Carbazole-, Aspidofractinine-, and Aspidocarpamine-Type Alkaloids from *Pleiocarpa pycnantha*

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ABSTRACT: Three new alkaloids, janetinine (1a), pleiokomenine A (2), and huncaniterine B (**3a**), and 13 known compounds, pleiomutinine (**3b**), huncaniterine A (**3c**), 1-carbomethoxy-*β*-carboline (**4**), evoxanthine (**5**), deformyltalbotine acid lactone (**6**), pleiocarpamine (**7**), N^4-methyl-10-hydroxygeissoschizol (**8**), spegatrine (**9**), neosarpagine (**10**), aspidofractinine (**11**), N^1-methylkopsinin (**12**), pleiocarpine (**13**), and N^1-methylkopsinin-N^4-oxide (**14**), were isolated from the stem bark of *Pleiocarpa pycnantha*. Janetinine (**1a**) is a carbazole alkaloid; in pleiokomenine A (**2**), two aspidofractinine-type alkaloids are bridged by a methylene unit in an unprecedented way, and huncaniterine B (**3a**) is a pleiocarpamine-aspidofractinine type dimer. The structures and relative configurations of these compounds were elucidated on the basis of NMR and MS analyses. Their absolute configurations were defined by means of experimental and calculated ECD data, and additionally, the structures of **5** and **13** were determined by X-ray diffraction data analysis. Compounds **1a**, **2**, **3b**, **4**, **6**, **9,** and **12** displayed cancer chemopreventive properties through either quinone reductase induction (C_D = 30.7, 30.2, 29.9, 43.5, and 36.7 μM for **1a**, **4**, **6**, **9,** and **12**, respectively), and/or NF-κB inhibition with IC_{50} values of 13.1, 8.4, 9.4, and 8.8 μM for **2**, **3b**, **6**, and **12**, respectively.

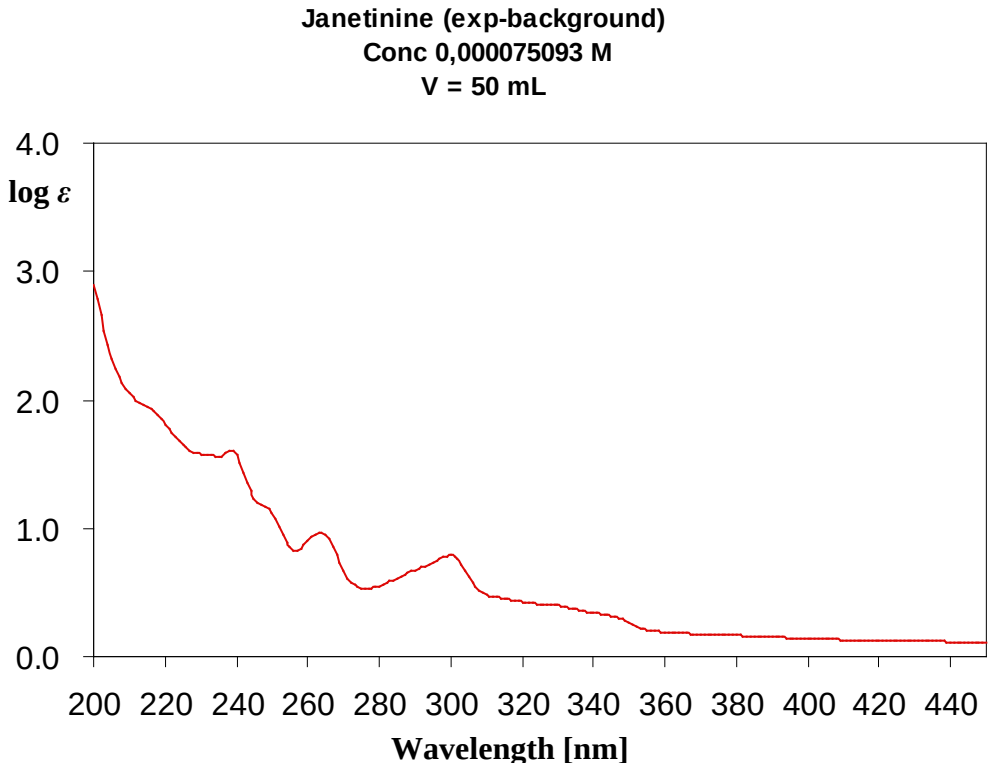

Figure S1: UV/vis spectrum of **1a** in MeOH.

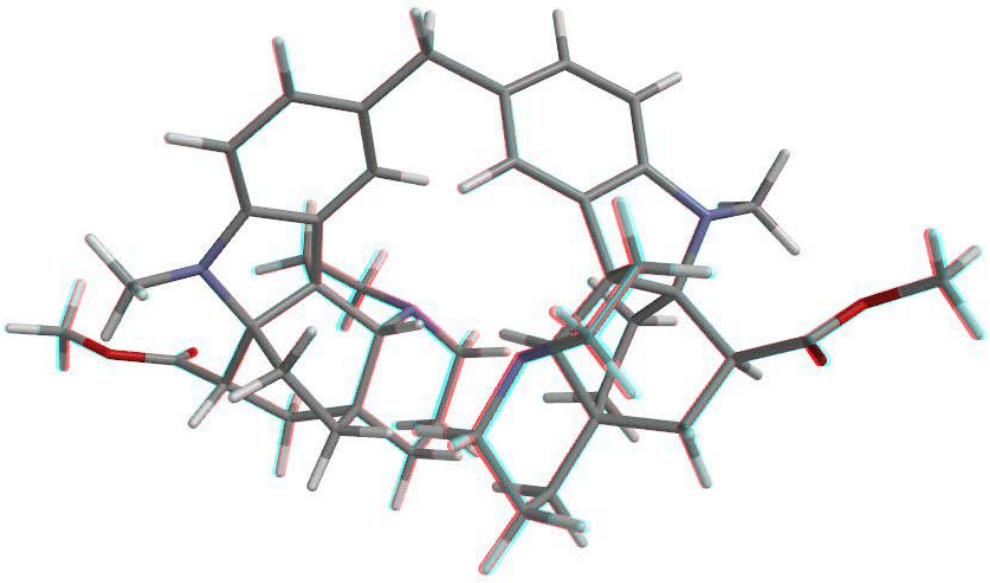

Figure S2: Stereo view of **2** in the DFT-caclulated main conformation (Boltzmann factor = 0.353)

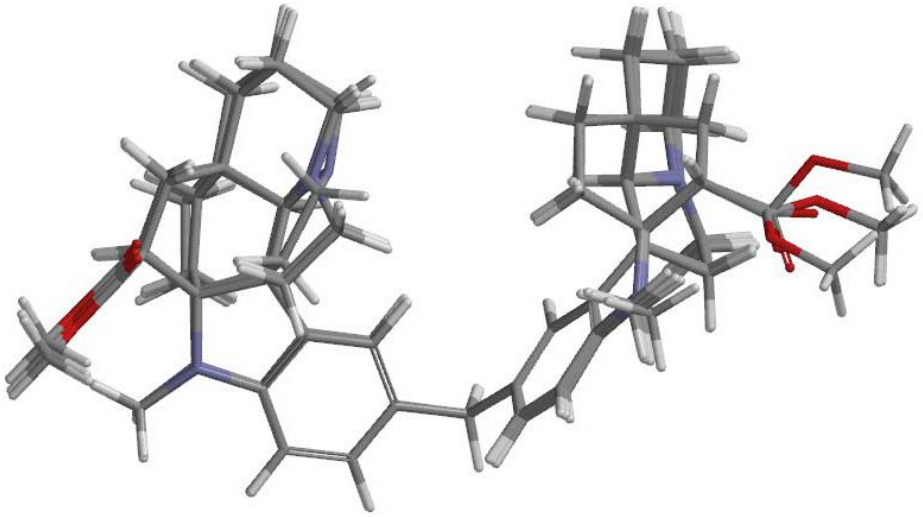

Figure S3: Stereo view of **2**, four DFT-calculated main conformations (Σ Boltzmann factors = 0.730).

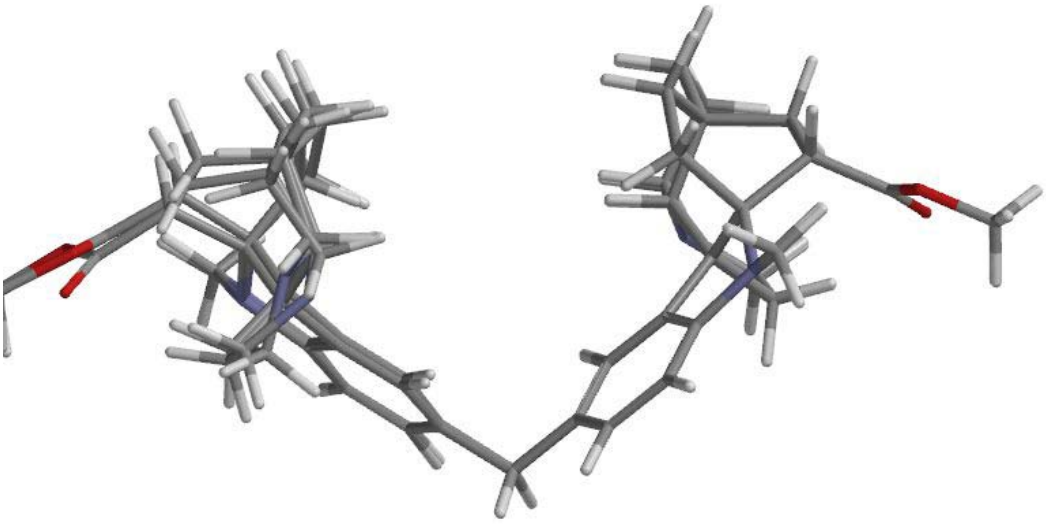

Figure S4: Stereo view of **2**, two DFT-calculated minor conformations (Σ Boltzmann factors = 0.182).

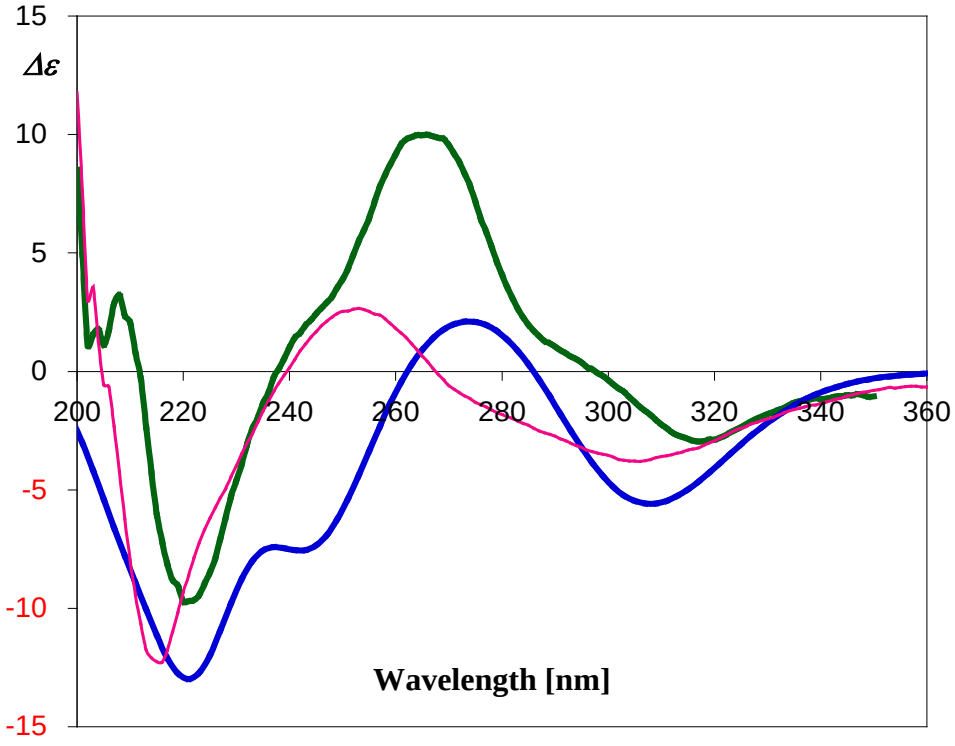

Figure S5: ECD spectra of **2**; green: exp. spectrum in methanol, blue = calculated spectrum of **2**, and experimental spectrum (red) of N^1-methylkopsinin in methanol for comparison.

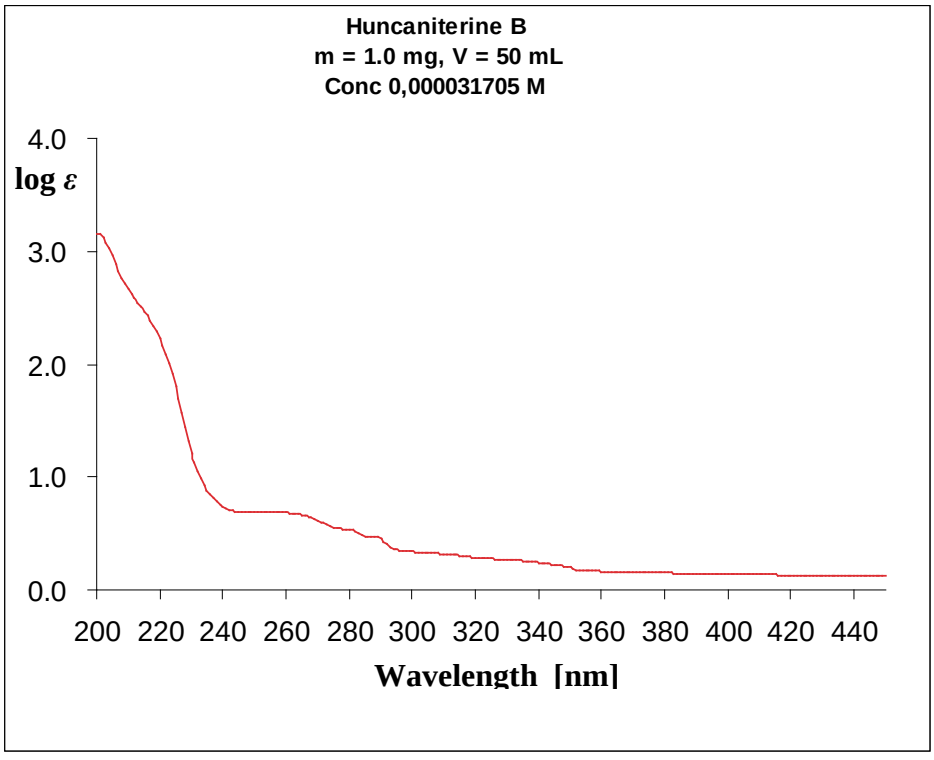

Figure S6: UV/vis spectrum of **3a** in Methanol

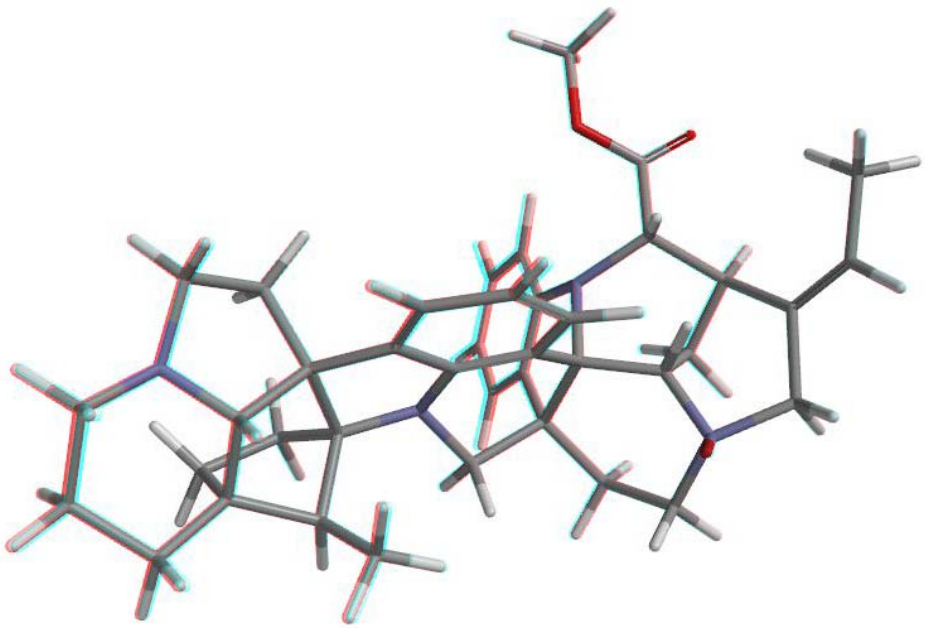

Figure S7: Stereo view of **3a** in the DFT-calculated main conformation (Boltzmann factor = 0.512).

