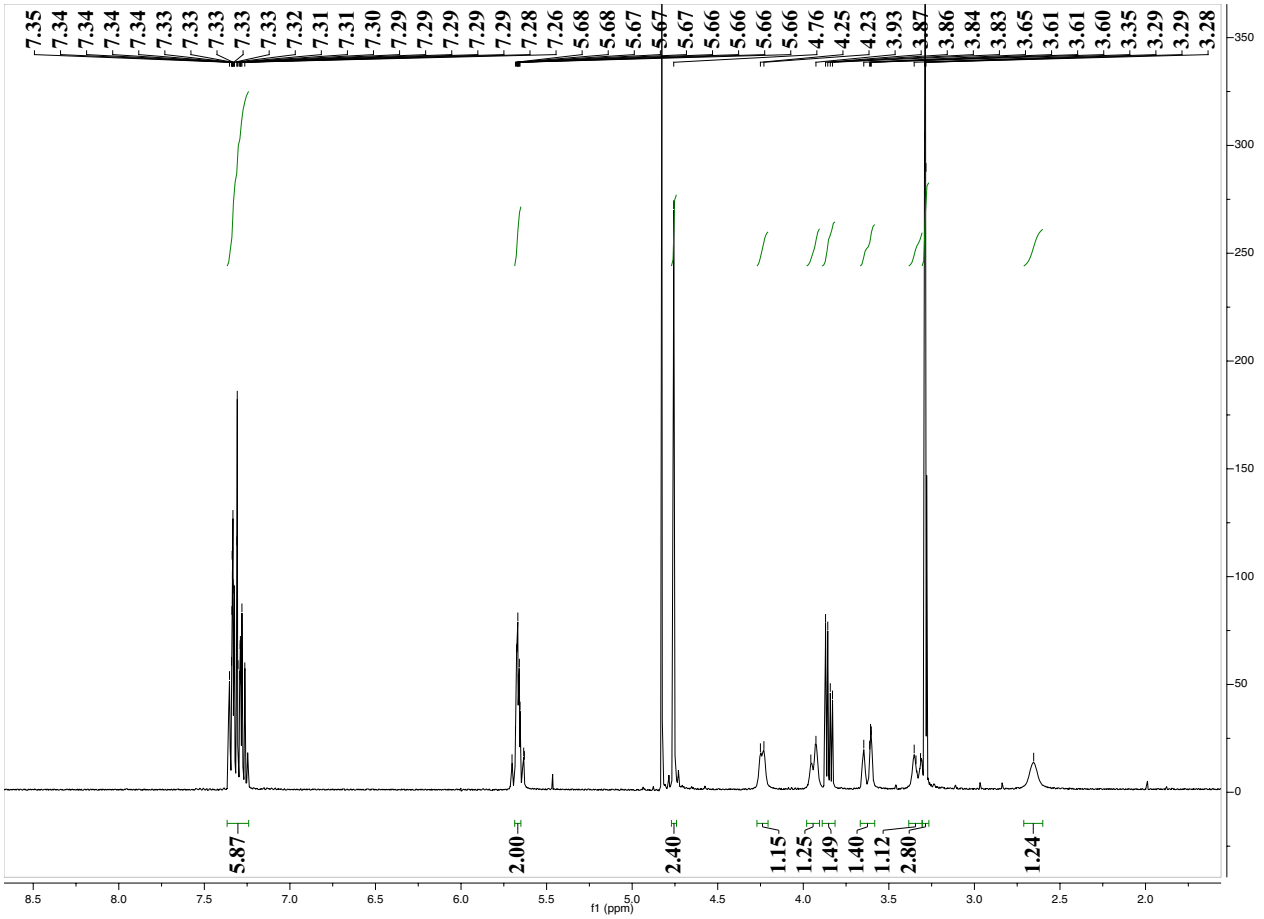

OH
O
N
HO

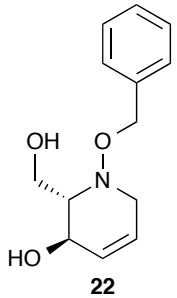
21


137.31
128.63
127.95
127.64
127.00
125.71
75.32
67.82
65.48
59.83
54.55
f1 (ppm)

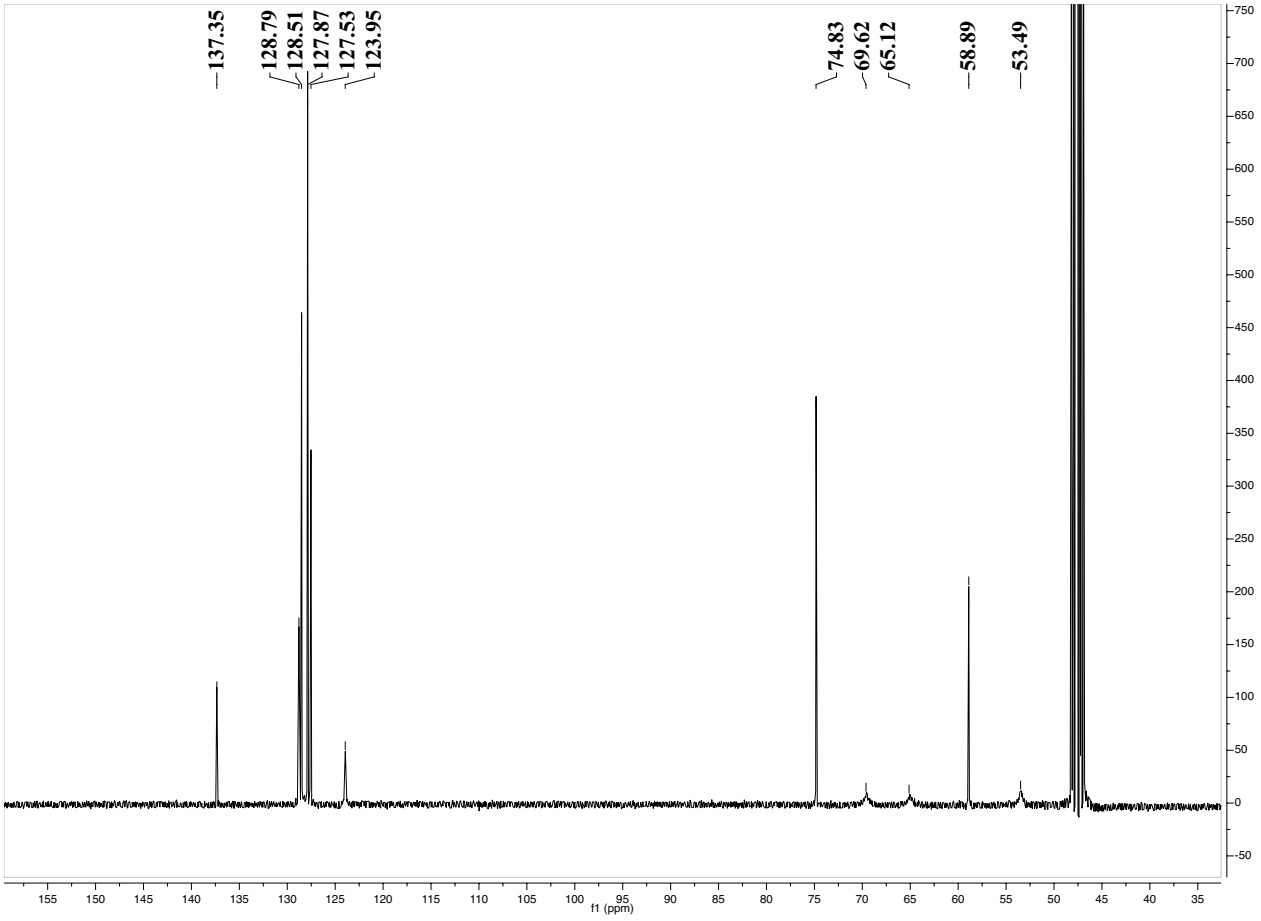

OH
O
N
HO

22


7.35 7.34 7.34 7.34 7.34 7.33 7.33 7.33 7.33 7.33 7.32 7.31 7.31 7.30 7.29 7.29 7.29 7.29 7.29 7.28 7.26 5.68 5.68 5.67 5.67 5.67 5.66 5.66 5.66 5.66 4.76 4.25 4.23 3.93 3.87 3.86 3.84 3.83 3.65 3.61 3.61 3.60 3.35 3.29 3.29 3.28
5.87
2.00
2.40
1.15
1.25
1.49
1.40
1.12
2.80
1.24
f1 (ppm)


OH
O
N
HO

22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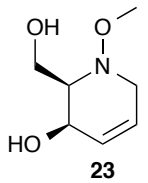
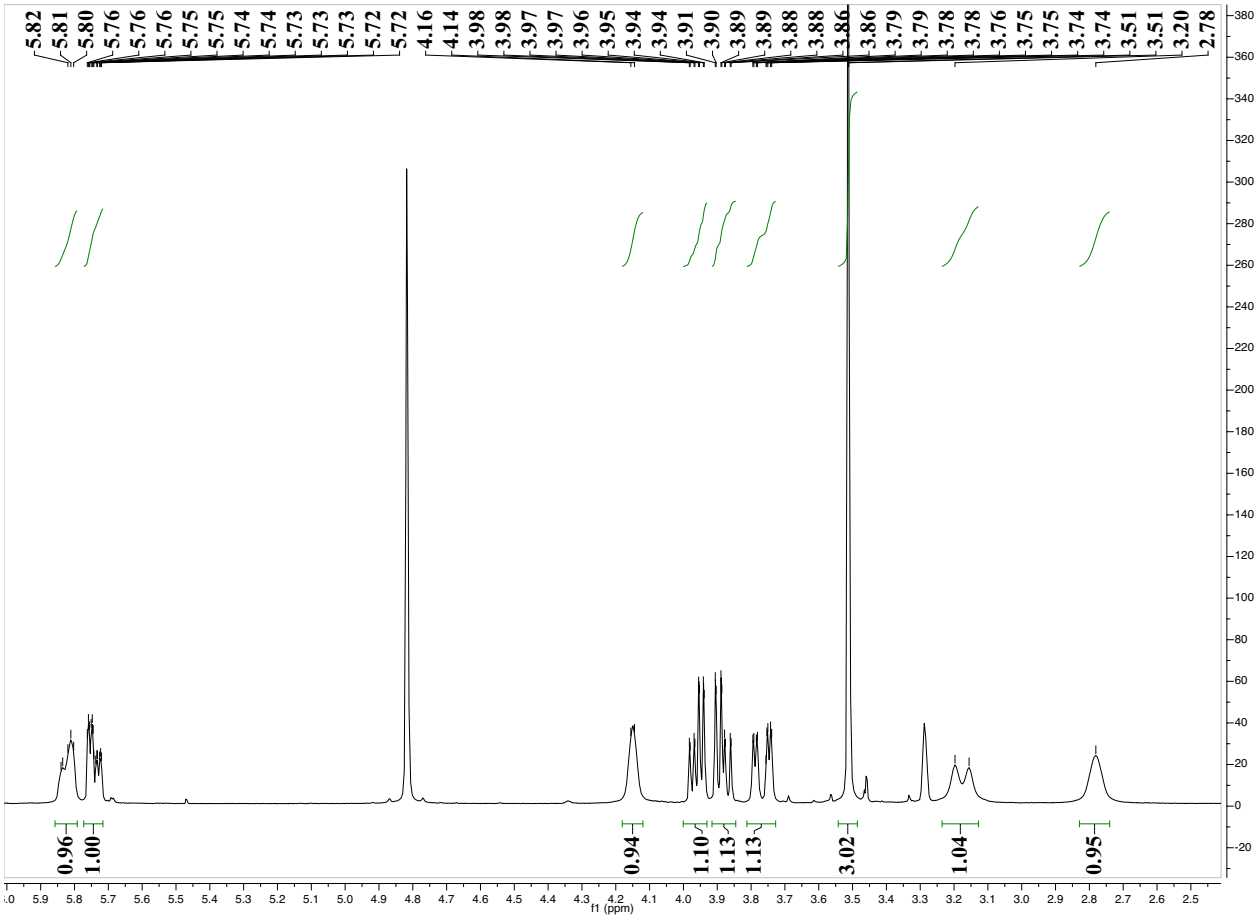
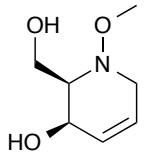
128.79
128.51
127.87
127.53
123.95
74.83
69.62
65.12
58.89
53.49
f1 (ppm)

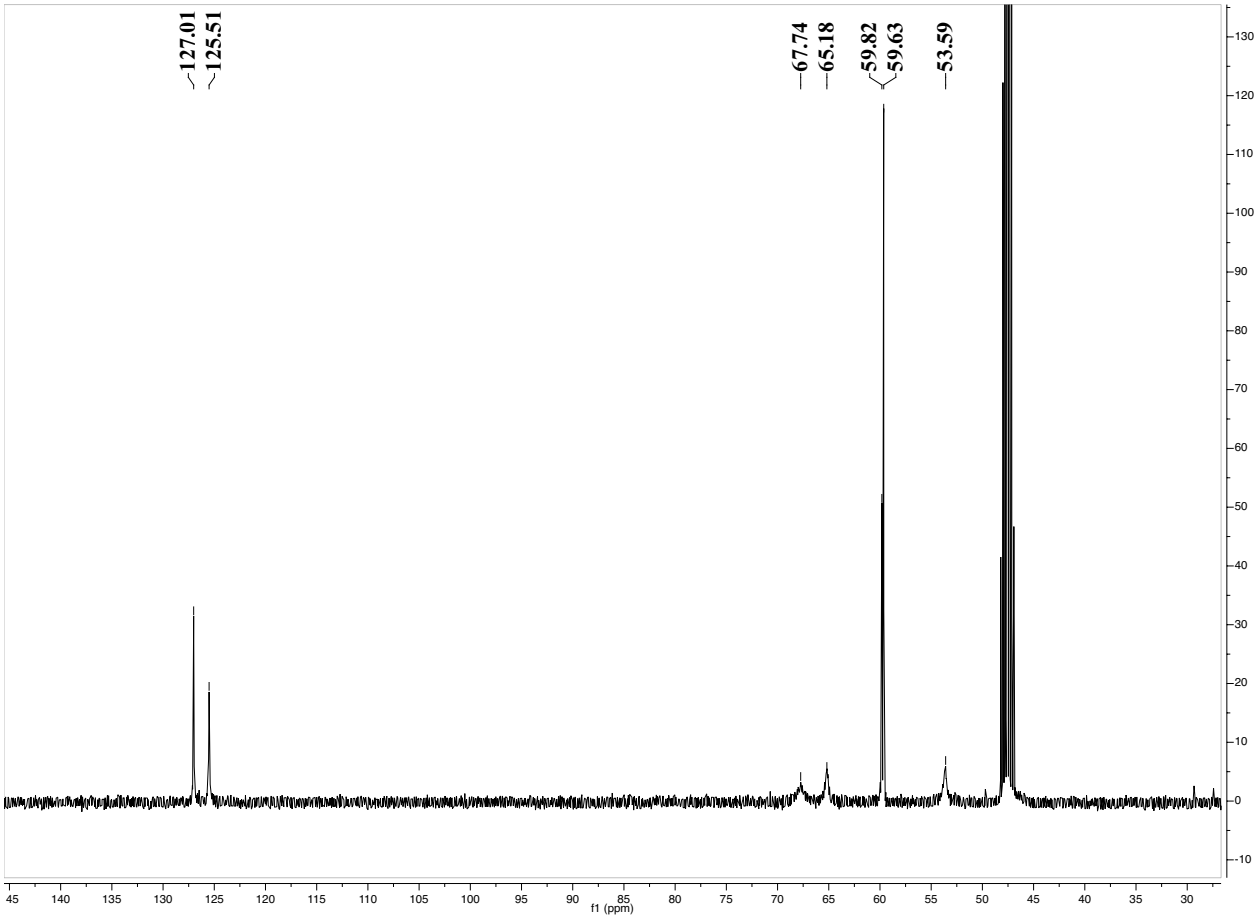

OH
O
N
HO

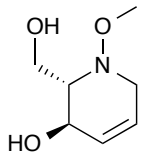
23


5.82 5.81 5.80 5.76 5.76 5.76 5.75 5.75 5.74 5.74 5.73 5.73 5.73 5.72 5.72
4.16 4.14 3.98 3.98 3.97 3.97 3.96 3.95 3.94 3.94 3.91 3.90 3.89 3.89 3.88 3.88 3.86 3.86 3.79 3.79 3.78 3.78 3.76 3.75 3.75 3.74 3.74 3.51 3.51 3.20 2.78
0.96 1.00 0.94 1.10 1.13 1.13 3.02 1.04 0.95
f1 (ppm)