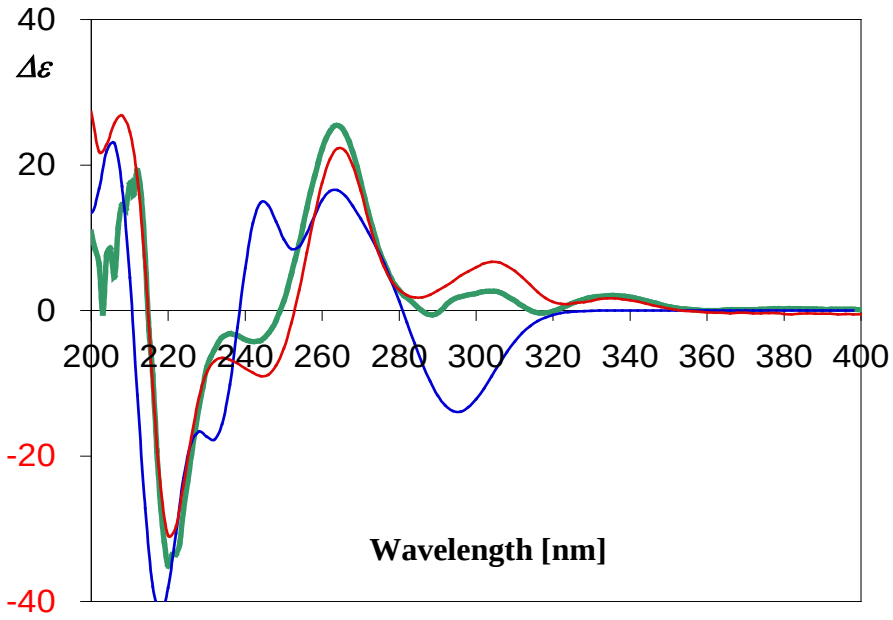

Figure S8: ECD spectra of **3a**, experimental in methanol (green) and calculated (blue), and of **3b** (red) in methanol

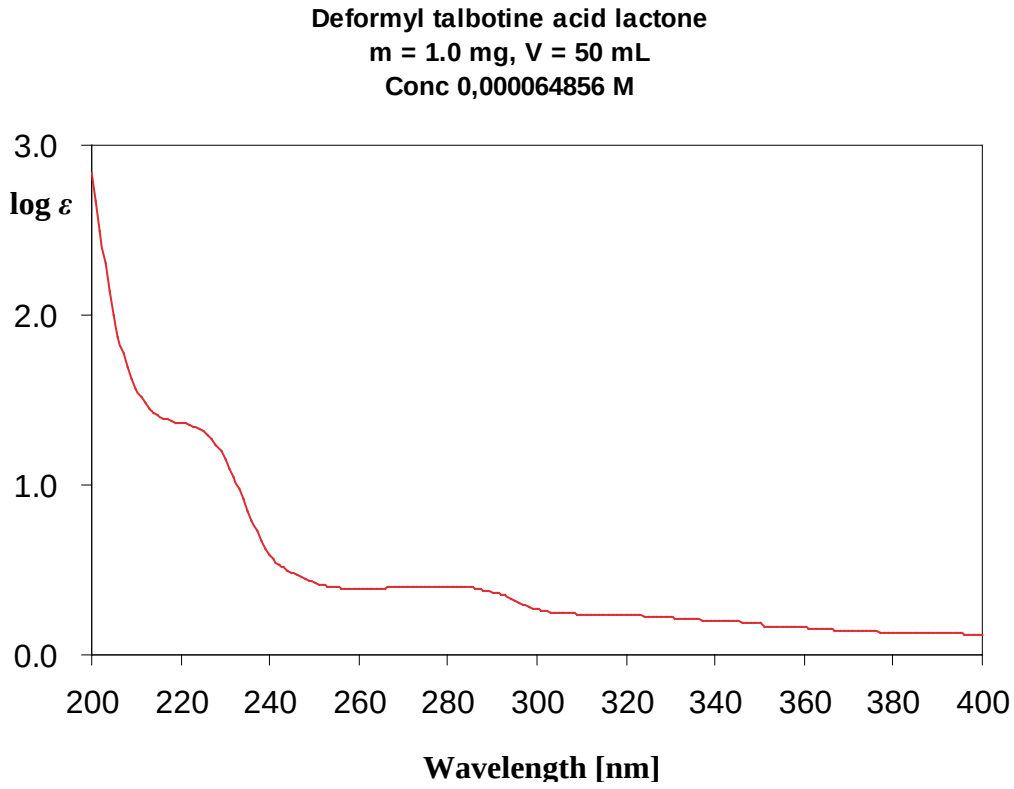

Figure S9: UV/vis spectrum of **6** in methanol.

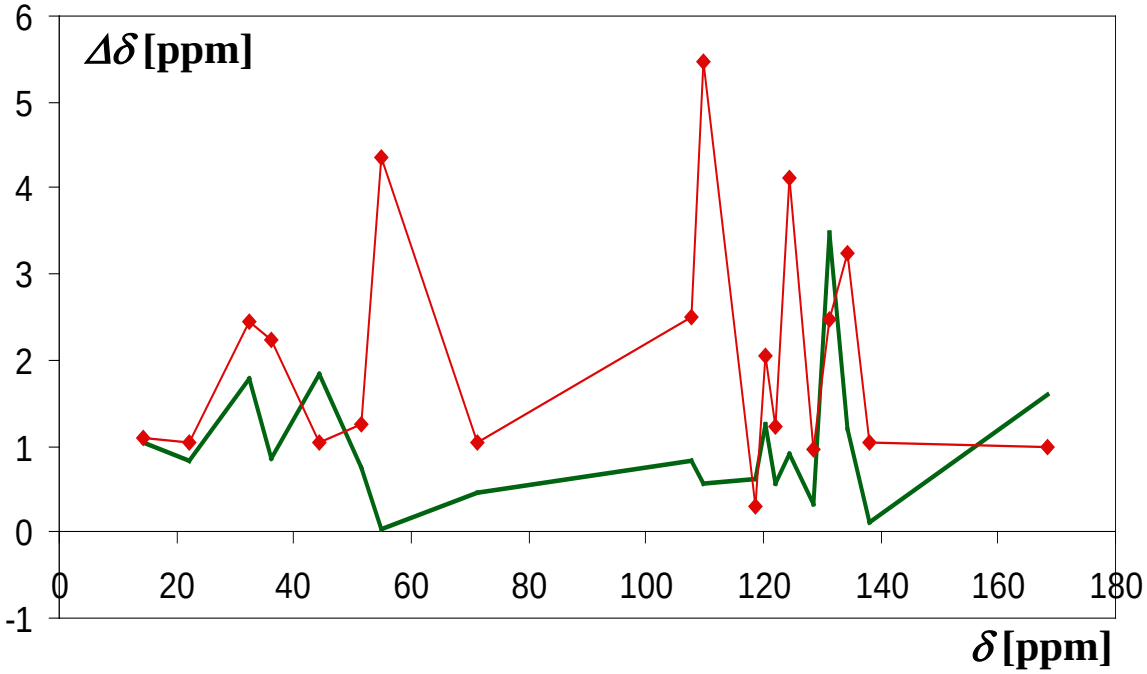

Figure S10: Plot of $\Delta\delta$ values of experimental ^{13}C NMR shifts of **6** in $CDCl_3$ minus calculated shifts for (15*S*,16*S*)-**6** [green line, $\sum abs(\delta_{exp} - \delta_{(16S)calcd}) = 19.0$] or (15S,16*R*)-**6** [red line, $\sum abs(\delta_{exp} - \delta_{(16R)calcd}) = 38.8$], respectively.

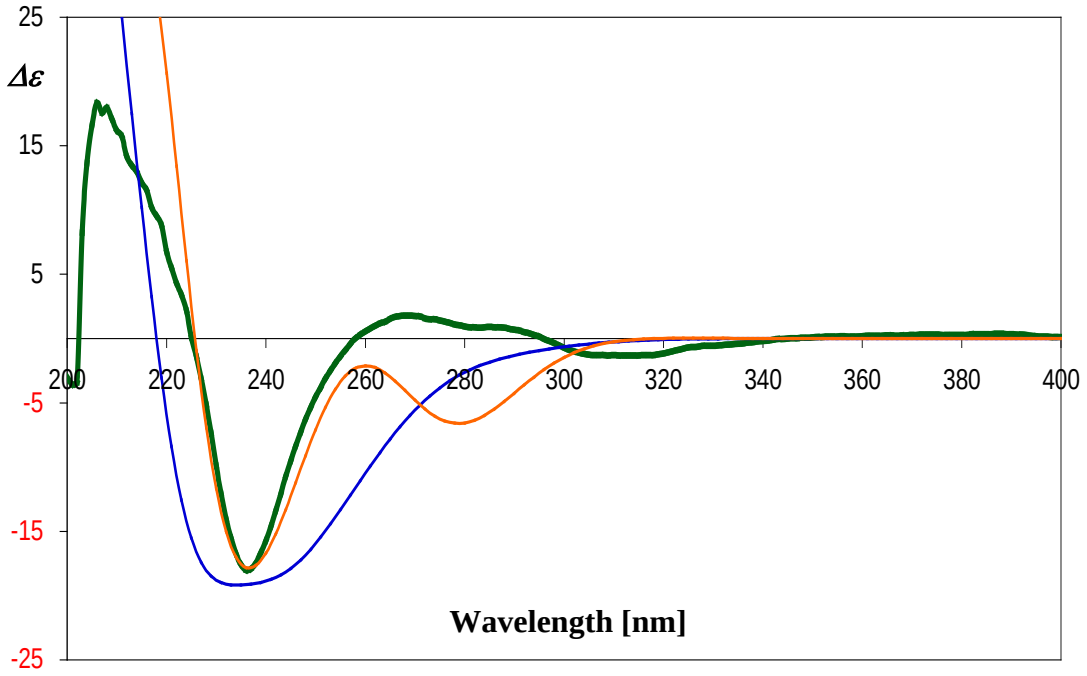

Figure S11: ECD spectra of **6**; green = experimental spectrum in methanol, blue = calculated spectrum of (15*S*,16*S*)-**6**, orange = (15*S*,16*R*)-**6**.

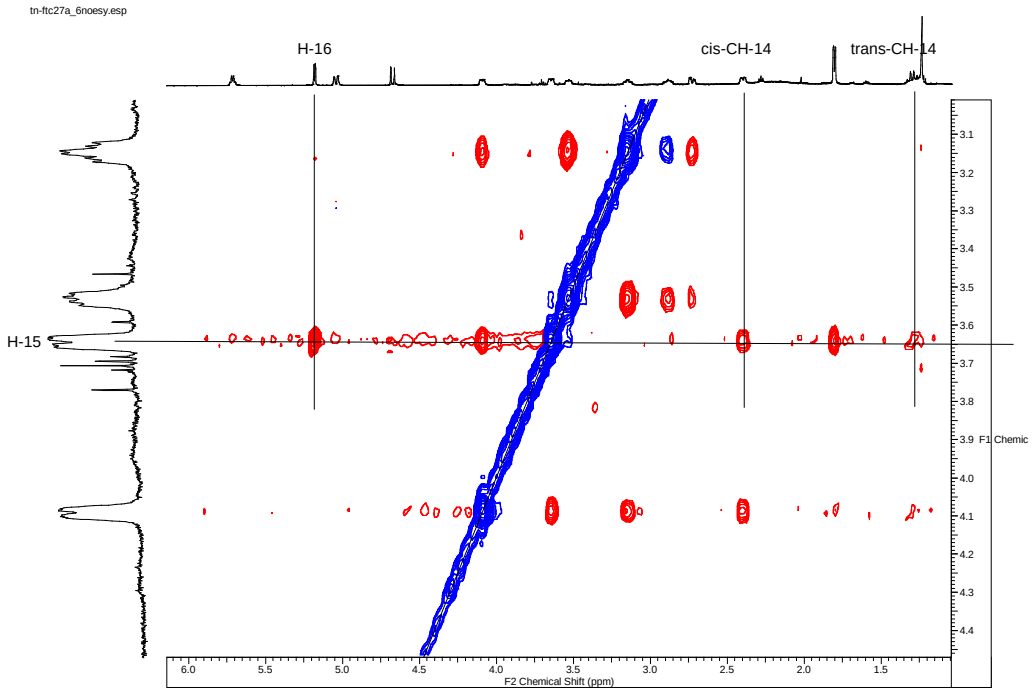

Figure S12: Detail of the NOESY spectrum of **6**: Correlations of H-15 with H-16, in comparison with H-15 / $CH_{2\alpha,\beta}$-14