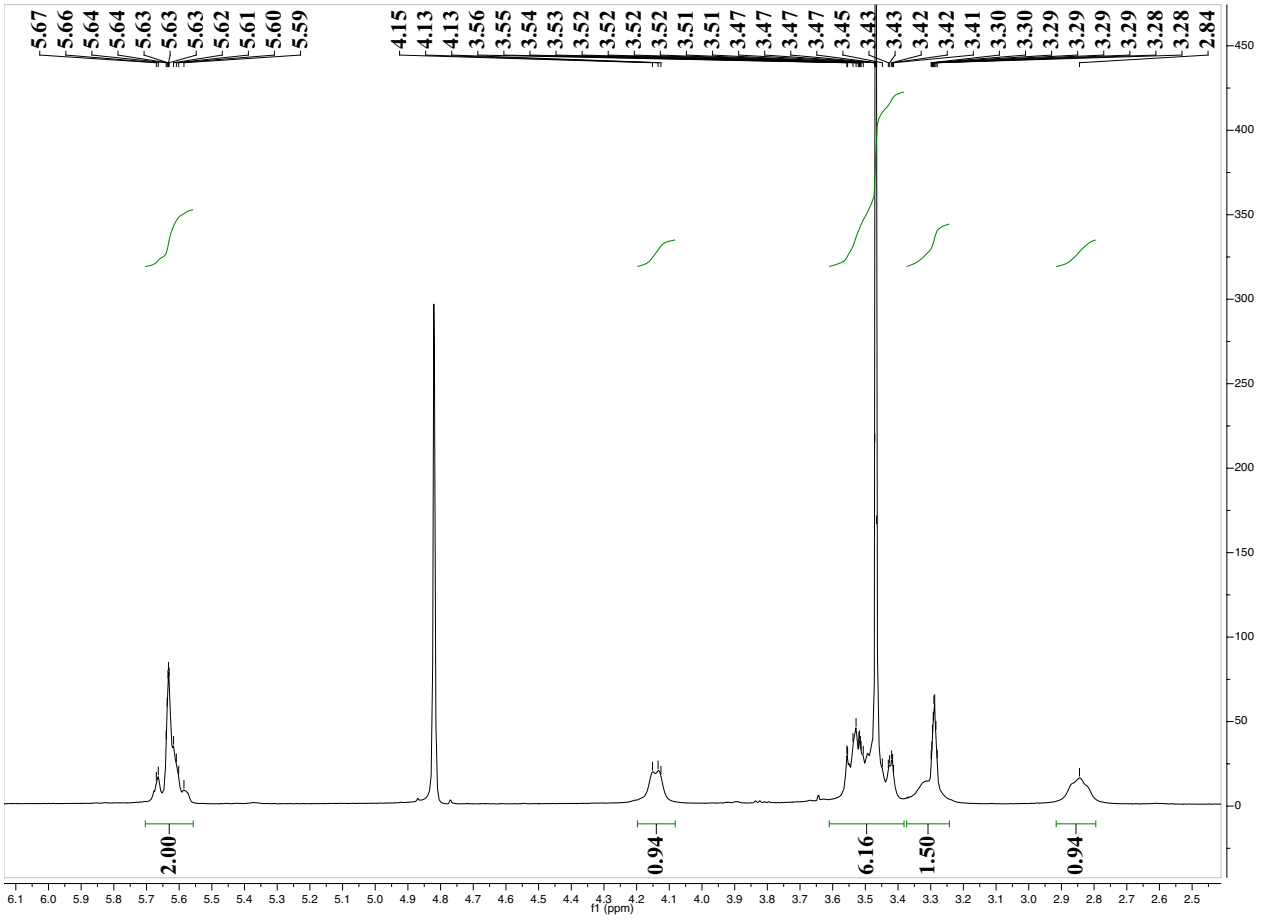


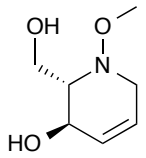
23



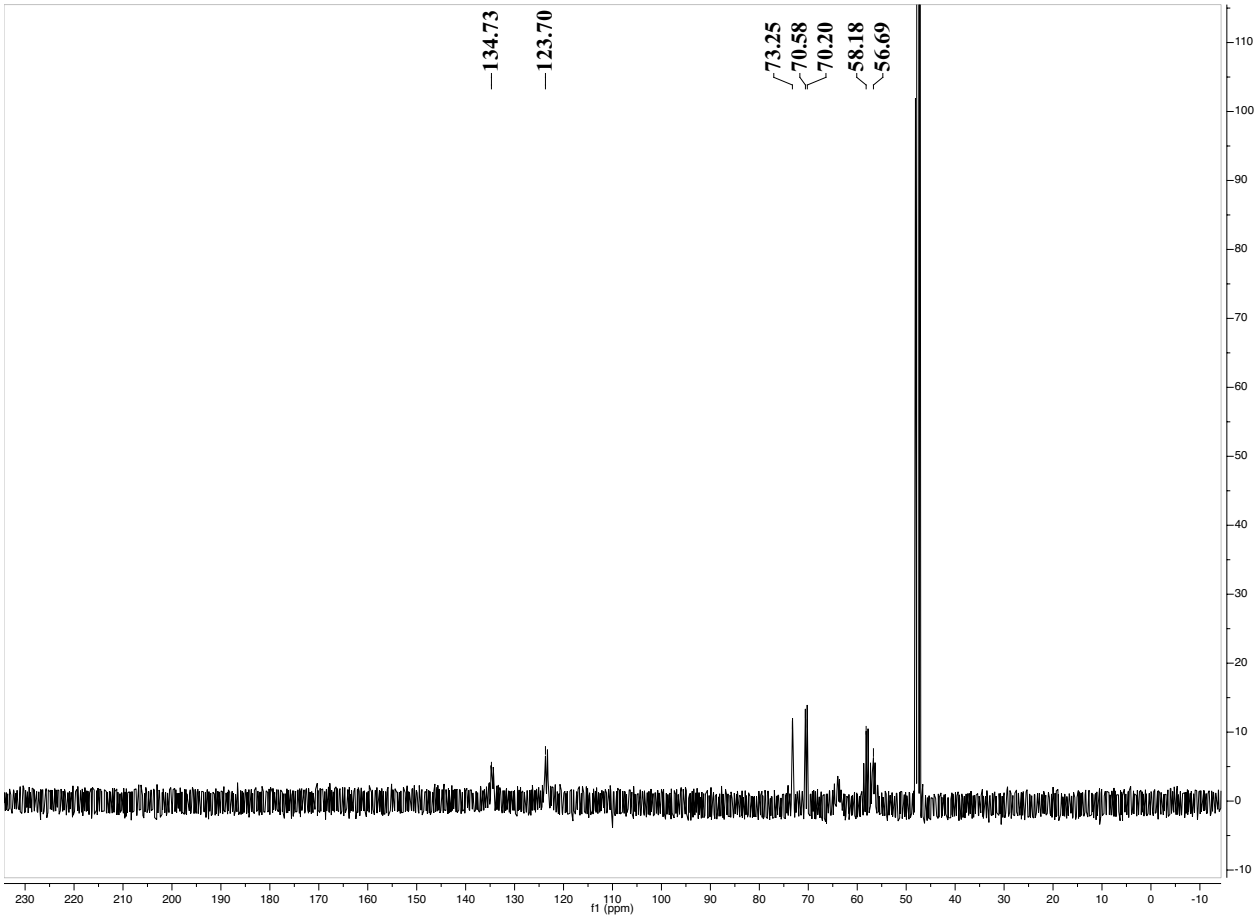

OH
O
N
HO

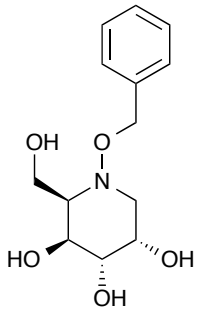
24


5.67 5.66 5.64 5.64 5.63 5.63 5.63 5.62 5.61 5.60 5.59
4.15 4.13 4.13 3.56 3.55 3.54 3.53 3.52 3.52 3.52 3.52 3.51 3.51 3.47 3.47 3.47 3.47 3.45 3.43 3.43 3.42 3.42 3.41 3.30 3.30 3.29 3.29 3.29 3.29 3.28 3.28 2.84
2.00
0.94
6.16
1.50
0.94
f1 (ppm)

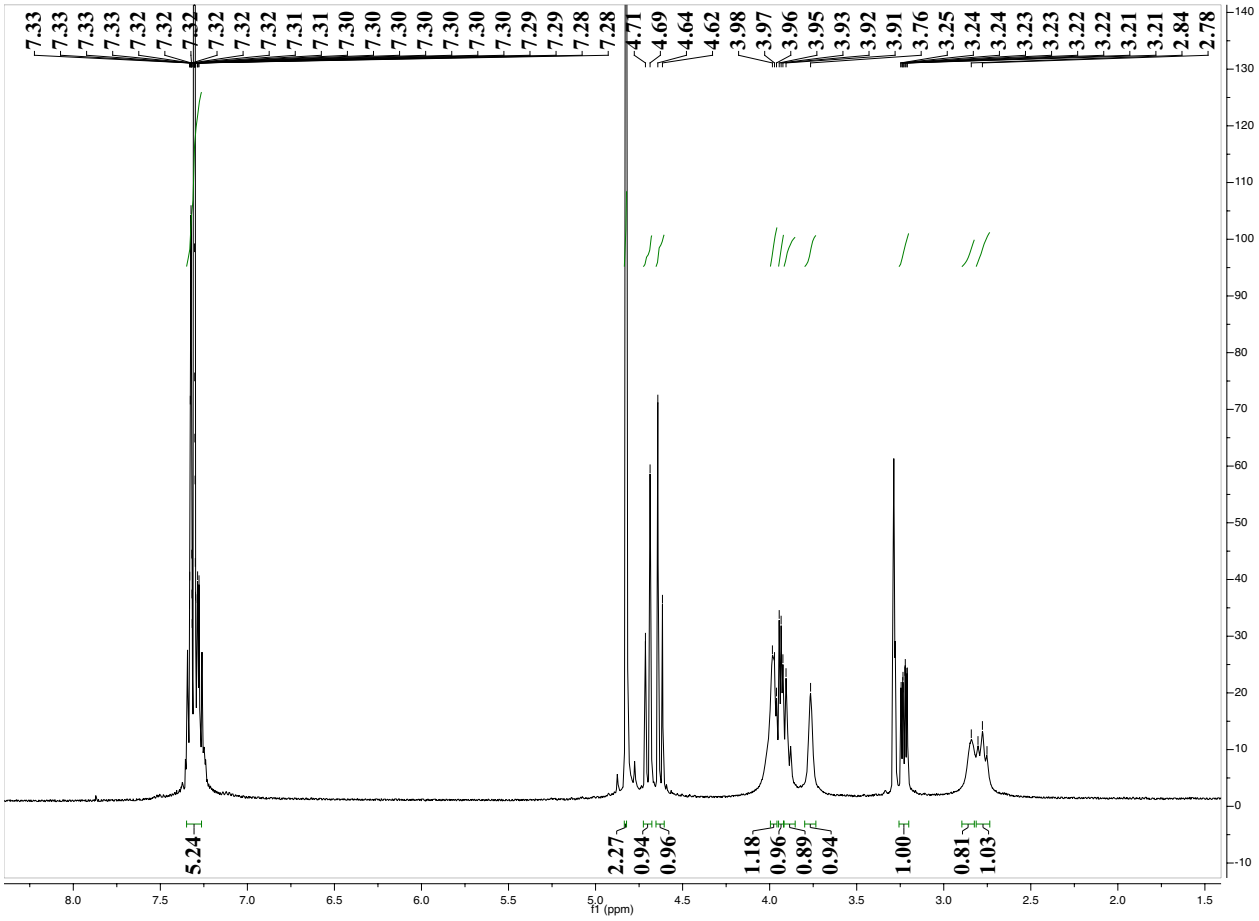


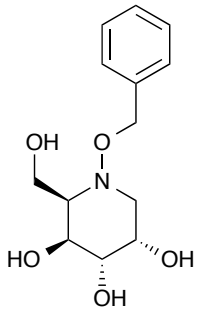
24



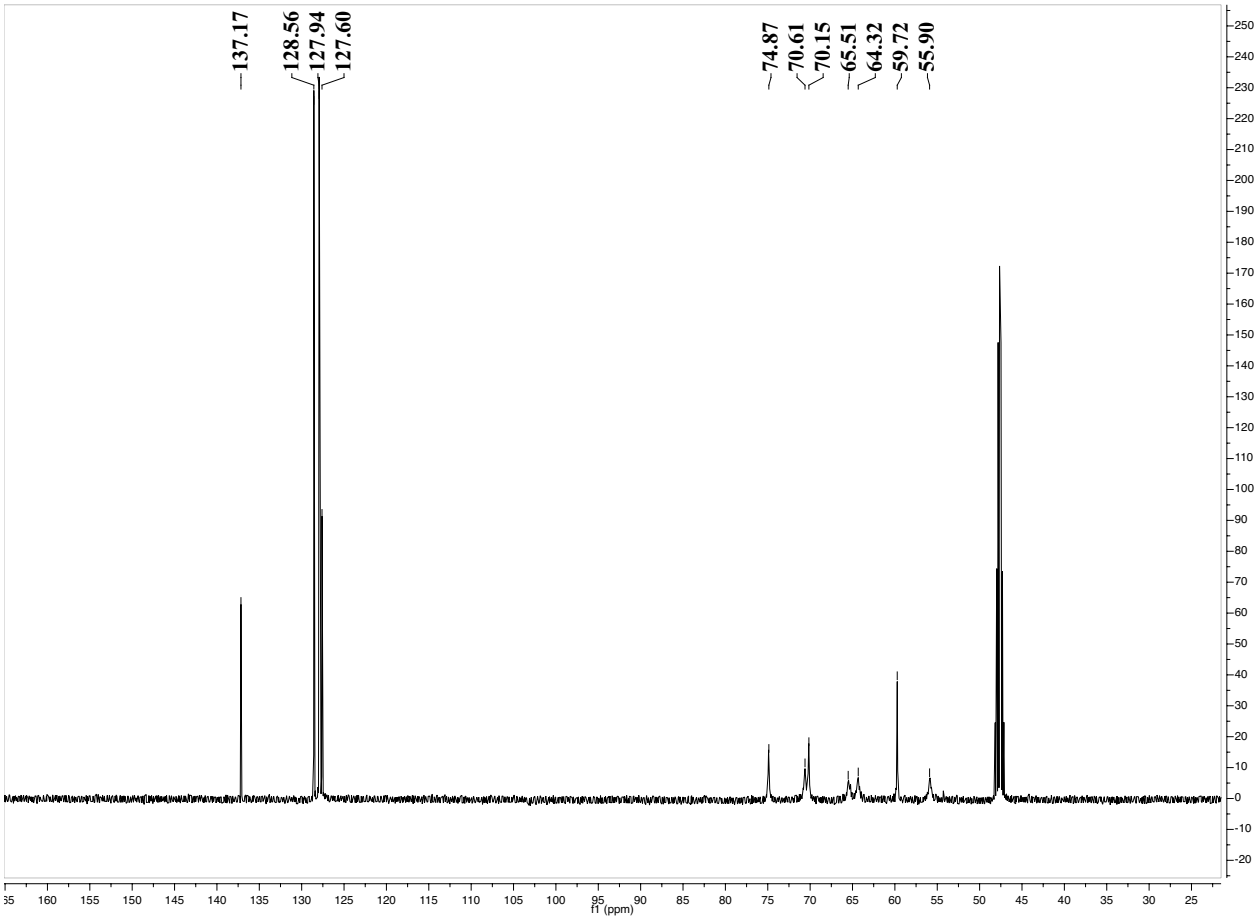

OH
O
N
HO
OH
OH

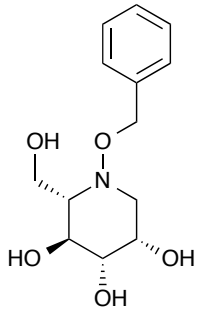
25


7.33 7.33 7.33 7.33 7.32 7.32 7.32 7.32 7.32 7.31 7.31 7.30 7.30 7.30 7.30 7.30 7.30 7.30 7.29 7.29 7.28 7.28
4.71 4.69 4.64 4.62
3.98 3.97 3.96 3.95 3.93 3.92 3.91 3.76 3.25 3.24 3.24 3.23 3.23 3.22 3.22 3.21 3.21 2.84 2.78
5.24 2.27 0.94 0.96 1.18 0.96 0.89 0.94 1.00 0.81 1.03
f1 (ppm)

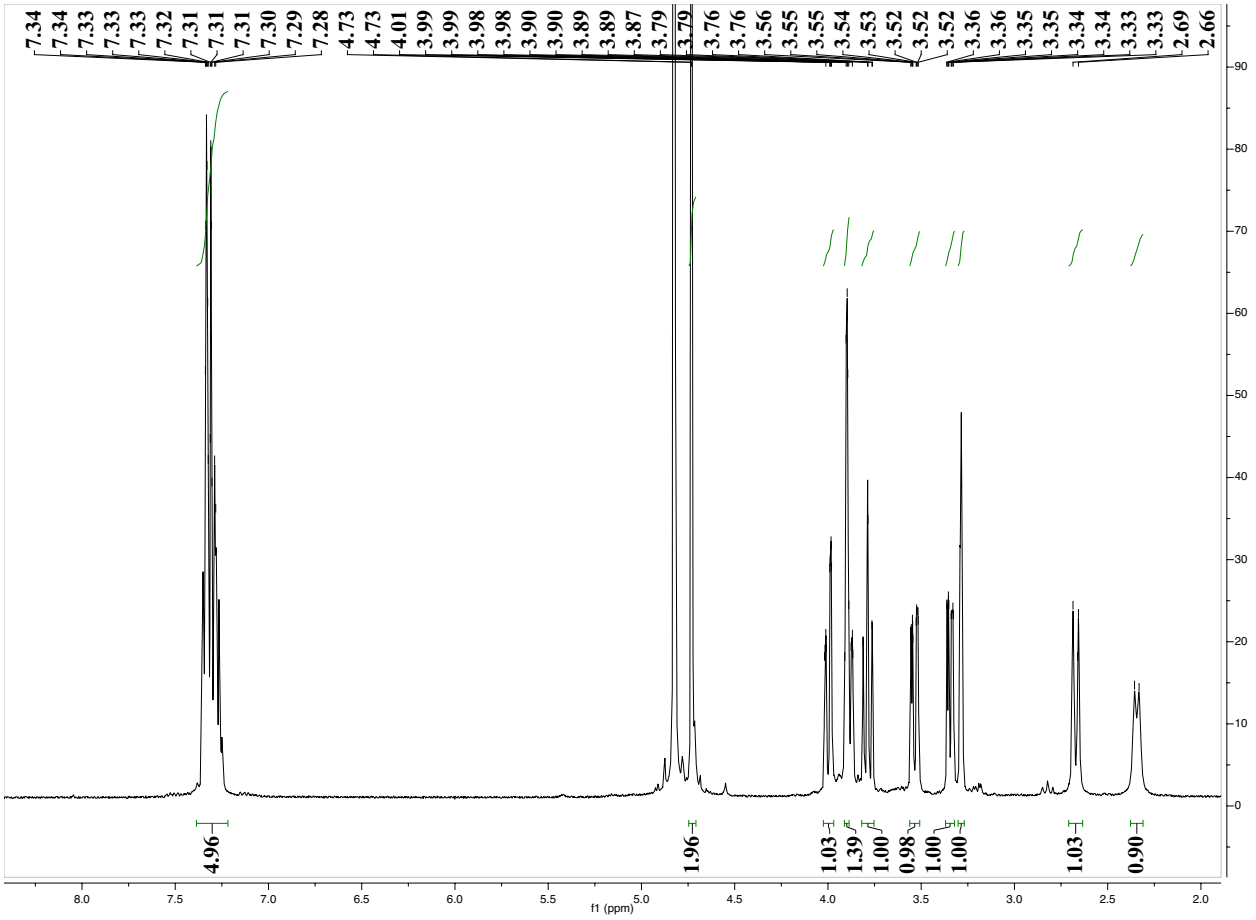

OH
O
N
HO
OH
OH

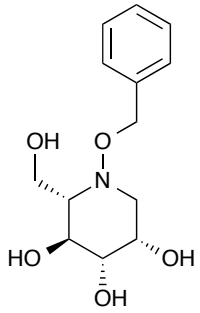
25


137.17
128.56
127.94
127.60
74.87
70.61
70.15
65.51
64.32
59.72
55.90
f1 (ppm)

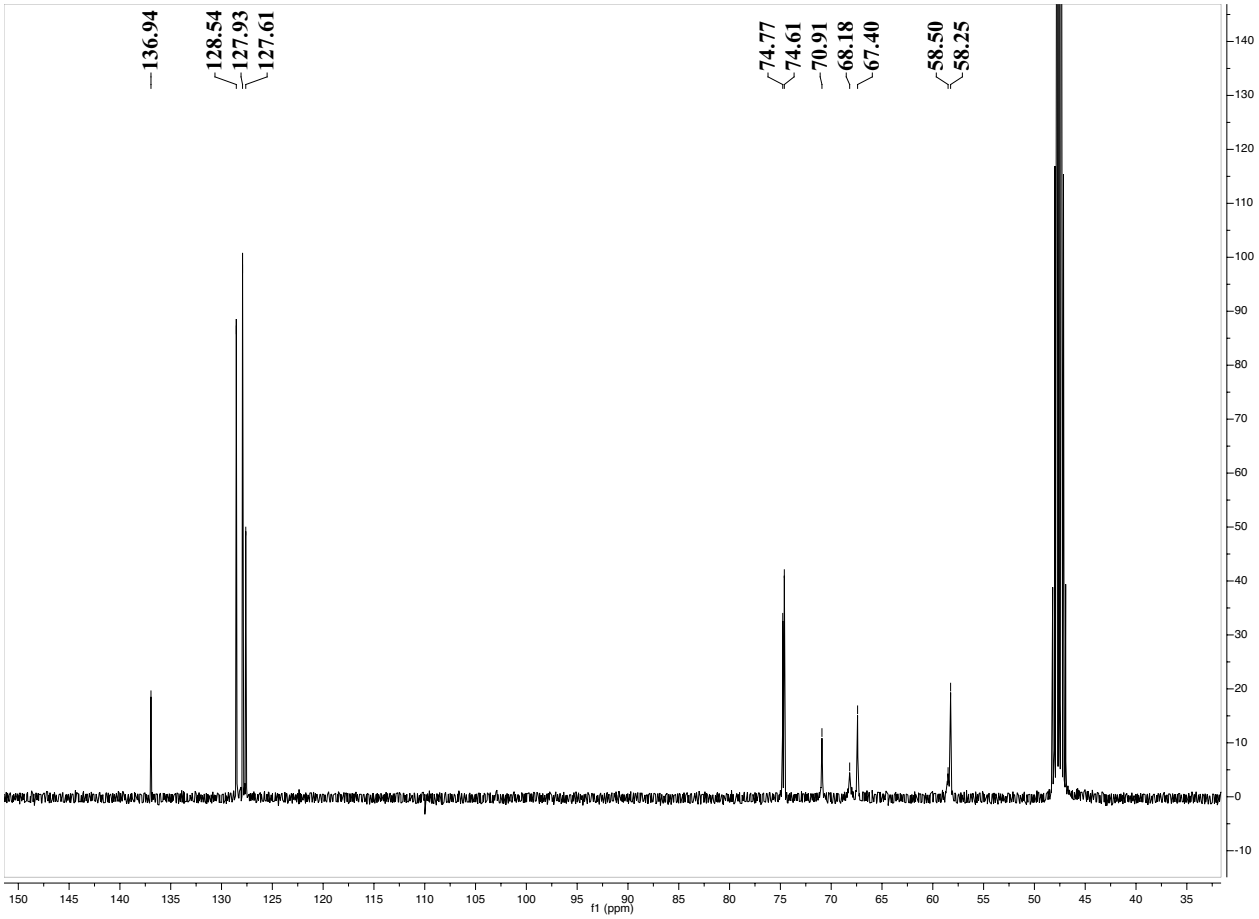

OH
O
N
HO
OH
OH

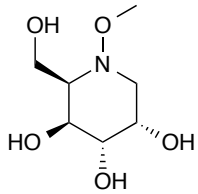
26


7.34 7.34 7.33 7.33 7.33 7.32 7.31 7.31 7.31 7.30 7.29 7.28
4.73 4.73 4.01 3.99 3.99 3.98 3.98 3.90 3.90 3.89 3.89 3.87 3.79 3.79 3.76 3.76 3.56 3.55 3.55 3.54 3.53 3.52 3.52 3.52 3.36 3.36 3.35 3.35 3.34 3.34 3.33 3.33 2.69 2.66
4.96
1.96
1.03
1.39
1.00
0.98
1.00
1.00
1.03
0.90
f1 (ppm)

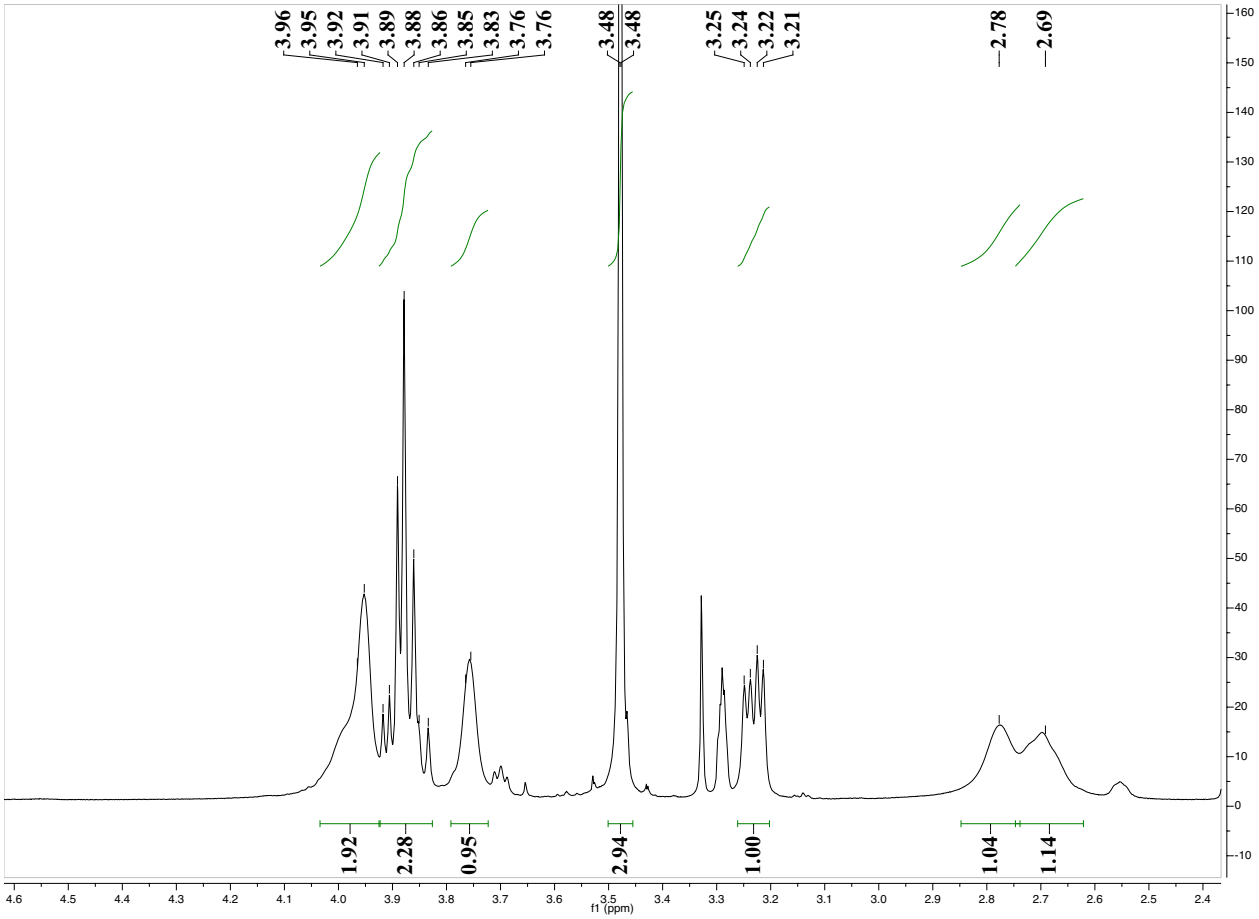

OH
O
N
HO
OH
OH

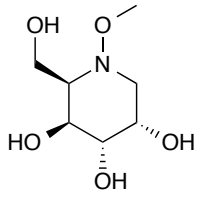
26


136.94
128.54
127.93
127.61
74.77
74.61
70.91
68.18
67.40
58.50
58.25
f1 (ppm)