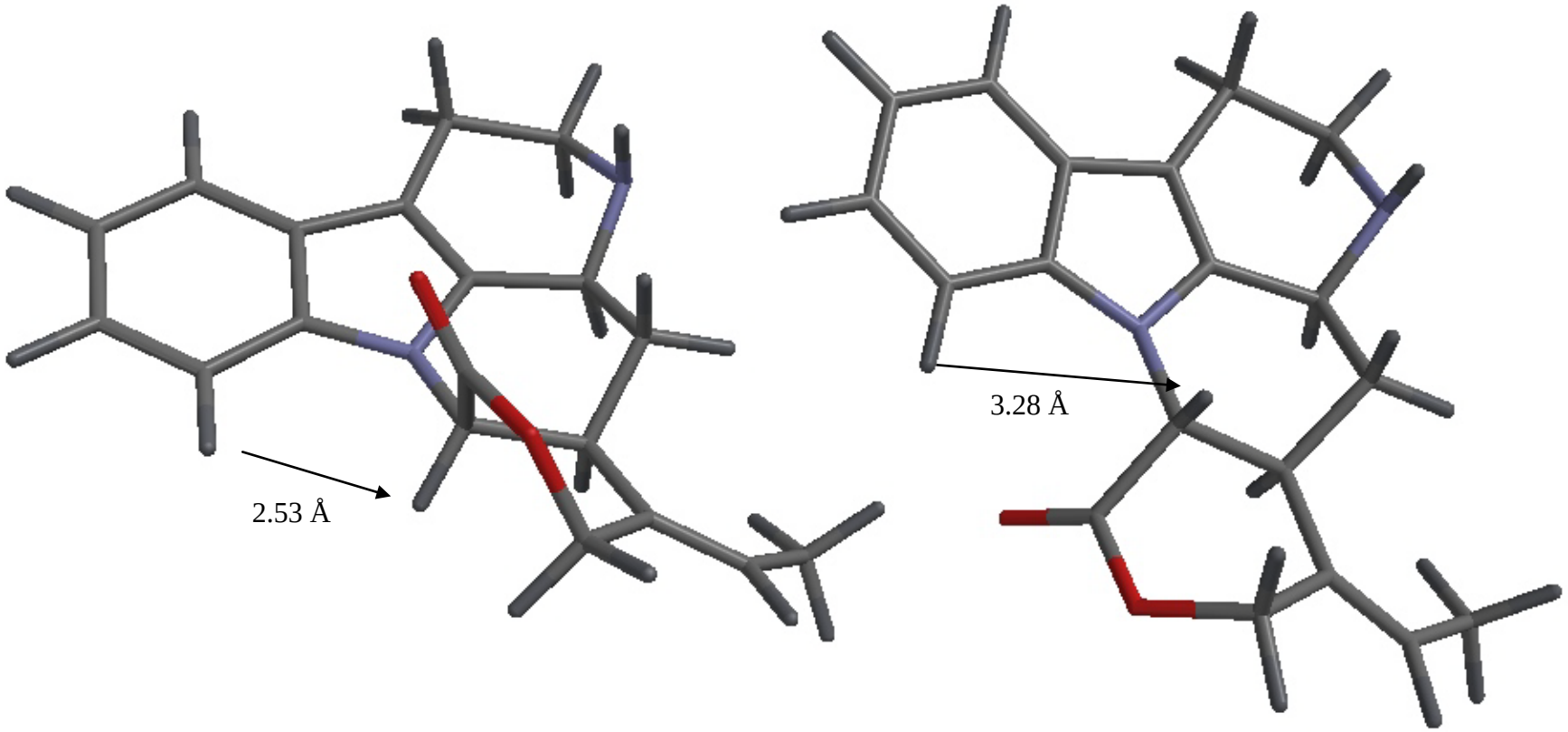

Figure S13: Main conformations of (16*S*)-**6** (left figure, H-12/H-16 distance 2.53 Å) and of the nonnatural (16*R*)-**6** (right, H-12/H-16 distance 3.28 Å)

Evoxanthine (5)

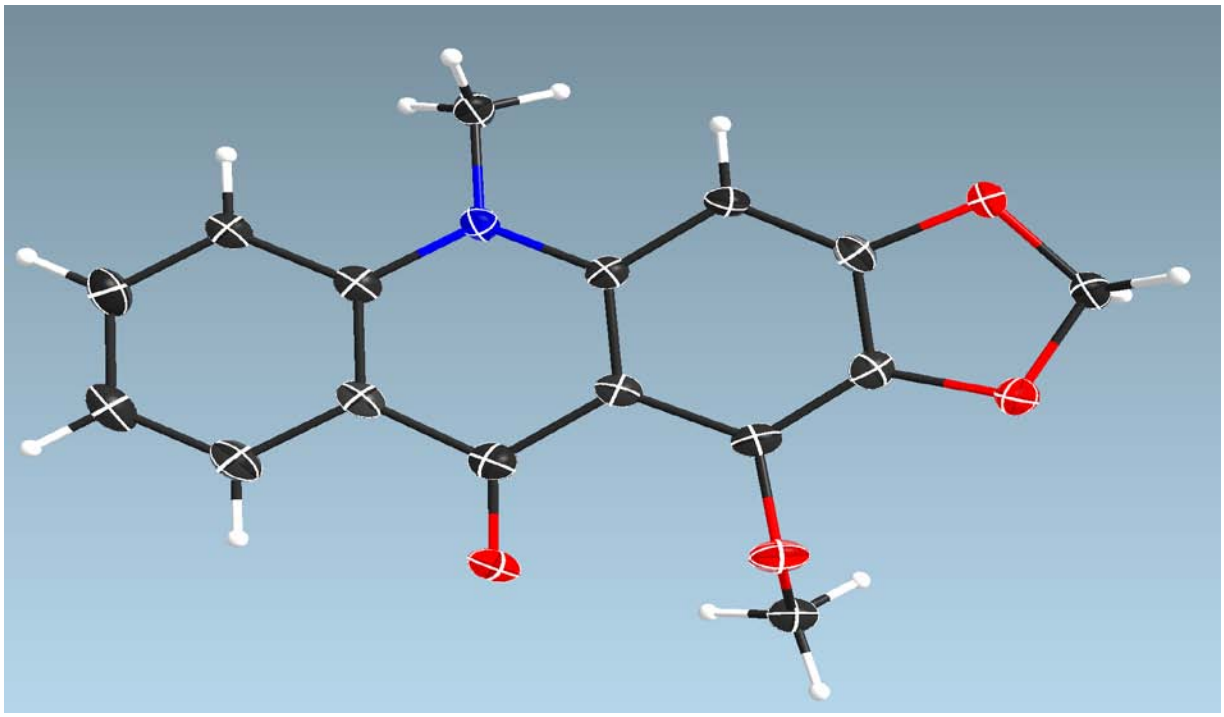

Figure S14: Crystal structure of **5**

Computing details for the crystal structure of 5

Data collection: *APEX2* v2014.11-0; cell refinement: *SAINT* V8.37A (Bruker AXS, 2013); data reduction: *SAINT* V8.37A (Bruker AXS, 2013); program(s) used to solve structure: The structure was known; program(s) used to refine structure: Volkov, A.; Macchi, P.; Farrugia, L. J.; Gatti, C.; Mallinson, P. R.; Richter, T. and Koritsanszky, T. (2006) XD2006 - a computer program for multipole refinement, topological analysis and evaluation of intermolecular energies from experimental and theoretical structure factors; molecular graphics: ShelXle, Hübschle, (2011); software used to prepare material for publication: *enCIFer* 1.5.1, CCDC, 2014.

References

NOT FOUND

Evoxanthine (5)

Crystal data

$C_{16}H_{13}NO_4$
M_r = 283.27
Monoclinic, $P2_1/c$
a = 7.4572 (8) Å
b = 8.9283 (10) Å
c = 18.5642 (19) Å
β = 92.91 (3)°
V = 1234.4 (2) Å^3
Z = 4

$F(000)$ = 592
D_x = 1.524 Mg m^{-3}
Mo $K\alpha$ radiation, λ = 0.7107 Å
Cell parameters from 9258 reflections
θ = 2.2–33.2°
μ = 0.11 mm^{-1}
T = 100 K
Plate
0.22 × 0.09 × 0.08 mm

Data collection

Huber Type 512 with Bruker APEX I diffractometer
Radiation source: INCOATEC Mo Microsource
φ scans
Absorption correction: empirical (using intensity measurements)
SADABS 2015/1
T_{min} = 0.516, T_{max} = 0.747

74625 measured reflections
4724 independent reflections
3677 reflections with $I > 2\sigma(I)$
R_{int} = 0.099
θ_{max} = 33.2°, θ_{min} = 2.2°
h = −11→11
k = −13→13
l = −28→28

Refinement

Refinement on F^2
Least-squares matrix: full $R[F^2 > 2\sigma(F^2)]$ = 0.042 $wR(F^2)$ = 0.08
S = 1.87
3677 reflections
203 parameters
0 restraints
0 constraints

Primary atom site location: dual
Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from eighboring sites
$w2 = /[s^2(F_o^2)]$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.34 e Å^{-3}
$\Delta\rho_{min}$ = −0.27 e Å^{-3}

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²) for evoxanthine (**5**)

	x	*y*	*z*	U_{iso}*/U_{eq}
O(1)	0.93583 (11)	1.01502 (8)	0.38734 (3)	0.022
O(2)	0.85181 (11)	0.89529 (8)	0.28063 (3)	0.024
O(3)	0.74081 (10)	0.58727 (9)	0.27241 (3)	0.022
O(4)	0.63978 (13)	0.35347 (9)	0.35593 (4)	0.032
N(1)	0.78606 (11)	0.59506 (9)	0.53763 (4)	0.016
C(1)	0.89488 (15)	1.03880 (12)	0.31169 (5)	0.022
C(2)	0.87066 (13)	0.87690 (11)	0.40223 (5)	0.017
C(3)	0.82001 (13)	0.80410 (12)	0.33813 (4)	0.017
C(4)	0.76643 (13)	0.65778 (11)	0.33761 (4)	0.016
C(5)	0.75162 (13)	0.58314 (11)	0.40577 (5)	0.016
C(6)	0.69138 (14)	0.42803 (11)	0.40934 (5)	0.019
C(7)	0.69568 (13)	0.36109 (11)	0.48159 (5)	0.018
C(9)	0.65314 (16)	0.14117 (12)	0.55558 (6)	0.025
C(8)	0.64907 (15)	0.20957 (12)	0.48892 (6)	0.023
C(10)	0.70857 (16)	0.22397 (12)	0.61719 (6)	0.025
C(11)	0.75434 (14)	0.37299 (11)	0.61179 (5)	0.02
C(12)	0.74543 (13)	0.44526 (11)	0.54360 (5)	0.016
C(13)	0.79942 (13)	0.66210 (11)	0.47063 (4)	0.014
C(14)	0.86450 (13)	0.81146 (11)	0.46865 (4)	0.017
C(15)	0.81166 (16)	0.68371 (12)	0.60391 (5)	0.021
C(16)	0.56022 (14)	0.59093 (13)	0.24281 (5)	0.021
H(1A)	0.7814	1.1146	0.3040	0.028 (4)*
H(1B)	1.0095	1.0876	0.2863	0.026 (4)*
H(9)	0.6145	0.0249	0.5604	0.029 (4)*
H(8)	0.6091	0.1452	0.4414	0.023 (4)*
H(10)	0.7147	0.1702	0.6695	0.022 (4)*
H(11)	0.7976	0.4351	0.6596	0.017 (3)*
H(14)	0.9071	0.8708	0.5174	0.017 (3)*
H(15A)	0.9495	0.6730	0.6249	0.035 (4)*
H(15B)	0.7218	0.6432	0.6437	0.023 (4)*
H(15C)	0.7826	0.8005	0.5922	0.036 (4)*
H(16A)	0.5111	0.7065	0.2427	0.030 (4)*
H(16B)	0.4755	0.5213	0.2757	0.032 (4)*
H(16C)	0.5556	0.5481	0.1875	0.036 (4)*

Atomic displacement parameters (Å^2) for evoxanthine (**5**)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
O(1)	0.0295 (4)	0.0243 (4)	0.0131 (3)	−0.0099 (3)	−0.0020 (3)	0.0030 (3)
O(2)	0.0294 (4)	0.0307 (4)	0.0106 (3)	−0.0076 (3)	0.0005 (3)	0.0002 (3)
O(3)	0.0183 (4)	0.0324 (4)	0.0143 (3)	0.0005 (3)	0.0013 (2)	−0.0099 (3)
O(4)	0.0518 (6)	0.0203 (4)	0.0232 (3)	−0.0054 (4)	−0.0141 (3)	−0.0056 (3)
N(1)	0.0201 (4)	0.0155 (4)	0.0121 (3)	−0.0030 (3)	0.0010 (3)	−0.0007 (3)
C(1)	0.0232 (6)	0.0277 (6)	0.0136 (4)	−0.0073 (4)	−0.0008 (3)	0.0040 (4)
C(2)	0.0188 (5)	0.0191 (5)	0.0116 (3)	−0.0050 (4)	0.0001 (3)	−0.0008 (3)
C(3)	0.0174 (5)	0.0244 (5)	0.0101 (3)	−0.0032 (4)	0.0009 (3)	−0.0016 (3)
C(4)	0.0156 (5)	0.0224 (5)	0.0114 (3)	−0.0007 (4)	0.0004 (3)	−0.0040 (3)
C(5)	0.0148 (5)	0.0188 (5)	0.0135 (3)	−0.0010 (4)	−0.0003 (3)	−0.0034 (3)
C(6)	0.0221 (5)	0.0168 (5)	0.0180 (4)	−0.0006 (4)	−0.0047 (3)	−0.0047 (3)
C(7)	0.0170 (5)	0.0149 (5)	0.0210 (4)	−0.0007 (4)	−0.0007 (3)	−0.0021 (3)
C(9)	0.0270 (6)	0.0157 (5)	0.0328 (5)	−0.0027 (4)	0.0042 (4)	0.0021 (4)
C(8)	0.0216 (5)	0.0165 (5)	0.0298 (5)	−0.0020 (4)	−0.0003 (4)	−0.0026 (4)
C(10)	0.0291 (6)	0.0190 (5)	0.0261 (5)	−0.0018 (4)	0.0057 (4)	0.0035 (4)
C(11)	0.0248 (6)	0.0179 (5)	0.0187 (4)	−0.0013 (4)	0.0045 (4)	0.0022 (4)
C(12)	0.0158 (5)	0.0161 (5)	0.0159 (4)	−0.0011 (4)	0.0017 (3)	−0.0005 (3)
C(13)	0.0151 (5)	0.0163 (5)	0.0115 (3)	−0.0022 (4)	0.0004 (3)	−0.0016 (3)
C(14)	0.0210 (5)	0.0176 (5)	0.0112 (3)	−0.0046 (4)	−0.0001 (3)	−0.0013 (3)
C(15)	0.0307 (6)	0.0199 (5)	0.0121 (3)	−0.0041 (4)	0.0007 (4)	−0.0004 (3)
C(16)	0.0224 (5)	0.0274 (6)	0.0141 (4)	0.0016 (4)	−0.0040 (3)	−0.0049 (4)

Geometric parameters (Å, º) for evoxanthine (**5**)

O(1)—C(2)	1.3591 (11)	C(7)—C(8)	1.4050 (14)
O(2)—C(3)	1.3727 (11)	C(7)—C(12)	1.4087 (12)
O(3)—C(4)	1.3691 (10)	C(9)—C(8)	1.3791 (15)
O(3)—C(16)	1.4289 (12)	C(9)—C(10)	1.4062 (15)
O(4)—C(6)	1.2393 (11)	C(9)—H(9)	1.0822
N(1)—C(12)	1.3770 (12)	C(8)—H(8)	1.0822
N(1)—C(13)	1.3884 (11)	C(10)—C(11)	1.3785 (14)
C(1)—H(1A)	1.0873	C(10)—H(10)	1.0823
C(1)—H(1B)	1.0873	C(11)—C(12)	1.4193 (13)
C(2)—C(3)	1.3913 (12)	C(11)—H(11)	1.0823
C(2)—C(14)	1.3672 (12)	C(13)—C(14)	1.4202 (13)
C(3)—C(4)	1.3660 (14)	C(14)—H(14)	1.0822
C(4)—C(5)	1.4393 (12)	C(15)—H(15A)	1.0848
C(5)—C(6)	1.4584 (14)	C(15)—H(15B)	1.0848
C(5)—C(13)	1.4249 (11)	C(15)—H(15C)	1.0848
C(6)—C(7)	1.4672 (13)		
C(4)—O(3)—C(16)	114.59 (7)	C(5)—C(6)—C(7)	115.84 (8)
C(12)—N(1)—C(13)	121.13 (7)	C(6)—C(7)—C(8)	119.12 (9)
O(1)—C(2)—C(3)	109.53 (8)	C(6)—C(7)—C(12)	121.49 (9)
O(1)—C(2)—C(14)	126.87 (8)	C(8)—C(7)—C(12)	119.39 (9)
C(3)—C(2)—C(14)	123.48 (9)	C(8)—C(9)—C(10)	119.29 (10)
O(2)—C(3)—C(2)	109.75 (9)	C(7)—C(8)—C(9)	121.26 (10)
O(2)—C(3)—C(4)	128.59 (8)	C(9)—C(10)—C(11)	120.79 (10)
C(2)—C(3)—C(4)	121.30 (8)	C(10)—C(11)—C(12)	120.21 (9)
O(3)—C(4)—C(3)	118.28 (8)	N(1)—C(12)—C(7)	120.14 (8)
O(3)—C(4)—C(5)	123.42 (9)	N(1)—C(12)—C(11)	120.86 (8)
C(3)—C(4)—C(5)	118.17 (8)	C(7)—C(12)—C(11)	119.00 (9)
C(4)—C(5)—C(6)	121.15 (8)	N(1)—C(13)—C(5)	121.16 (9)
C(4)—C(5)—C(13)	119.12 (9)	N(1)—C(13)—C(14)	117.91 (7)
C(6)—C(5)—C(13)	119.72 (8)	C(5)—C(13)—C(14)	120.93 (8)
O(4)—C(6)—C(5)	123.88 (9)	C(2)—C(14)—C(13)	116.85 (8)
O(4)—C(6)—C(7)	120.27 (10)		

Pleiocarpine (13)

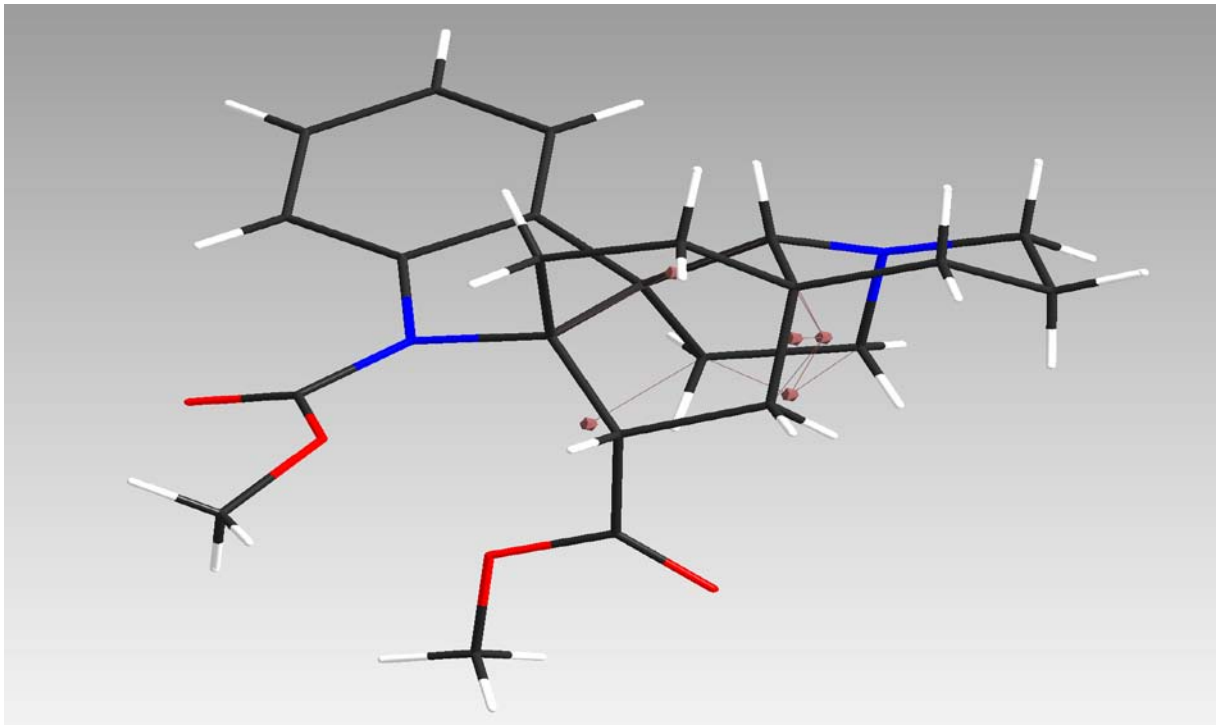

Figure S15: Crystal structure of **13**

Computing details for 13

Data collection: *APEX2* v2014.11-0; cell refinement: *SAINT* V8.37A (Bruker AXS, 2013); data reduction: *SAINT* V8.37A (Bruker AXS, 2013); program(s) used to solve structure: The structure was known; program(s) used to refine structure: Volkov, A.; Macchi, P.; Farrugia, L. J.; Gatti, C.; Mallinson, P. R.; Richter, T. and Koritsanszky, T. (2006) XD2006 - a computer program for multipole refinement, topological analysis and evaluation of intermolecular energies from experimental and theoretical structure factors.; molecular graphics: Shelxle, Hübschle, (2011); software used to prepare material for publication: *enCIFer* 1.5.1, CCDC, 2014.

Pleiocarpine (13)

Crystal data

$C_{23}H_{28}N_2O_4$
M_r = 396.47
Monoclinic, $P2_1$
a = 7.4061 (3) Å
b = 9.1421 (4) Å
c = 14.8478 (6) Å
β = 95.826 (2)°
V = 1000.11 (7) Å^3
Z = 2

$F(000)$ = 424
D_x = 1.317 Mg m^{-3}
Mo $K\alpha$ radiation, λ = 0.71073 Å
Cell parameters from 9801 reflections
θ = 2.8–23.2°
μ = 0.09 mm^{-1}
T = 298 K
Cube
0.31 × 0.24 × 0.21 mm

Data collection

Huber Type 512 with Bruker APEX I diffractometer
Radiation source: INCOATEC Mo Microsource
φ scans
Absorption correction: empirical (using intensity measurements)
SADABS 2015/1
T_{min} = 0.750, T_{max} = 0.875

37617 measured reflections
3491 independent reflections
2580 reflections with $I > 2\sigma(I)$
R_{int} = 0.074
θ_{max} = 25.4°, θ_{min} = 1.4°
h = −8→8
k = −10→10
l = −17→17

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.033
$wR(F^2)$ = 0.036
S = 2.22
1482 reflections
289 parameters
0 restraints
0 constraints
Primary atom site location: dual

Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from neighboring sites
H-atom parameters constrained
$w2 = 1/[s^2(F_o^2)]$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.17 e Å^{-3}
$\Delta\rho_{min}$ = −0.14 e Å^{-3}
Absolute structure: Flack x parameter could not be determined reliably

Special details

Refinement. An invariom refinement (with aspherical scattering factors predicted by DFT computations) was carried out. (Dittrich *et al.*, Acta Cryst. B69, 91-104.) Hydrogen atom positions were calculated with shelxl and their bond distances elongated to idealized values from geometry optimizations of suitable model compounds from the invariom database. The program XDLSM was used with Friedel pairs merged.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2) for pleiocarpine **(13)**

	x	*y*	*z*	U_{iso}*/U_{eq}
O(1)	0.6885 (2)	0.338977	0.46554 (12)	0.047
O(2)	0.6016 (2)	0.5751 (3)	0.46623 (11)	0.037
O(3)	0.0010 (2)	0.5966 (3)	0.41026 (13)	0.059
O(4)	0.2456 (2)	0.4731 (3)	0.46442 (12)	0.046
N(1)	0.5230 (2)	0.4391 (3)	0.34300 (14)	0.032
N(2)	0.0817 (3)	0.5428 (3)	0.09829 (15)	0.048
C(1)	0.3160 (3)	0.4794 (4)	0.21359 (16)	0.03
C(2)	0.4154 (3)	0.5598 (3)	0.29730 (15)	0.027
C(3)	0.2547 (3)	0.5961 (4)	0.14140 (16)	0.035
C(5)	0.4570 (3)	0.3676 (4)	0.19502 (18)	0.036
C(6)	0.4761 (4)	0.2847 (4)	0.1185 (2)	0.048
C(7)	0.6039 (4)	0.1718 (4)	0.1232 (2)	0.056
C(8)	0.7095 (4)	0.1437 (4)	0.2047 (2)	0.053
C(9)	0.6913 (3)	0.2253 (4)	0.2826 (2)	0.046
C(10)	0.5646 (3)	0.3377 (4)	0.27649 (18)	0.034
C(11)	0.6125 (3)	0.4439 (4)	0.42911 (18)	0.035
C(12)	0.6578 (4)	0.5828 (5)	0.56144 (17)	0.053
C(13)	0.2824 (3)	0.6486 (3)	0.34917 (17)	0.032
C(14)	0.1589 (3)	0.5703 (4)	0.40930 (17)	0.037
C(15)	0.1419 (4)	0.4043 (4)	0.5297 (2)	0.057
C(16)	0.1688 (3)	0.7432 (4)	0.27729 (17)	0.037
C(17)	0.5503 (3)	0.6698 (3)	0.26240 (19)	0.04
C(18)	0.4495 (3)	0.7954 (4)	0.2084 (2)	0.046
C(19)	0.2510 (3)	0.7483 (4)	0.18633 (18)	0.036
C(20)	0.1476 (3)	0.8561 (4)	0.12075 (19)	0.05
C(21)	−0.0421 (4)	0.7985 (4)	0.0875 (2)	0.052
C(22)	−0.0235 (5)	0.6501 (4)	0.0414 (2)	0.061
C(23)	−0.0128 (4)	0.4656 (4)	0.1641 (2)	0.058
C(24)	0.1363 (3)	0.3936 (4)	0.22784 (19)	0.04
H(3)	0.3536	0.5986	0.0908	0.063 (10)*
H(6)	0.3931	0.3062	0.0557	0.053 (10)*
H(7)	0.6218	0.1071	0.0637	0.077 (12)*
H(8)	0.8075	0.0555	0.2075	0.065 (11)*
H(9)	0.7741	0.2029	0.3454	0.057 (10)*
H(12A)	0.8006	0.5508	0.5738	0.103 (14)*
H(12B)	0.5748	0.5090	0.5981	0.082 (14)*
H(12C)	0.6415	0.6951	0.5849	0.068 (12)*
H(13)	0.3649	0.7249	0.3930	0.067 (11)*
H(15A)	0.0229	0.3508	0.4943	0.089 (13)*
H(15B)	0.0978	0.4873	0.5758	0.117 (17)*
H(15C)	0.2256	0.3227	0.5684	0.094 (13)*
H(16A)	0.0310	0.6992	0.2664	0.053 (10)*
H(16B)	0.1598	0.8545	0.3034	0.033 (8)*
H(17A)	0.6350	0.7163	0.3200	0.060 (10)*
H(17B)	0.6393	0.6129	0.2195	0.042 (9)*
H(18A)	0.5120	0.8150	0.1459	0.064 (11)*
H(18B)	0.4572	0.8964	0.2481	0.064 (11)*

H(20A)	0.1338	0.9607	0.1552	0.065 (11)*
H(20B)	0.2244	0.8753	0.0627	0.070 (11)*
H(21A)	−0.1228	0.7859	0.1447	0.071 (12)*
H(21B)	−0.1118	0.8759	0.0397	0.101 (13)*
H(22A)	−0.1599	0.6060	0.0217	0.099 (14)*
H(22B)	0.0422	0.6673	−0.0209	0.094 (14)*
H(23A)	−0.1050	0.3826	0.1316	0.085 (12)*
H(23B)	−0.0921	0.5425	0.2013	0.096 (14)*
H(24A)	0.1494	0.2778	0.2112	0.060 (11)*
H(24B)	0.1056	0.4025	0.2982	0.072 (11)*

Atomic displacement parameters (Å^2) for (pleio)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
O(1)	0.0458 (12)	0.0410 (15)	0.0522 (13)	0.0087 (10)	−0.0029 (10)	0.0122 (11)
O(2)	0.0295 (10)	0.0415 (13)	0.0399 (12)	0.0022 (10)	0.0040 (8)	−0.0013 (11)
O(3)	0.0318 (11)	0.0715 (17)	0.0786 (15)	0.0180 (11)	0.0248 (10)	0.0200 (12)
O(4)	0.0309 (11)	0.0542 (15)	0.0550 (12)	0.0057 (10)	0.0120 (9)	0.0178 (11)
N(1)	0.0262 (12)	0.0302 (16)	0.0419 (14)	0.0063 (10)	0.0072 (11)	0.0029 (13)
N(2)	0.0479 (15)	0.0428 (18)	0.0509 (16)	−0.0009 (13)	−0.0119 (13)	−0.0079 (13)
C(1)	0.0269 (15)	0.031 (2)	0.0342 (16)	−0.0005 (13)	0.0067 (12)	−0.0031 (13)
C(2)	0.0218 (13)	0.0273 (17)	0.0335 (16)	0.0008 (13)	0.0055 (11)	0.0004 (14)
C(3)	0.0327 (15)	0.037 (2)	0.0370 (17)	0.0033 (14)	0.0035 (13)	0.0026 (15)
C(5)	0.0354 (17)	0.034 (2)	0.0408 (19)	−0.0002 (14)	0.0112 (14)	−0.0055 (15)
C(6)	0.0455 (19)	0.044 (2)	0.056 (2)	0.0048 (16)	0.0170 (16)	−0.0126 (18)
C(7)	0.055 (2)	0.051 (2)	0.066 (2)	−0.0009 (18)	0.0231 (19)	−0.016 (2)
C(8)	0.0513 (19)	0.039 (2)	0.073 (3)	0.0084 (17)	0.0274 (19)	−0.0043 (19)
C(9)	0.0368 (19)	0.041 (2)	0.064 (2)	0.0094 (15)	0.0190 (17)	0.0015 (18)
C(10)	0.0252 (15)	0.032 (2)	0.0480 (19)	0.0043 (14)	0.0130 (14)	−0.0018 (16)
C(11)	0.0233 (15)	0.039 (2)	0.0431 (19)	0.0016 (14)	0.0041 (14)	0.0078 (18)
C(12)	0.056 (2)	0.069 (3)	0.0335 (18)	0.009 (2)	−0.0046 (15)	−0.0068 (19)
C(13)	0.0259 (14)	0.0280 (18)	0.0417 (17)	0.0054 (13)	0.0063 (13)	0.0026 (14)
C(14)	0.0302 (16)	0.0356 (18)	0.0454 (17)	0.0055 (15)	0.0119 (14)	0.0005 (15)
C(15)	0.045 (2)	0.070 (3)	0.059 (2)	0.002 (2)	0.0220 (18)	0.029 (2)
C(16)	0.0385 (19)	0.038 (2)	0.0357 (18)	0.0070 (14)	0.0019 (14)	0.0001 (15)
C(17)	0.0318 (16)	0.041 (2)	0.0469 (19)	−0.0077 (15)	0.0047 (15)	0.0041 (16)
C(18)	0.0374 (18)	0.043 (2)	0.058 (2)	−0.0099 (15)	0.0018 (15)	0.0114 (18)
C(19)	0.0365 (17)	0.031 (2)	0.0404 (18)	−0.0009 (14)	0.0004 (14)	0.0060 (15)
C(20)	0.051 (2)	0.047 (2)	0.049 (2)	0.0013 (16)	−0.0025 (17)	0.0120 (18)
C(21)	0.050 (2)	0.051 (3)	0.052 (2)	0.0059 (17)	−0.0085 (18)	0.0046 (18)
C(22)	0.064 (2)	0.060 (3)	0.054 (2)	0.0135 (19)	−0.019 (2)	−0.0017 (19)
C(23)	0.0308 (18)	0.056 (2)	0.084 (2)	−0.0066 (18)	−0.0071 (17)	0.003 (2)
C(24)	0.0284 (16)	0.040 (2)	0.053 (2)	−0.0098 (14)	0.0075 (14)	−0.0038 (15)