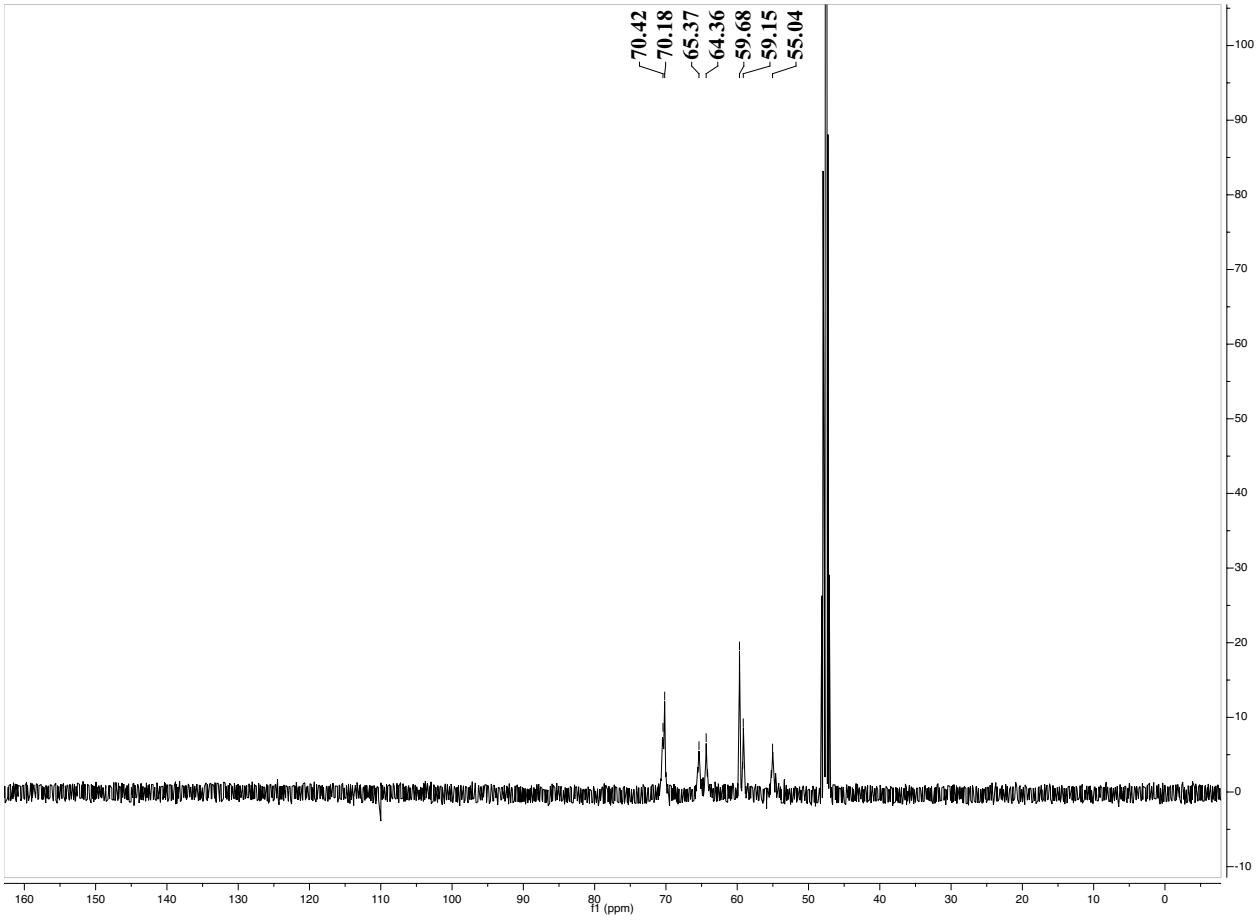

OH
O
N
HO
OH
OH

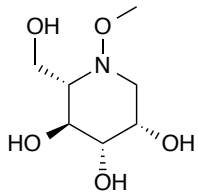
27


3.96
3.95
3.92
3.91
3.89
3.88
3.86
3.85
3.83
3.76
3.76
3.48
3.48
3.25
3.24
3.22
3.21
2.78
2.69
1.92
2.28
0.95
2.94
1.00
1.04
1.14
f1 (ppm)

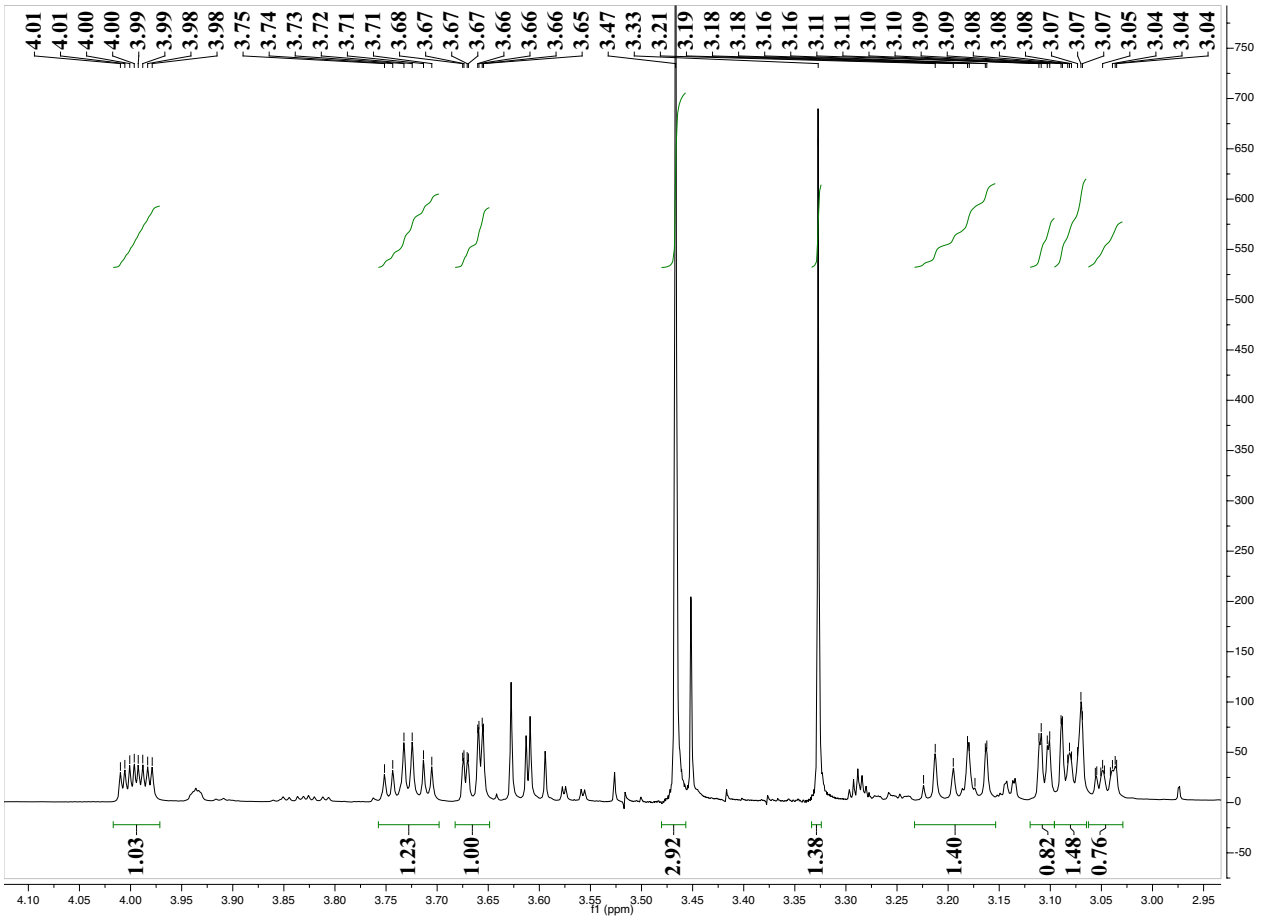


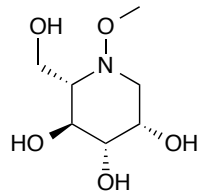
27



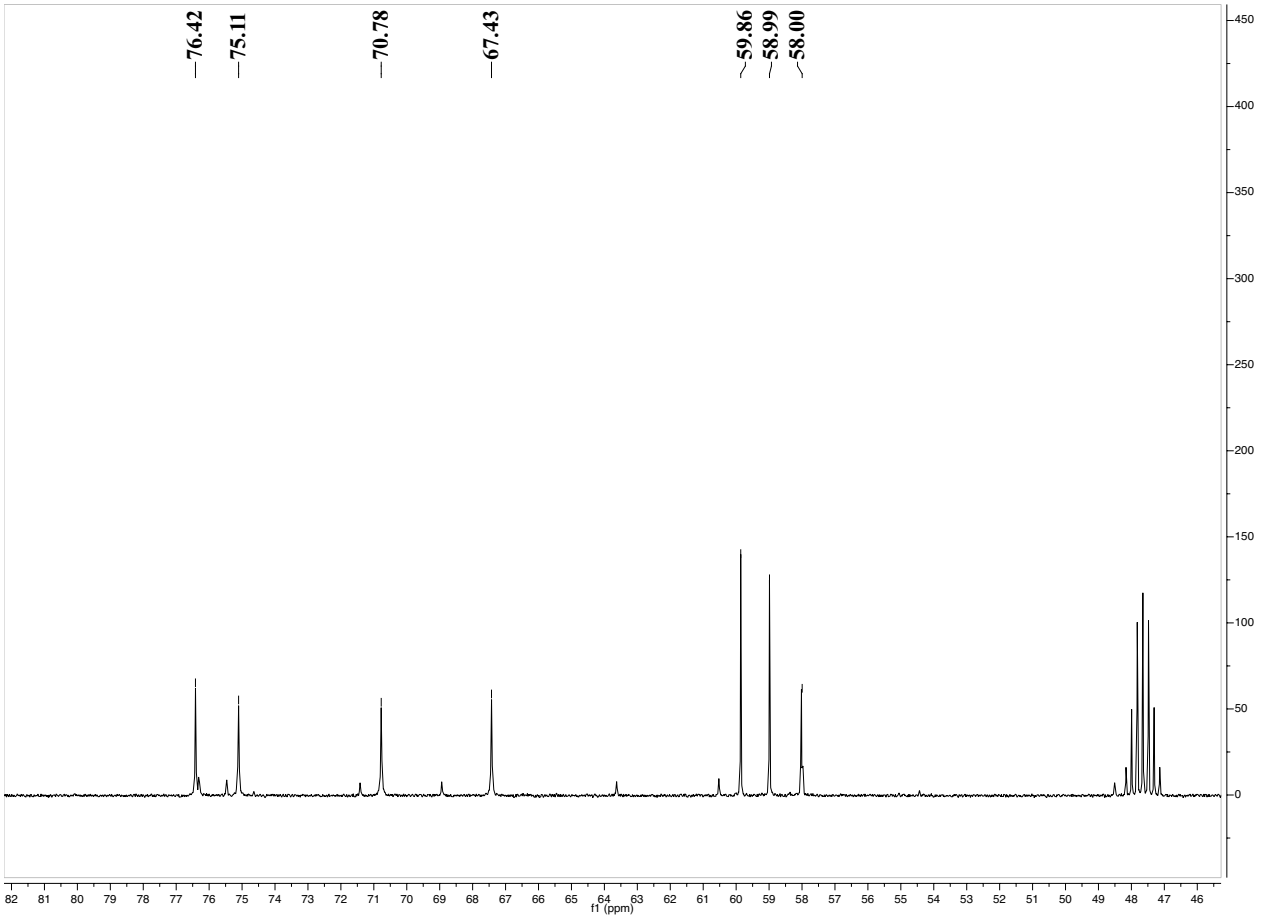

OH
O
N
HO
OH
OH

28


4.01 4.01 4.00 4.00 3.99 3.99 3.98 3.98 3.75 3.74 3.73 3.72 3.71 3.71 3.68 3.67 3.67 3.67 3.66 3.66 3.66 3.65 3.47 3.33 3.21 3.19 3.18 3.18 3.16 3.16 3.11 3.11 3.10 3.10 3.09 3.09 3.08 3.08 3.08 3.07 3.07 3.07 3.05 3.04 3.04 3.04
1.03 1.23 1.00 2.92 1.38 1.40 0.82 1.48 0.76
f1 (ppm)