Geometric parameters (Å, º) for pleiocarpine **(13)**

O(1)—C(11)	1.211 (3)	C(7)—C(8)	1.396 (4)
O(2)—C(11)	1.326 (3)	C(7)—H(7)	1.0822
O(3)—C(14)	1.195 (3)	C(8)—C(9)	1.394 (3)
O(4)—C(14)	1.328 (3)	C(8)—H(8)	1.0822
N(1)—C(10)	1.411 (3)	C(9)—C(10)	1.389 (3)
N(1)—C(11)	1.380 (3)	C(9)—H(9)	1.0822
N(2)—C(3)	1.457 (3)	C(13)—C(14)	1.521 (3)
N(2)—C(23)	1.443 (3)	C(16)—C(19)	1.537 (3)
C(1)—C(5)	1.506 (3)	C(18)—C(19)	1.535 (3)
C(5)—C(6)	1.385 (3)	C(19)—C(20)	1.534 (3)
C(5)—C(10)	1.406 (3)	C(20)—C(21)	1.535 (3)
C(6)—C(7)	1.398 (4)	C(21)—C(22)	1.532 (4)
C(6)—H(6)	1.0822	C(23)—C(24)	1.528 (3)
C(10)—N(1)—C(11)	123.4 (2)	O(1)—C(11)—O(2)	125.2 (3)
C(3)—N(2)—C(23)	109.4 (2)	O(1)—C(11)—N(1)	123.1 (3)
C(1)—C(5)—C(6)	130.7 (3)	O(2)—C(11)—N(1)	111.7 (2)
C(1)—C(5)—C(10)	108.5 (2)	O(3)—C(14)—O(4)	122.6 (3)
C(6)—C(5)—C(10)	120.2 (3)	O(3)—C(14)—C(13)	124.1 (3)
C(5)—C(6)—C(7)	119.2 (3)	O(4)—C(14)—C(13)	113.2 (2)
C(6)—C(7)—C(8)	119.8 (3)	C(16)—C(19)—C(18)	106.1 (2)
C(7)—C(8)—C(9)	121.8 (3)	C(16)—C(19)—C(20)	111.1 (2)
C(8)—C(9)—C(10)	117.6 (3)	C(18)—C(19)—C(20)	111.2 (2)
N(1)—C(10)—C(5)	109.2 (2)	C(19)—C(20)—C(21)	111.4 (2)
N(1)—C(10)—C(9)	129.4 (3)	C(20)—C(21)—C(22)	109.1 (3)
C(5)—C(10)—C(9)	121.4 (3)	N(2)—C(23)—C(24)	105.1 (2)

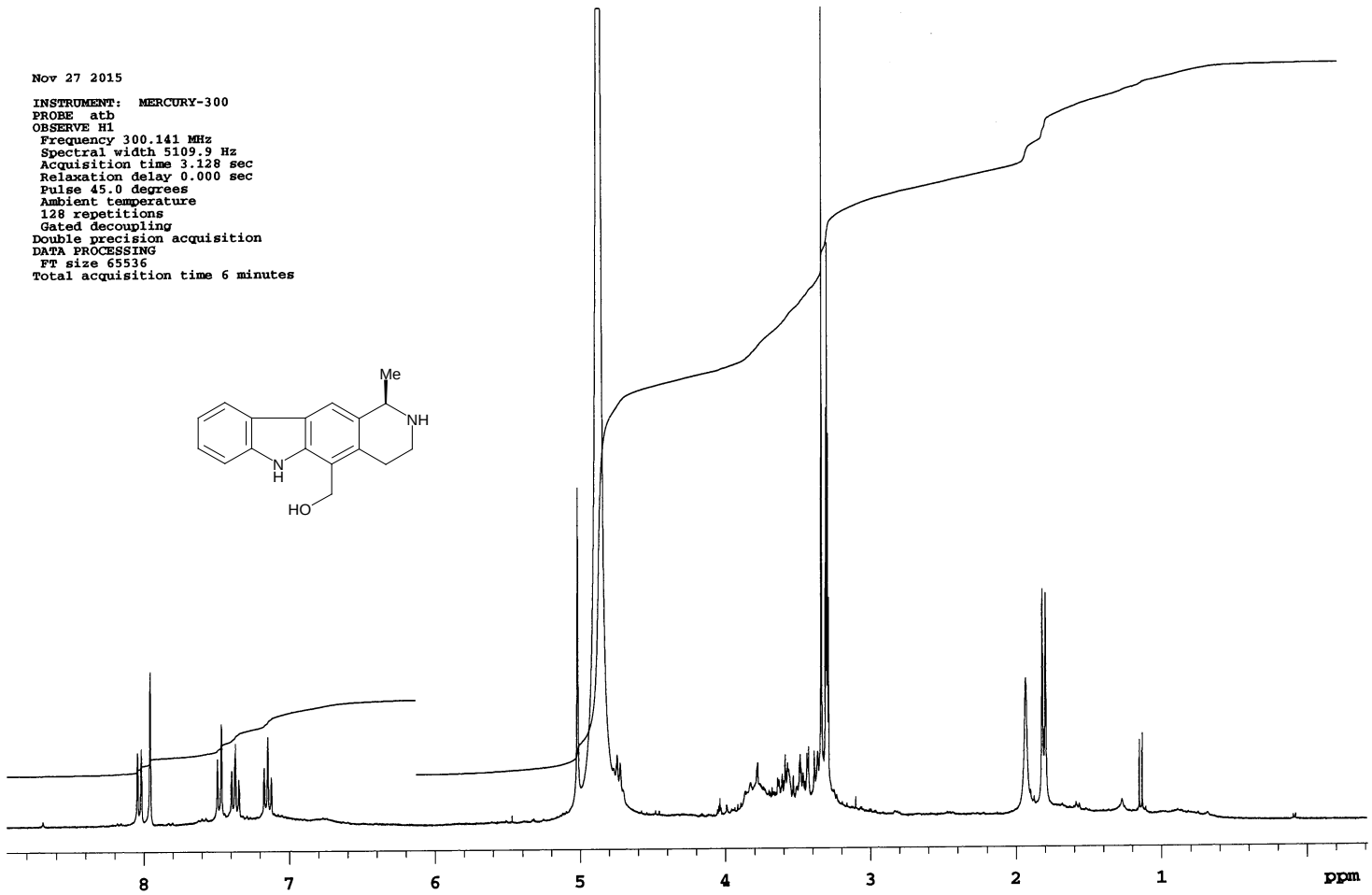

Figure S16: ^{1}H NMR spectrum (300 MHz, Methanol-d_4) of **1a**.

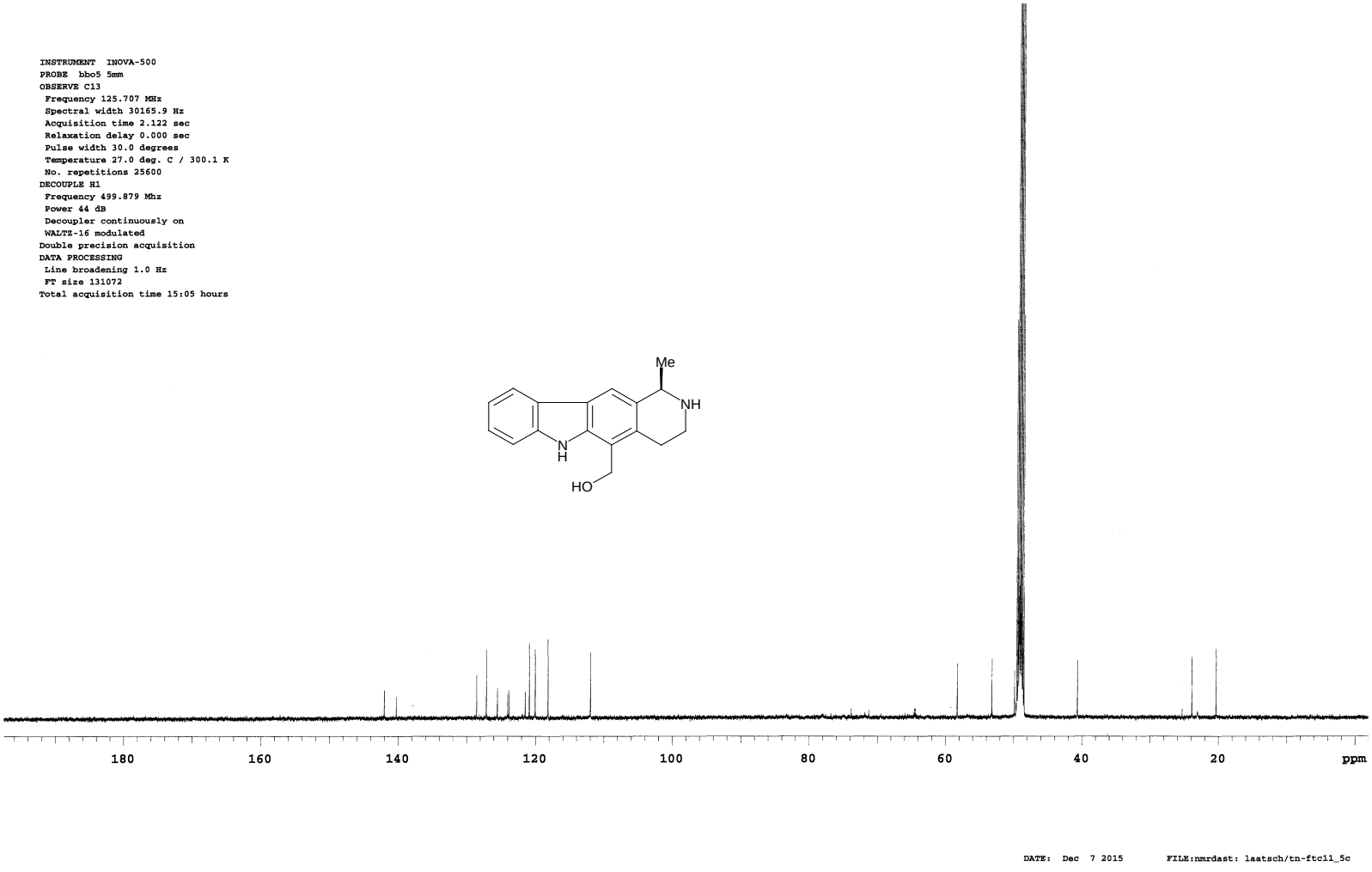

Figure S17: ^{13}C NMR spectrum (125 MHz, Methanol-d_4) of **1a**.

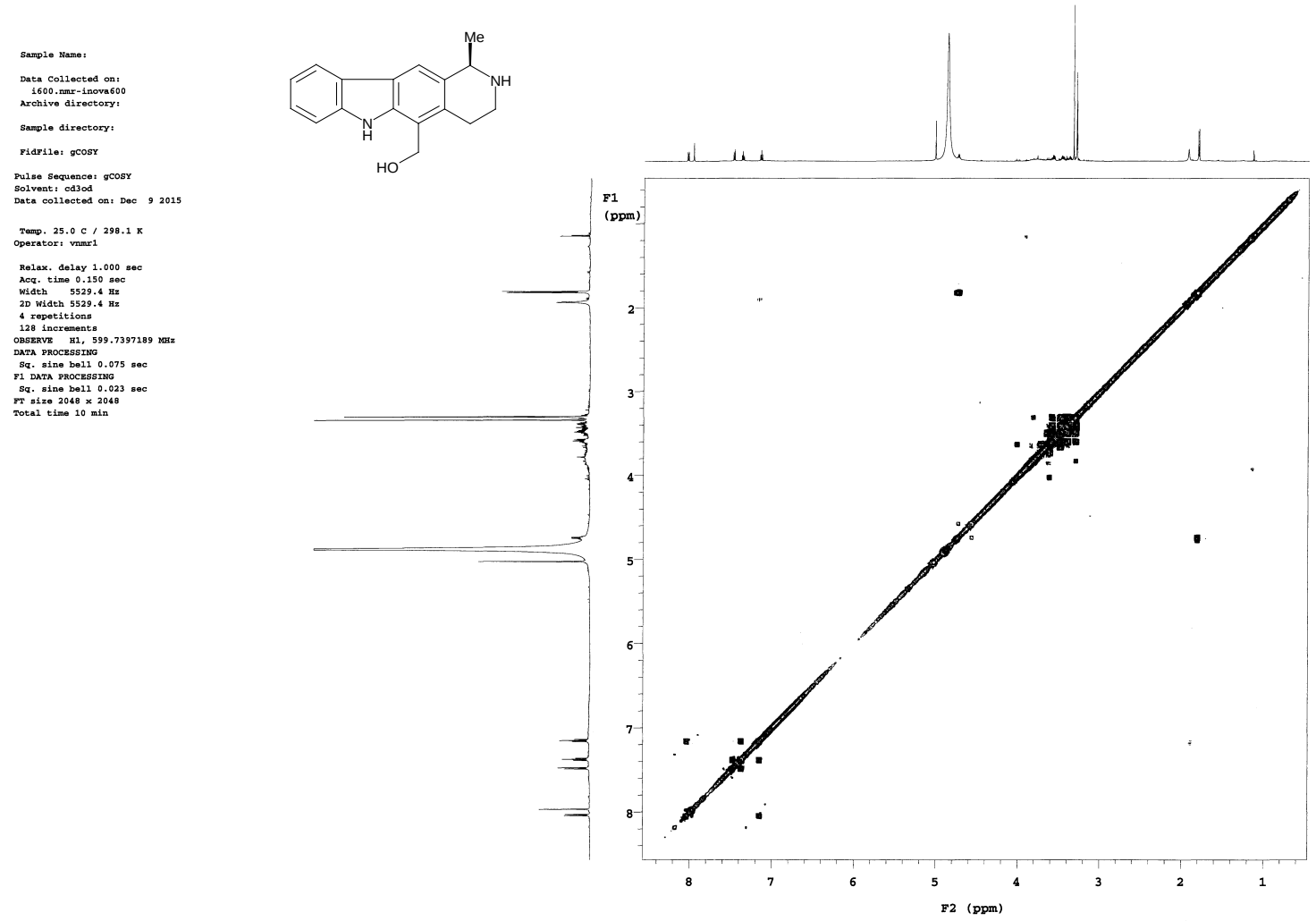

Figure S18: ^{1}H, ^{1}H COSY spectrum (600 MHz, Methanol-d_4) of **1a**.

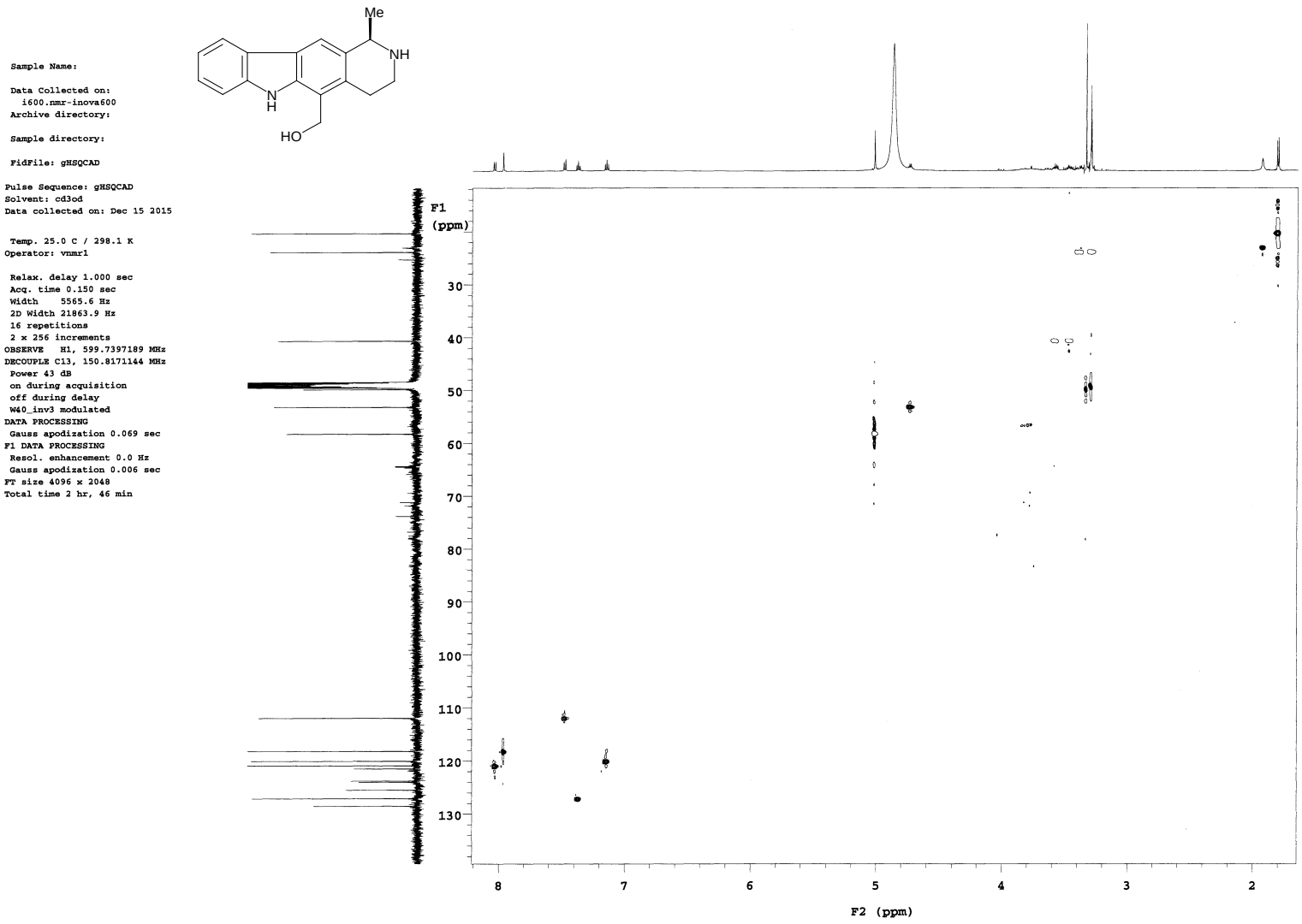

Figure S19: HSQC spectrum (600 MHz, Methanol-d_4) of **1a**.

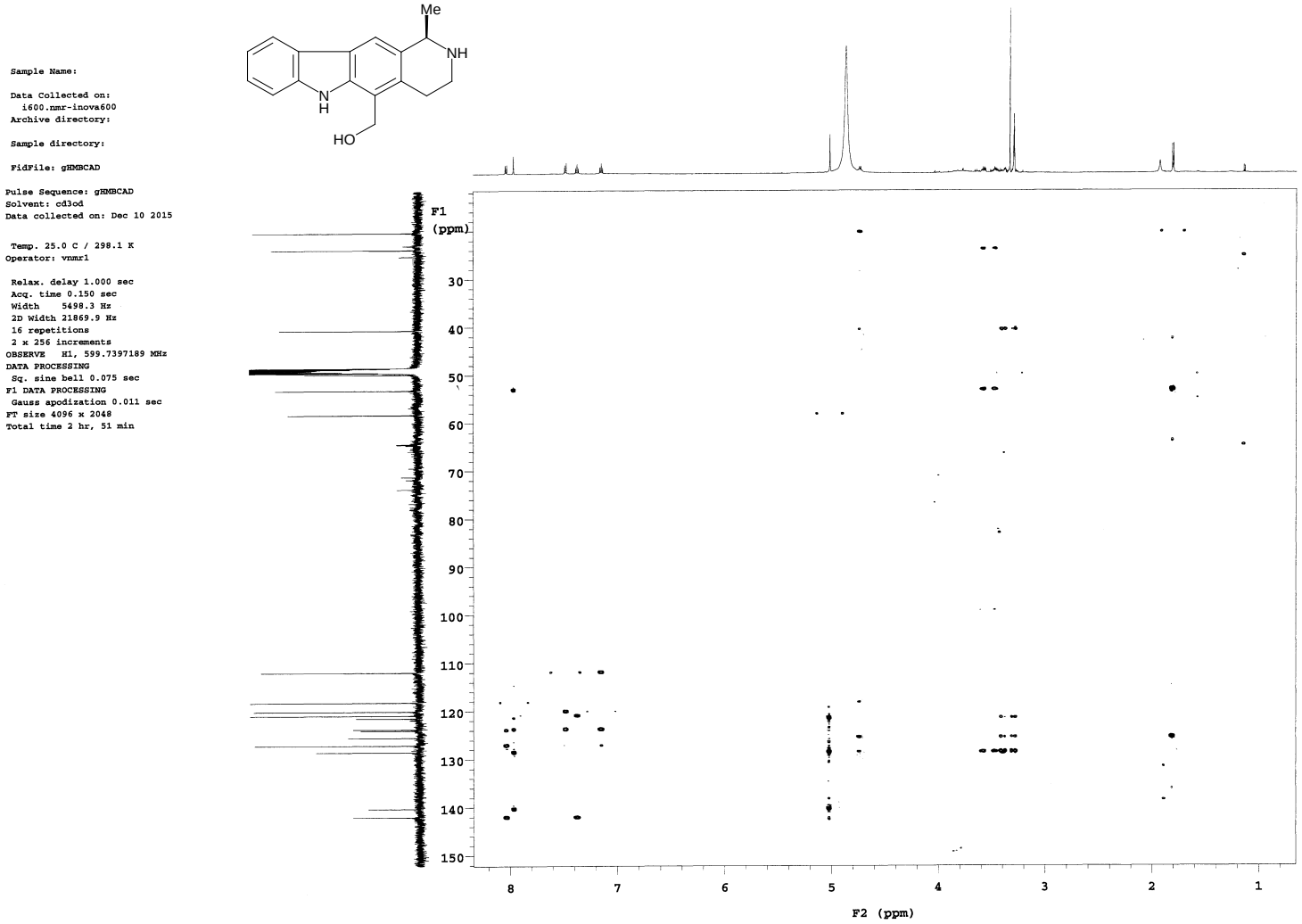

Figure S20: HSQC spectrum (600 MHz, Methanol-d_4) of **1a**.

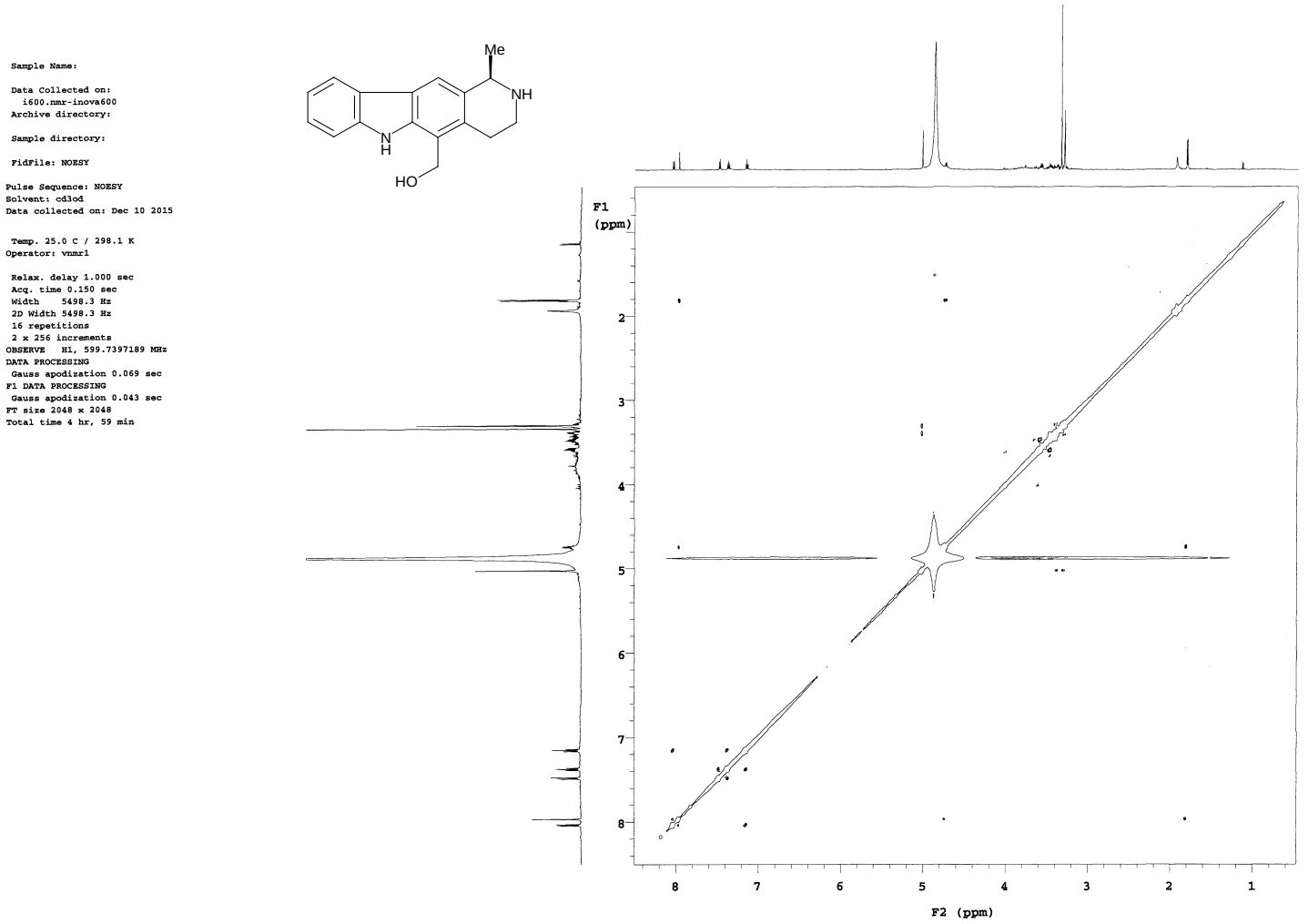

Figure S21: HSQC spectrum (600 MHz, Methanol-d_4) of **1a**.