OH
O
N
HO
OH
OH

28


76.42
75.11
70.78
67.43
59.86
58.99
58.00
450
400
350
300
250
200
150
100
50
0
82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46
f1 (ppm)

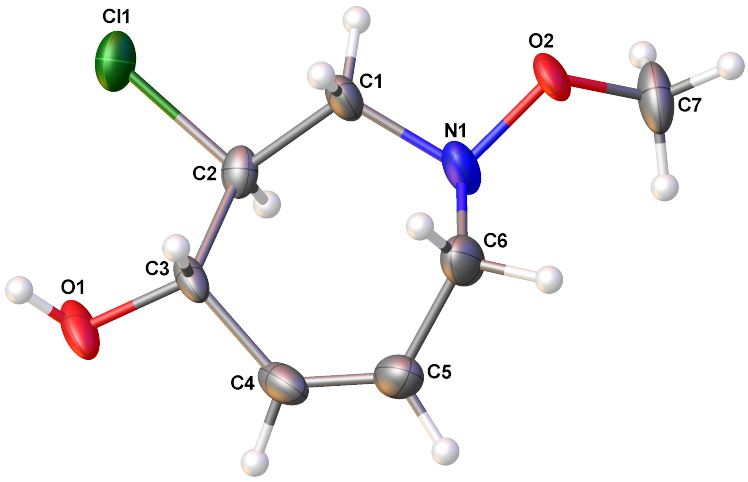


Figure S1. Thermal ellipsoid plot of **14** at 50%. Hydrogen atoms are shown as spheres of arbitrary radius.

Table S1. Crystal data and structure refinement for **14**.

CCDC no.	1028235	
Identification code	klb008_0m	
Empirical formula	C7 H7 Cl N O2	
Formula weight	172.59	
Temperature	100.15 K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	*C*2/c	
Unit cell dimensions	a = 24.849(3) Å	α = 90°.
	b = 4.7231(5) Å	β = 103.467(2)°.
	c = 14.8643(17) Å	γ = 90°.
Volume	1696.6(3) Å^3	
Z	8	
Density (calculated)	1.351 Mg/m^3	
Absorption coefficient	0.400 mm^{-1}	
F(000)	712	
Crystal size	0.159 x 0.063 x 0.057 mm^3	
Theta range for data collection	1.685 to 26.426°.	
Index ranges	-30<=h<=30, -5<=k<=5, -18<=l<=18	
Reflections collected	12847	
Independent reflections	1736 [R(int) = 0.0616]	
Completeness to theta = 25.242°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7454 and 0.6525	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	1736 / 6 / 106	
Goodness-of-fit on F^2	1.000	
Final R indices [I>2sigma(I)]	R1 = 0.0562, wR2 = 0.1727	
R indices (all data)	R1 = 0.0797, wR2 = 0.1969	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.894 and -0.478 e.Å^{-3}	

Table S2. Bond lengths [Å] and angles [°] for **14**.

C(1)-C(2)	1.522(4)	C(3)-C(2)-C(1)	114.8(3)
C(1)-N(1)	1.471(4)	C(3)-C(2)-Cl(1)	108.4(2)
C(2)-C(3)	1.523(4)	C(4)-C(3)-C(2)	111.1(2)
C(2)-Cl(1)	1.812(3)	O(1)-C(3)-C(2)	112.5(3)
C(3)-C(4)	1.505(5)	O(1)-C(3)-C(4)	106.4(2)
C(3)-O(1)	1.423(3)	C(5)-C(4)-C(3)	126.6(3)
C(4)-C(5)	1.315(5)	C(4)-C(5)-C(6)	125.1(3)
C(5)-C(6)	1.498(5)	N(1)-C(6)-C(5)	109.8(3)
C(6)-N(1)	1.484(5)	C(1)-N(1)-C(6)	111.4(3)
C(7)-O(2)	1.426(4)	O(2)-N(1)-C(1)	104.2(3)
C(7)-O(2A)	1.598(13)	O(2)-N(1)-C(6)	106.6(3)
N(1)-O(2)	1.423(4)	O(2A)-N(1)-C(1)	130.0(8)
N(1)-O(2A)	0.964(12)	O(2A)-N(1)-C(6)	117.8(8)
		C(7)-O(2)-N(1)	107.1(3)
N(1)-C(1)-C(2)	112.3(3)	N(1)-O(2A)-C(7)	125.0(11)
C(1)-C(2)-Cl(1)	105.1(2)		

Table S3. Torsion angles [°] for **14**.

C(1)-C(2)-C(3)-C(4)	-71.9(3)
C(1)-C(2)-C(3)-O(1)	169.0(3)
C(1)-N(1)-O(2)-C(7)	-136.7(3)
C(1)-N(1)-O(2A)-C(7)	101.7(11)
C(2)-C(1)-N(1)-C(6)	-78.1(4)
C(2)-C(1)-N(1)-O(2)	167.3(3)
C(2)-C(1)-N(1)-O(2A)	90.8(10)
C(2)-C(3)-C(4)-C(5)	56.7(4)
C(3)-C(4)-C(5)-C(6)	-2.2(6)
C(4)-C(5)-C(6)-N(1)	-59.3(5)
C(5)-C(6)-N(1)-C(1)	83.6(4)
C(5)-C(6)-N(1)-O(2)	-163.4(3)
C(5)-C(6)-N(1)-O(2A)	-86.8(9)
C(6)-N(1)-O(2)-C(7)	105.5(3)
C(6)-N(1)-O(2A)-C(7)	-89.9(11)
N(1)-C(1)-C(2)-C(3)	72.1(4)
N(1)-C(1)-C(2)-Cl(1)	-169.0(2)
O(1)-C(3)-C(4)-C(5)	179.4(3)
O(2)-C(7)-O(2A)-N(1)	-10.4(9)
O(2)-N(1)-O(2A)-C(7)	9.2(8)
O(2A)-C(7)-O(2)-N(1)	6.0(5)
O(2A)-N(1)-O(2)-C(7)	-8.8(8)
Cl(1)-C(2)-C(3)-C(4)	171.0(2)
Cl(1)-C(2)-C(3)-O(1)	51.9(3)

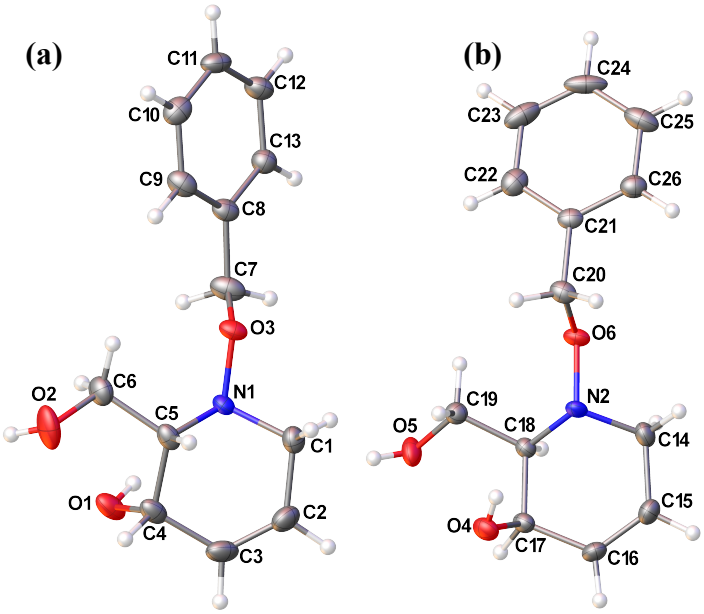


Figure S2. Thermal ellipsoid plot of **21** at 50%. Molecules (a) and (b) both appear in the asymmetric unit. Hydrogen atoms are shown as spheres of arbitrary radius.

Table S4. Crystal data and structure refinement for **21**.

CCDC no.	1028236	
Identification code	klb009_0m	
Empirical formula	C26 H34 N2 O6	
Formula weight	470.55	
Temperature	99.65 K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	*P*-1	
Unit cell dimensions	a = 9.9549(4) Å	α= 106.4607(7)°.
	b = 11.3328(5) Å	β= 101.6175(7)°.
	c = 11.8818(5) Å	γ = 100.1738(7)°.
Volume	1219.60(9) $Å^3$	
Z	2	
Density (calculated)	1.281 Mg/m^3	
Absorption coefficient	0.091 mm^{-1}	
F(000)	504	
Crystal size	0.161 x 0.126 x 0.072 mm^3	
Theta range for data collection	1.854 to 26.413°.	
Index ranges	-12<=h<=12, -14<=k<=14, -14<=l<=14	
Reflections collected	23662	
Independent reflections	5015 [R(int) = 0.0515]	
Completeness to theta = 25.242°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7454 and 0.7196	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	5015 / 0 / 317	
Goodness-of-fit on F^2	1.000	
Final R indices [I>2sigma(I)]	R1 = 0.0367, wR2 = 0.0677	
R indices (all data)	R1 = 0.0618, wR2 = 0.0727	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.209 and -0.188 $e.Å^{-3}$	

Table S5. Bond lengths [Å] and angles [°] for **21**.