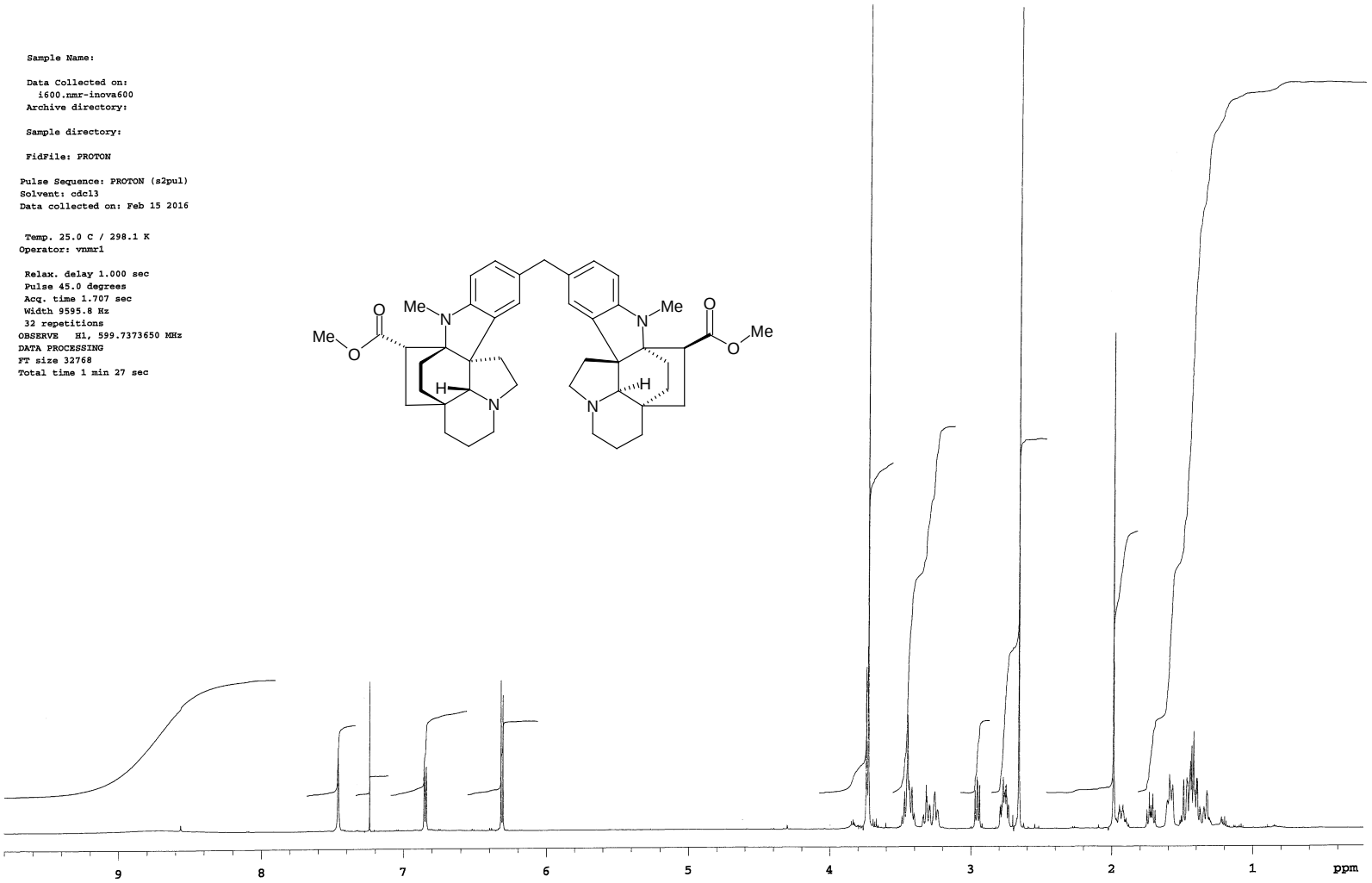

Figure S22: ^{1}H NMR spectrum (600 MHz, $CDCl_3$) of **2.**

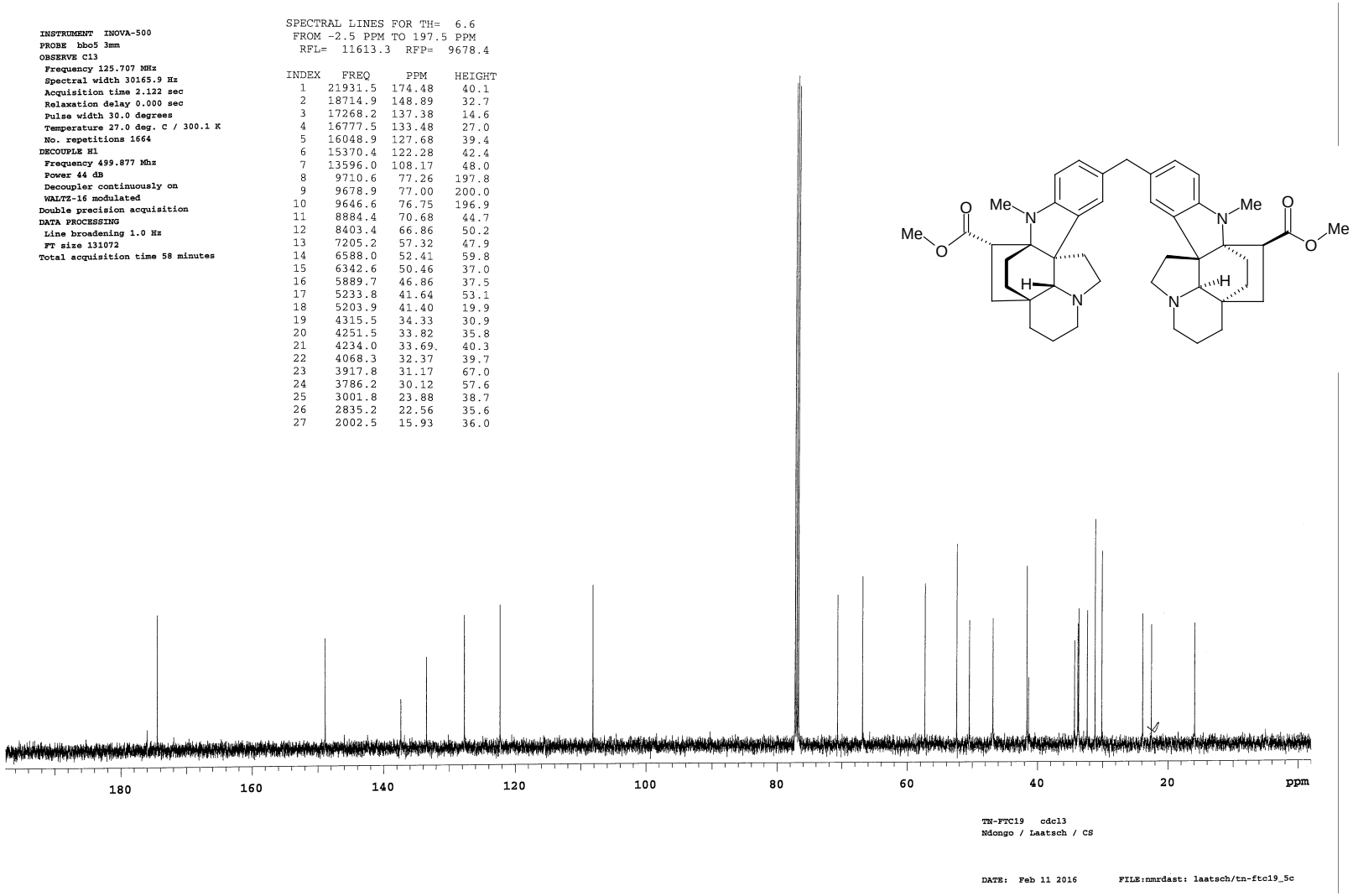

Figure S23: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **2.**

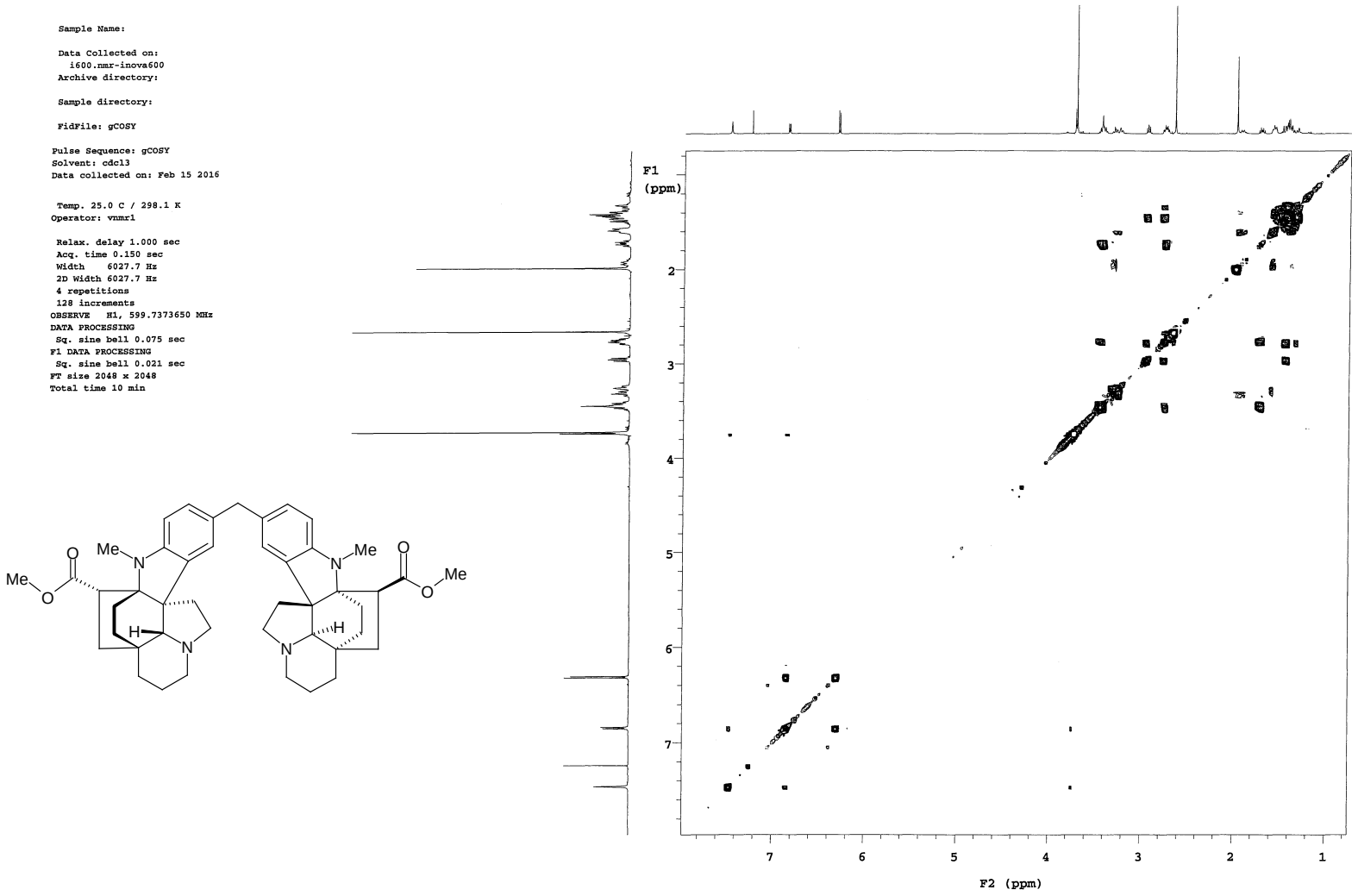

Figure S24: ^{1}H, ^{1}H COSY spectrum (600 MHz, $CDCl_3$) of **2.**

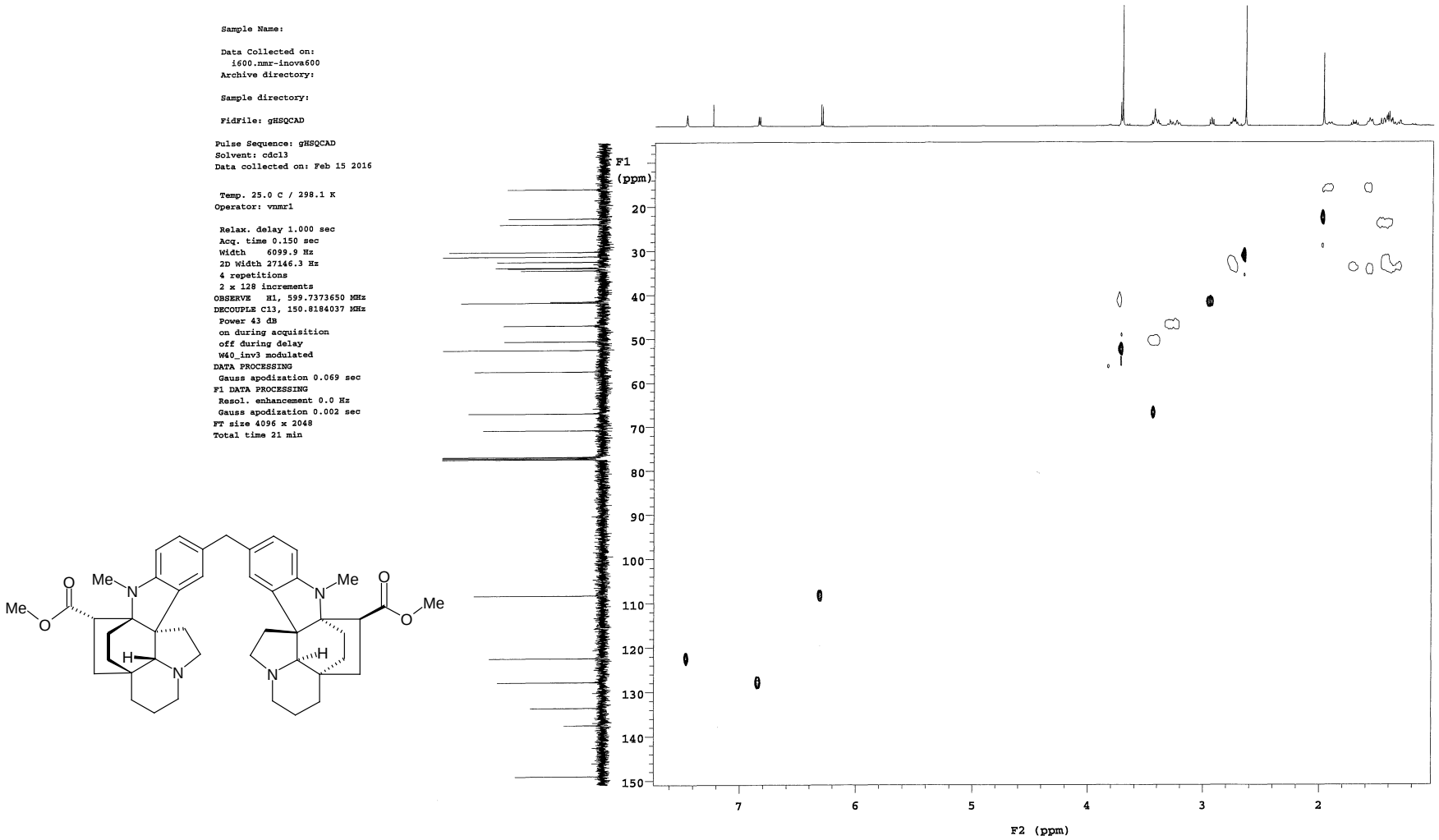

Figure S25: HSQC spectrum (600 MHz, $CDCl_3$) of **2**.