C(14)-C(15)	1.4928(18)	O(4)-C(17)-C(18)	112.60(10)
C(14)-N(2)	1.4654(16)	C(19)-C(18)-C(17)	112.10(10)
C(15)-C(16)	1.3203(18)	N(2)-C(18)-C(17)	107.16(10)
C(16)-C(17)	1.4974(17)	N(2)-C(18)-C(19)	111.69(10)
C(17)-C(18)	1.5323(17)	O(5)-C(19)-C(18)	107.66(10)
C(17)-O(4)	1.4369(15)	O(6)-C(20)-C(21)	106.61(10)
C(18)-C(19)	1.5120(17)	C(22)-C(21)-C(20)	120.88(13)
C(18)-N(2)	1.4757(15)	C(26)-C(21)-C(20)	120.31(12)
C(19)-O(5)	1.4286(14)	C(26)-C(21)-C(22)	118.80(13)
C(20)-C(21)	1.4999(17)	C(23)-C(22)-C(21)	120.32(14)
C(20)-O(6)	1.4366(14)	C(24)-C(23)-C(22)	120.30(14)
C(21)-C(22)	1.3855(18)	C(23)-C(24)-C(25)	119.86(14)
C(21)-C(26)	1.3837(18)	C(24)-C(25)-C(26)	119.89(14)
C(22)-C(23)	1.3860(19)	C(21)-C(26)-C(25)	120.82(14)
C(23)-C(24)	1.374(2)	C(14)-N(2)-C(18)	109.55(10)
C(24)-C(25)	1.379(2)	O(6)-N(2)-C(14)	103.67(9)
C(25)-C(26)	1.3821(18)	O(6)-N(2)-C(18)	106.96(9)
N(2)-O(6)	1.4588(12)	C(20)-O(6)-N(2)	107.97(8)
C(1)-C(2)	1.4917(19)	N(1)-C(1)-C(2)	109.19(11)
C(1)-N(1)	1.4653(16)	C(3)-C(2)-C(1)	122.54(14)
C(2)-C(3)	1.3216(19)	C(2)-C(3)-C(4)	122.00(13)
C(3)-C(4)	1.4948(19)	C(3)-C(4)-C(5)	111.16(11)
C(4)-C(5)	1.5294(18)	O(1)-C(4)-C(3)	110.80(11)
C(4)-O(1)	1.4366(15)	O(1)-C(4)-C(5)	111.44(11)
C(5)-C(6)	1.5135(18)	C(6)-C(5)-C(4)	112.03(11)
C(5)-N(1)	1.4702(15)	N(1)-C(5)-C(4)	105.42(10)
C(6)-O(2)	1.4267(15)	N(1)-C(5)-C(6)	111.74(10)
C(7)-C(8)	1.5016(18)	O(2)-C(6)-C(5)	108.65(11)
C(7)-O(3)	1.4305(15)	O(3)-C(7)-C(8)	109.43(10)
C(8)-C(9)	1.3918(18)	C(9)-C(8)-C(7)	121.74(12)
C(8)-C(13)	1.3875(17)	C(13)-C(8)-C(7)	119.48(12)
C(9)-C(10)	1.3824(18)	C(13)-C(8)-C(9)	118.64(12)
C(10)-C(11)	1.3852(18)	C(10)-C(9)-C(8)	120.81(12)
C(11)-C(12)	1.3807(19)	C(9)-C(10)-C(11)	119.99(13)
C(12)-C(13)	1.3851(18)	C(12)-C(11)-C(10)	119.67(13)
N(1)-O(3)	1.4535(13)	C(11)-C(12)-C(13)	120.28(13)
		C(12)-C(13)-C(8)	120.60(13)
N(2)-C(14)-C(15)	110.45(11)	C(1)-N(1)-C(5)	110.04(10)
C(16)-C(15)-C(14)	122.24(13)	O(3)-N(1)-C(1)	106.10(9)
C(15)-C(16)-C(17)	122.23(12)	O(3)-N(1)-C(5)	108.29(9)
C(16)-C(17)-C(18)	111.51(11)	C(7)-O(3)-N(1)	106.43(9)
O(4)-C(17)-C(16)	110.43(10)		

Table S6. Torsion angles [°] for **21**.

C(14)-C(15)-C(16)-C(17)	1.9(2)	C(17)-C(18)-N(2)-C(14)	69.77(12)
C(14)-N(2)-O(6)-C(20)	-120.51(10)	C(17)-C(18)-N(2)-O(6)	-178.49(9)
C(15)-C(14)-N(2)-C(18)	-54.91(13)	C(18)-N(2)-O(6)-C(20)	123.76(10)
C(15)-C(14)-N(2)-O(6)	-168.80(10)	C(19)-C(18)-N(2)-C(14)	-167.10(10)
C(15)-C(16)-C(17)-C(18)	12.64(18)	C(19)-C(18)-N(2)-O(6)	-55.36(12)
C(15)-C(16)-C(17)-O(4)	-113.35(14)	C(20)-C(21)-C(22)-C(23)	-177.60(12)
C(16)-C(17)-C(18)-C(19)	-169.57(10)	C(20)-C(21)-C(26)-C(25)	177.77(12)
C(16)-C(17)-C(18)-N(2)	-46.69(14)	C(21)-C(20)-O(6)-N(2)	174.53(9)
C(17)-C(18)-C(19)-O(5)	-62.84(13)	C(21)-C(22)-C(23)-C(24)	-0.3(2)

C(22)-C(21)-C(26)-C(25)	-0.69(19)	C(4)-C(5)-N(1)-O(3)	171.98(9)
C(22)-C(23)-C(24)-C(25)	-0.5(2)	C(5)-N(1)-O(3)-C(7)	-129.59(11)
C(23)-C(24)-C(25)-C(26)	0.7(2)	C(6)-C(5)-N(1)-C(1)	165.61(11)
C(24)-C(25)-C(26)-C(21)	-0.1(2)	C(6)-C(5)-N(1)-O(3)	50.05(13)
C(26)-C(21)-C(22)-C(23)	0.86(19)	C(7)-C(8)-C(9)-C(10)	-175.87(13)
N(2)-C(14)-C(15)-C(16)	18.79(18)	C(7)-C(8)-C(13)-C(12)	175.27(13)
N(2)-C(18)-C(19)-O(5)	176.88(10)	C(8)-C(7)-O(3)-N(1)	171.39(10)
O(4)-C(17)-C(18)-C(19)	-44.78(14)	C(8)-C(9)-C(10)-C(11)	0.6(2)
O(4)-C(17)-C(18)-N(2)	78.09(13)	C(9)-C(8)-C(13)-C(12)	-0.5(2)
O(6)-C(20)-C(21)-C(22)	91.95(14)	C(9)-C(10)-C(11)-C(12)	-0.3(2)
O(6)-C(20)-C(21)-C(26)	-86.48(14)	C(10)-C(11)-C(12)-C(13)	-0.4(2)
C(1)-C(2)-C(3)-C(4)	-1.7(2)	C(11)-C(12)-C(13)-C(8)	0.8(2)
C(1)-N(1)-O(3)-C(7)	112.31(11)	C(13)-C(8)-C(9)-C(10)	-0.2(2)
C(2)-C(1)-N(1)-C(5)	55.71(14)	N(1)-C(1)-C(2)-C(3)	-17.85(19)
C(2)-C(1)-N(1)-O(3)	172.64(10)	N(1)-C(5)-C(6)-O(2)	176.75(10)
C(2)-C(3)-C(4)-C(5)	-14.86(19)	O(1)-C(4)-C(5)-C(6)	46.89(15)
C(2)-C(3)-C(4)-O(1)	109.64(15)	O(1)-C(4)-C(5)-N(1)	-74.86(13)
C(3)-C(4)-C(5)-C(6)	171.02(11)	O(3)-C(7)-C(8)-C(9)	-45.44(18)
C(3)-C(4)-C(5)-N(1)	49.28(14)	O(3)-C(7)-C(8)-C(13)	138.89(12)
C(4)-C(5)-C(6)-O(2)	58.70(14)		
C(4)-C(5)-N(1)-C(1)	-72.46(12)		

Table S7. Hydrogen bonds for **21** [Å and °].

D-H...A	d(D-H)	d(H...A)	d(D...A)	<(DHA)
O(1)-H(1)...O(5)#1	0.84	1.97	2.7226(13)	148.4
O(2)-H(2A)...O(1)#2	0.84	1.87	2.6837(13)	164.4
O(4)-H(4)...O(2)#3	0.837(16)	1.950(16)	2.7199(14)	152.4(15)
O(5)-H(5)...O(4)#4	0.832(16)	1.896(17)	2.7070(14)	164.5(17)

Symmetry transformations used to generate equivalent atoms:
#1 -x,-y+1,-z+1 #2 -x+1,-y+1,-z+2 #3 -x+1,-y+1,-z+1
#4 -x,-y+1,-z

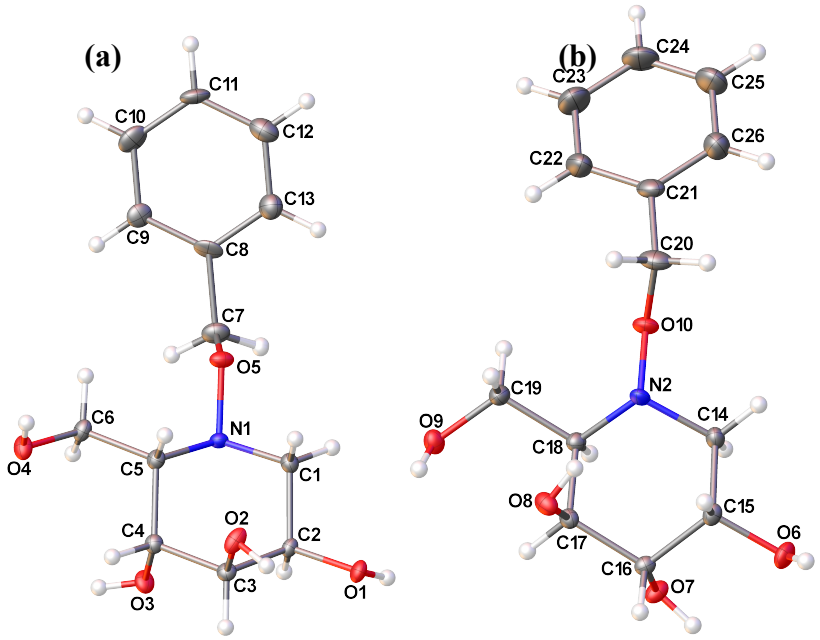


Figure S3. Thermal ellipsoid plot of **25** at 50%. Molecules (a) and (b) both appear in the asymmetric unit. Hydrogen atoms are shown as spheres of arbitrary radius.

Table S8. Crystal data and structure refinement for **25**.

CCDC no.	1028237	
Identification code	klb010_0m	
Empirical formula	C26 H38 N2 O10	
Formula weight	538.58	
Temperature	99.65 K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	*P*-1	
Unit cell dimensions	a = 5.3906(3) Å	α= 112.4571(11)°.
	b = 15.9299(9) Å	β= 97.7331(11)°.
	c = 17.3564(10) Å	γ = 99.3952(11)°.
Volume	1326.85(13) $Å^3$	
Z	2	
Density (calculated)	1.348 Mg/m^3	
Absorption coefficient	0.104 mm^{-1}	
F(000)	576	
Crystal size	0.401 x 0.191 x 0.176 mm^3	
Theta range for data collection	1.300 to 30.593°.	
Index ranges	-7<=h<=7, -22<=k<=22, -24<=l<=24	
Reflections collected	33786	
Independent reflections	8134 [R(int) = 0.0579]	
Completeness to theta = 25.242°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7461 and 0.6922	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	8134 / 0 / 376	
Goodness-of-fit on F^2	1.000	
Final R indices [I>2sigma(I)]	R1 = 0.0467, wR2 = 0.1191	
R indices (all data)	R1 = 0.0775, wR2 = 0.1352	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.406 and -0.296 $e.Å^{-3}$	

Table S9. Bond lengths [Å] and angles [°] for **25**.

C(1)-C(2)	1.5303(18)	O(2)-C(3)-C(4)	108.74(10)
C(1)-N(1)	1.4736(17)	C(3)-C(4)-C(5)	111.04(11)
C(2)-C(3)	1.5126(18)	O(3)-C(4)-C(3)	106.47(10)
C(2)-O(1)	1.4354(15)	O(3)-C(4)-C(5)	111.66(11)
C(3)-C(4)	1.5209(18)	C(6)-C(5)-C(4)	111.36(11)
C(3)-O(2)	1.4243(15)	N(1)-C(5)-C(4)	108.96(10)
C(4)-C(5)	1.5323(18)	N(1)-C(5)-C(6)	111.05(10)
C(4)-O(3)	1.4182(15)	O(4)-C(6)-C(5)	109.98(10)
C(5)-C(6)	1.5310(18)	O(5)-C(7)-C(8)	102.87(17)
C(5)-N(1)	1.4813(16)	O(5)-C(7)-C(8A)	109.19(17)
C(6)-O(4)	1.4253(16)	C(9)-C(8)-C(7)	120.0(3)
C(7)-C(8)	1.526(3)	C(9)-C(8)-C(13)	120.0
C(7)-C(8A)	1.489(3)	C(13)-C(8)-C(7)	120.0(3)
C(7)-O(5)	1.4350(16)	C(10)-C(9)-C(8)	120.0
C(8)-C(9)	1.3900	C(9)-C(10)-C(11)	120.0
C(8)-C(13)	1.3900	C(12)-C(11)-C(10)	120.0
C(9)-C(10)	1.3900	C(11)-C(12)-C(13)	120.0
C(10)-C(11)	1.3900	C(12)-C(13)-C(8)	120.0
C(11)-C(12)	1.3900	C(13A)-C(8A)-C(7)	120.5(3)
C(12)-C(13)	1.3900	C(13A)-C(8A)-C(9A)	120.0
C(8A)-C(13A)	1.3900	C(9A)-C(8A)-C(7)	119.2(3)
C(8A)-C(9A)	1.3900	C(8A)-C(13A)-C(12A)	120.0
C(13A)-C(12A)	1.3900	C(13A)-C(12A)-C(11A)	120.0
C(12A)-C(11A)	1.3900	C(12A)-C(11A)-C(10A)	120.0
C(11A)-C(10A)	1.3900	C(9A)-C(10A)-C(11A)	120.0
C(10A)-C(9A)	1.3900	C(10A)-C(9A)-C(8A)	120.0
N(1)-O(5)	1.4575(13)	C(1)-N(1)-C(5)	109.79(10)
C(14)-C(15)	1.5243(18)	O(5)-N(1)-C(1)	104.45(9)
C(14)-N(2)	1.4716(17)	O(5)-N(1)-C(5)	104.98(9)
C(15)-C(16)	1.5200(18)	C(7)-O(5)-N(1)	109.50(9)
C(15)-O(6)	1.4251(15)	N(2)-C(14)-C(15)	108.50(11)
C(16)-C(17)	1.5251(18)	C(14)-C(15)-C(16)	110.63(10)
C(16)-O(7)	1.4257(16)	O(6)-C(15)-C(14)	109.53(11)
C(17)-C(18)	1.5293(18)	O(6)-C(15)-C(16)	110.03(11)
C(17)-O(8)	1.4270(16)	C(15)-C(16)-C(17)	109.70(11)
C(18)-C(19)	1.5335(18)	O(7)-C(16)-C(15)	111.63(11)
C(18)-N(2)	1.4695(16)	O(7)-C(16)-C(17)	107.61(10)
C(19)-O(9)	1.4297(16)	C(16)-C(17)-C(18)	111.82(11)
C(20)-C(21)	1.5095(17)	O(8)-C(17)-C(16)	110.06(10)
C(20)-O(10)	1.4324(18)	O(8)-C(17)-C(18)	110.80(11)
C(21)-C(22)	1.3900	C(17)-C(18)-C(19)	111.04(11)
C(21)-C(26)	1.3900	N(2)-C(18)-C(17)	106.73(10)
C(22)-C(23)	1.3900	N(2)-C(18)-C(19)	110.37(11)
C(23)-C(24)	1.3900	O(9)-C(19)-C(18)	111.51(11)
C(24)-C(25)	1.3900	O(10)-C(20)-C(21)	105.62(12)
C(25)-C(26)	1.3900	C(22)-C(21)-C(20)	119.39(9)
N(2)-O(10)	1.4540(14)	C(22)-C(21)-C(26)	120.0
		C(26)-C(21)-C(20)	120.59(9)
N(1)-C(1)-C(2)	108.76(10)	C(21)-C(22)-C(23)	120.0
C(3)-C(2)-C(1)	110.44(10)	C(24)-C(23)-C(22)	120.0
O(1)-C(2)-C(1)	109.92(10)	C(25)-C(24)-C(23)	120.0
O(1)-C(2)-C(3)	108.33(10)	C(26)-C(25)-C(24)	120.0
C(2)-C(3)-C(4)	108.38(10)	C(25)-C(26)-C(21)	120.0
O(2)-C(3)-C(2)	110.20(11)	C(18)-N(2)-C(14)	110.65(10)

O(10)-N(2)-C(14)	106.01(10)	C(20)-O(10)-N(2)	109.12(10)
O(10)-N(2)-C(18)	104.87(9)		

Table S10. Torsion angles [°] for **25**.

C(1)-C(2)-C(3)-C(4)	57.08(13)	C(14)-C(15)-C(16)-O(7)	66.23(13)
C(1)-C(2)-C(3)-O(2)	-61.80(13)	C(14)-N(2)-O(10)-C(20)	-105.72(12)
C(1)-N(1)-O(5)-C(7)	121.05(11)	C(15)-C(14)-N(2)-C(18)	-65.77(13)
C(2)-C(1)-N(1)-C(5)	63.20(12)	C(15)-C(14)-N(2)-O(10)	-178.93(10)
C(2)-C(1)-N(1)-O(5)	175.31(9)	C(15)-C(16)-C(17)-C(18)	54.02(14)
C(2)-C(3)-C(4)-C(5)	-56.11(13)	C(15)-C(16)-C(17)-O(8)	-69.58(13)
C(2)-C(3)-C(4)-O(3)	65.64(13)	C(16)-C(17)-C(18)-C(19)	-179.34(10)
C(3)-C(4)-C(5)-C(6)	-178.48(10)	C(16)-C(17)-C(18)-N(2)	-59.00(13)
C(3)-C(4)-C(5)-N(1)	58.70(13)	C(17)-C(18)-C(19)-O(9)	-52.84(15)
C(4)-C(5)-C(6)-O(4)	60.08(13)	C(17)-C(18)-N(2)-C(14)	65.06(13)
C(4)-C(5)-N(1)-C(1)	-61.96(13)	C(17)-C(18)-N(2)-O(10)	178.94(10)
C(4)-C(5)-N(1)-O(5)	-173.72(9)	C(18)-N(2)-O(10)-C(20)	137.16(12)
C(5)-N(1)-O(5)-C(7)	-123.43(11)	C(19)-C(18)-N(2)-C(14)	-174.18(11)
C(6)-C(5)-N(1)-C(1)	175.04(10)	C(19)-C(18)-N(2)-O(10)	-60.29(13)
C(6)-C(5)-N(1)-O(5)	63.27(12)	C(20)-C(21)-C(22)-C(23)	-178.32(12)
C(7)-C(8)-C(9)-C(10)	-179.4(3)	C(20)-C(21)-C(26)-C(25)	178.30(12)
C(7)-C(8)-C(13)-C(12)	179.4(3)	C(21)-C(20)-O(10)-N(2)	-172.96(10)
C(7)-C(8A)-C(13A)-C(12A)	-173.6(3)	C(21)-C(22)-C(23)-C(24)	0.0
C(7)-C(8A)-C(9A)-C(10A)	173.7(3)	C(22)-C(21)-C(26)-C(25)	0.0
C(8)-C(7)-C(8A)-C(13A)	106(2)	C(22)-C(23)-C(24)-C(25)	0.0
C(8)-C(7)-C(8A)-C(9A)	-68(2)	C(23)-C(24)-C(25)-C(26)	0.0
C(8)-C(7)-O(5)-N(1)	172.28(17)	C(24)-C(25)-C(26)-C(21)	0.0
C(8)-C(9)-C(10)-C(11)	0.0	C(26)-C(21)-C(22)-C(23)	0.0
C(9)-C(8)-C(13)-C(12)	0.0	N(2)-C(14)-C(15)-C(16)	58.47(14)
C(9)-C(10)-C(11)-C(12)	0.0	N(2)-C(14)-C(15)-O(6)	179.93(10)
C(10)-C(11)-C(12)-C(13)	0.0	N(2)-C(18)-C(19)-O(9)	-171.00(11)
C(11)-C(12)-C(13)-C(8)	0.0	O(6)-C(15)-C(16)-C(17)	-174.12(10)
C(13)-C(8)-C(9)-C(10)	0.0	O(6)-C(15)-C(16)-O(7)	-54.93(13)
C(8A)-C(7)-C(8)-C(9)	83(2)	O(7)-C(16)-C(17)-C(18)	-67.61(13)
C(8A)-C(7)-C(8)-C(13)	-97(2)	O(7)-C(16)-C(17)-O(8)	168.80(10)
C(8A)-C(7)-O(5)-N(1)	172.99(17)	O(8)-C(17)-C(18)-C(19)	-56.16(14)
C(8A)-C(13A)-C(12A)-C(11A)	0.0	O(8)-C(17)-C(18)-N(2)	64.18(13)
C(13A)-C(8A)-C(9A)-C(10A)	0.0	O(10)-C(20)-C(21)-C(22)	72.71(14)
C(13A)-C(12A)-C(11A)-C(10A)	0.0	O(10)-C(20)-C(21)-C(26)	-105.59(12)
C(12A)-C(11A)-C(10A)-C(9A)	0.0		
C(11A)-C(10A)-C(9A)-C(8A)	0.0		
C(9A)-C(8A)-C(13A)-C(12A)	0.0		
N(1)-C(1)-C(2)-C(3)	-61.18(13)		
N(1)-C(1)-C(2)-O(1)	179.34(9)		
N(1)-C(5)-C(6)-O(4)	-178.31(10)		
O(1)-C(2)-C(3)-C(4)	177.51(9)		
O(1)-C(2)-C(3)-O(2)	58.64(13)		
O(2)-C(3)-C(4)-C(5)	63.69(13)		
O(2)-C(3)-C(4)-O(3)	-174.56(10)		
O(3)-C(4)-C(5)-C(6)	62.85(13)		
O(3)-C(4)-C(5)-N(1)	-59.97(13)		
O(5)-C(7)-C(8)-C(9)	-103.4(3)		
O(5)-C(7)-C(8)-C(13)	77.2(3)		
O(5)-C(7)-C(8A)-C(13A)	99.8(3)		
O(5)-C(7)-C(8A)-C(9A)	-73.8(3)		
C(14)-C(15)-C(16)-C(17)	-52.96(14)		

Table S11. Hydrogen bonds for **25** [Å and °].

D-H...A	d(D-H)	d(H...A)	d(D...A)	<(DHA)
O(2)-H(2A)...O(8)#1	0.84	1.83	2.6499(13)	163.8
O(3)-H(3A)...O(4)#2	0.84	1.87	2.7132(13)	176.5
O(6)-H(6)...O(7)#3	0.84	2.06	2.8814(13)	165.8
O(7)-H(7)...O(1)	0.84	1.94	2.7666(13)	170.2
O(8)-H(8)...O(9)#3	0.84	2.01	2.7652(14)	148.7
O(9)-H(9B)...O(1)#1	0.84	2.12	2.9047(14)	154.4
O(4)-H(4A)...N(1)#4	0.82(2)	2.16(2)	2.9729(14)	171.5(19)

Symmetry transformations used to generate equivalent atoms:
#1 -x,-y+1,-z #2 -x,-y+2,-z+1 #3 x+1,y,z
#4 x-1,y,z