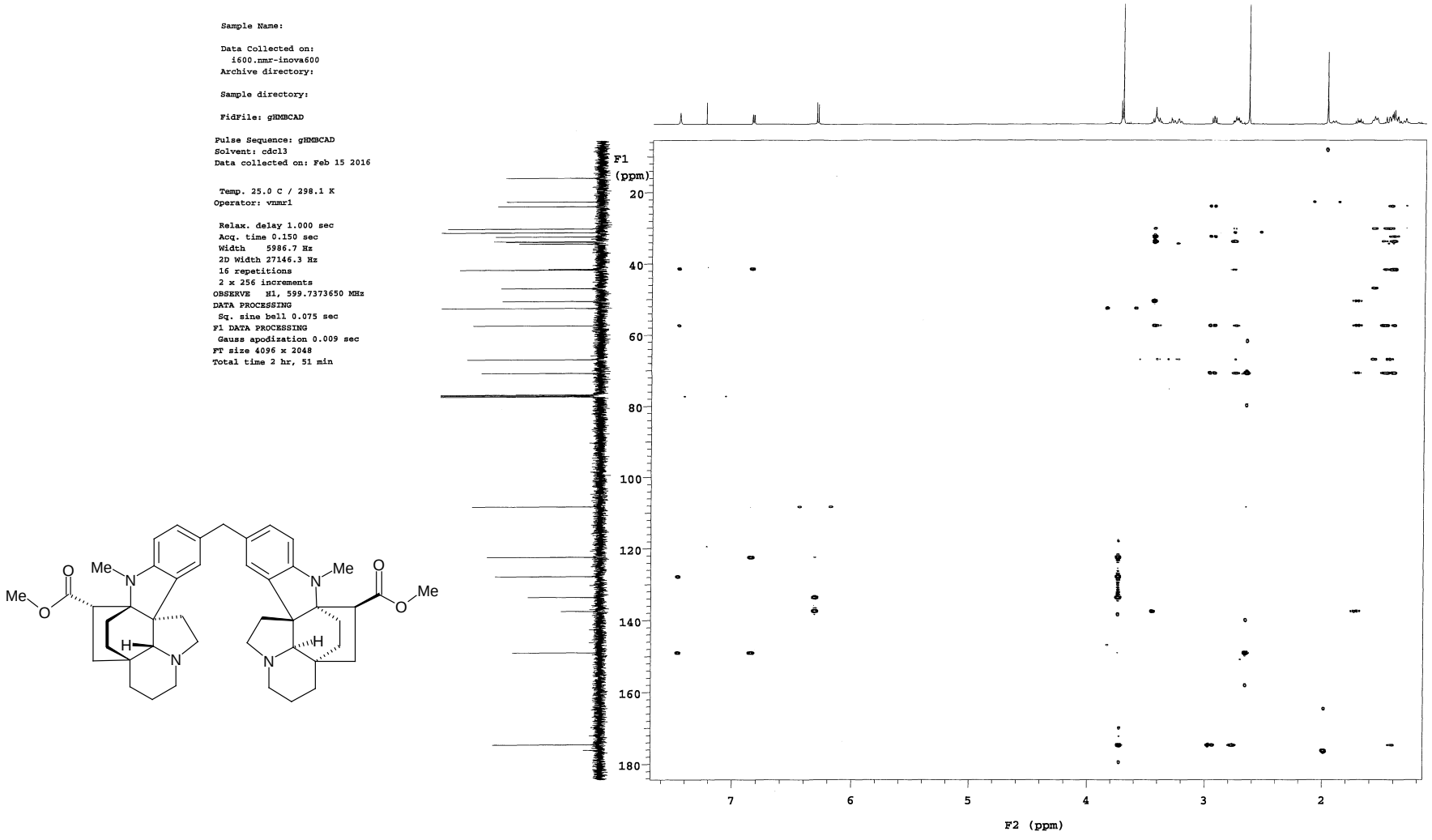

Figure S26: HMBC spectrum (600 MHz, $CDCl_3$) of **2.**

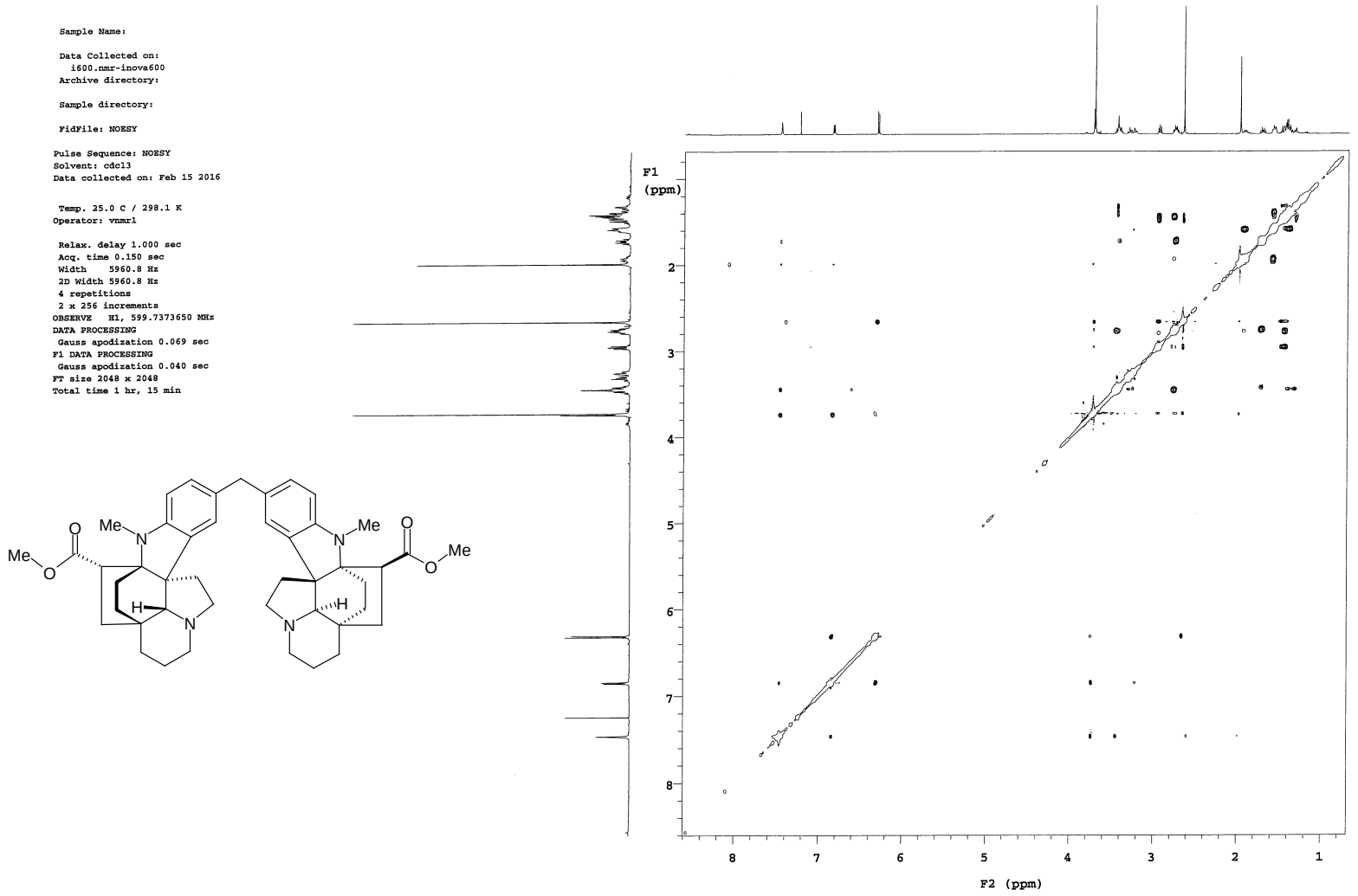

Figure S27: NOESY spectrum (600 MHz, $CDCl_3$) of **2.**

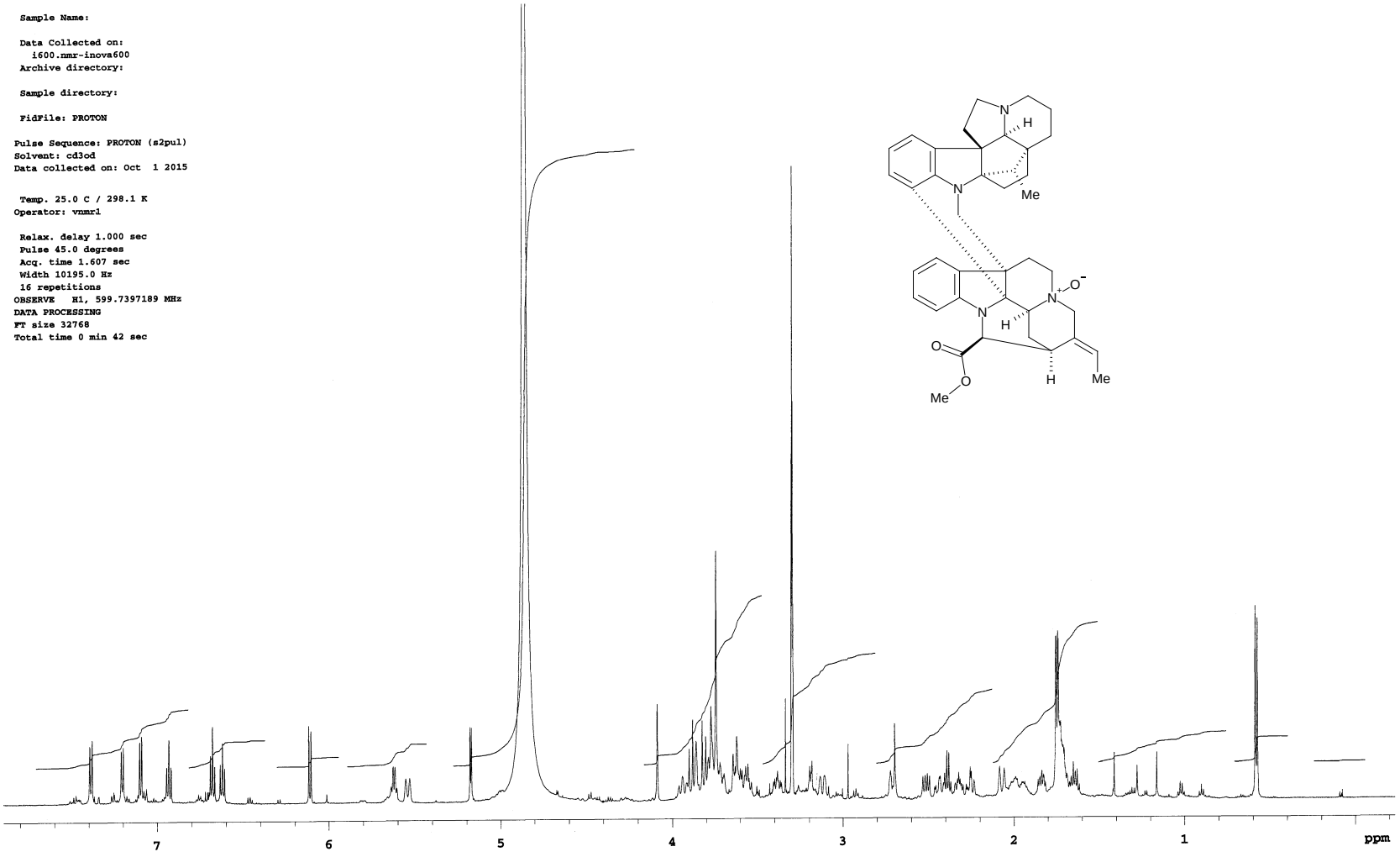

Figure S28: ^{1}H NMR spectrum (600 MHz, Methanol-d_4) of **3a.**

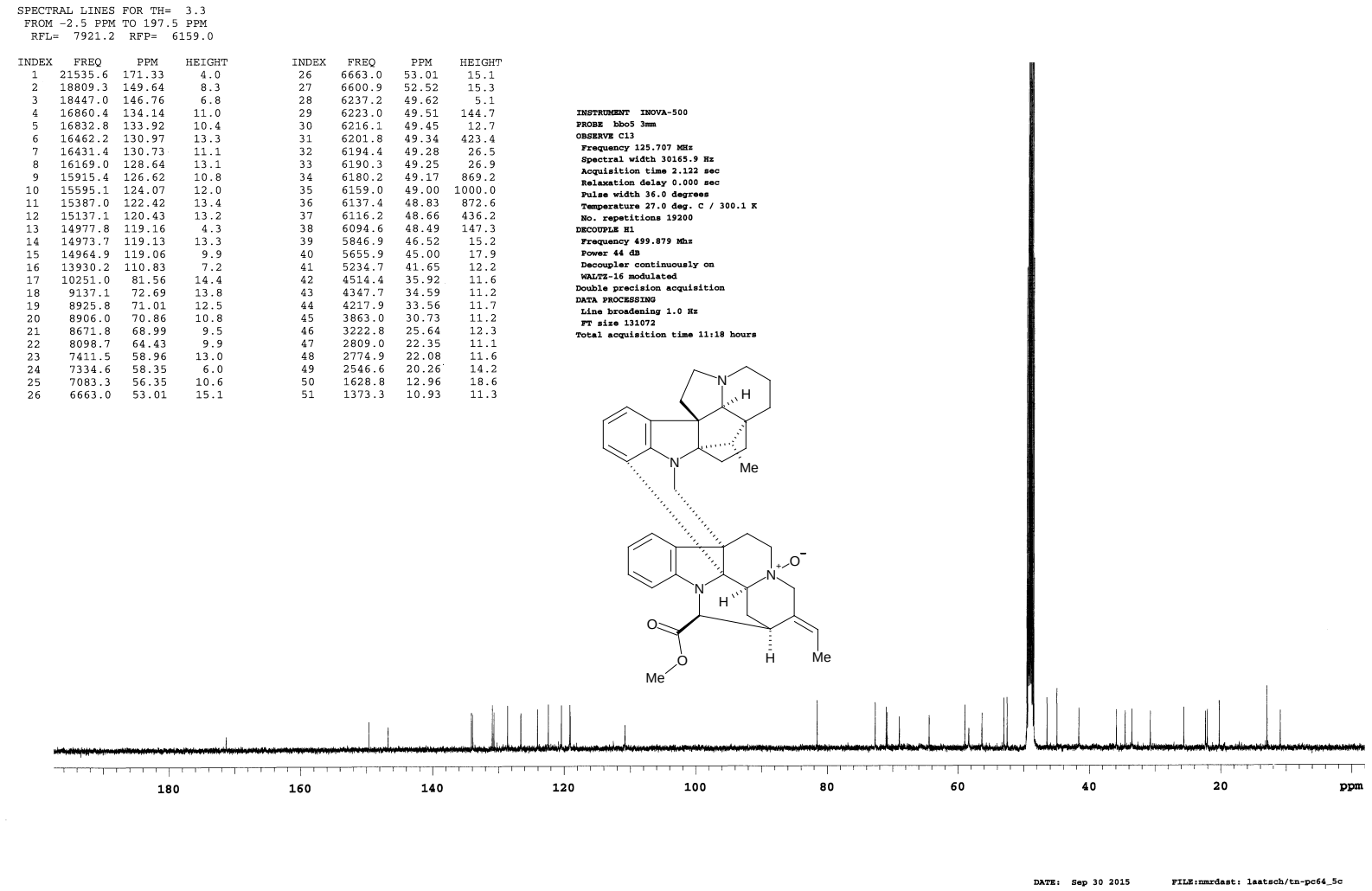

Figure S29: ^{13}C NMR spectrum (125 MHz, Methanol-d_4) of **3a.**

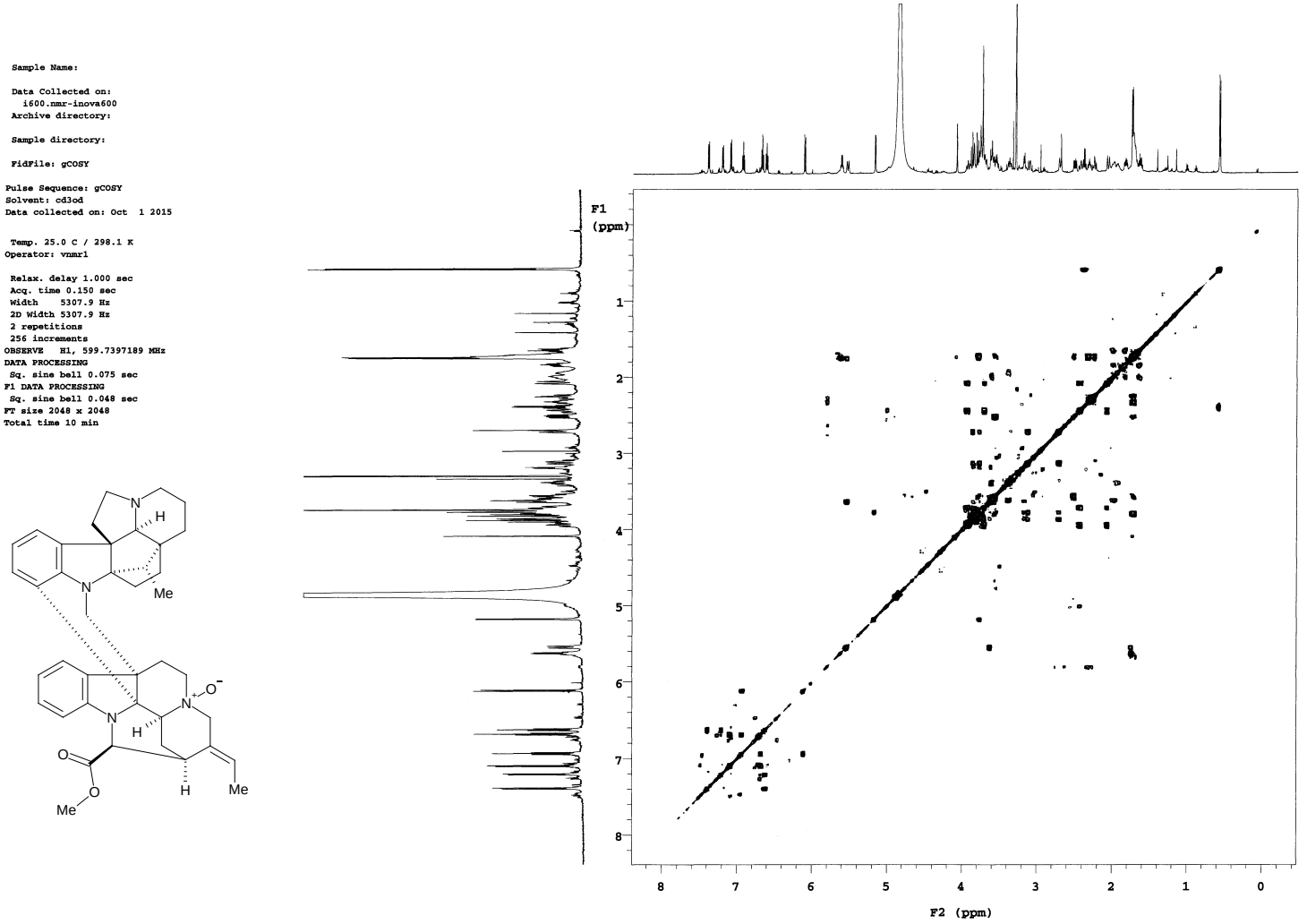

Figure S30: ^{1}H, ^{1}H COSY spectrum (600 MHz, Methanol-d_4) of **3a.**

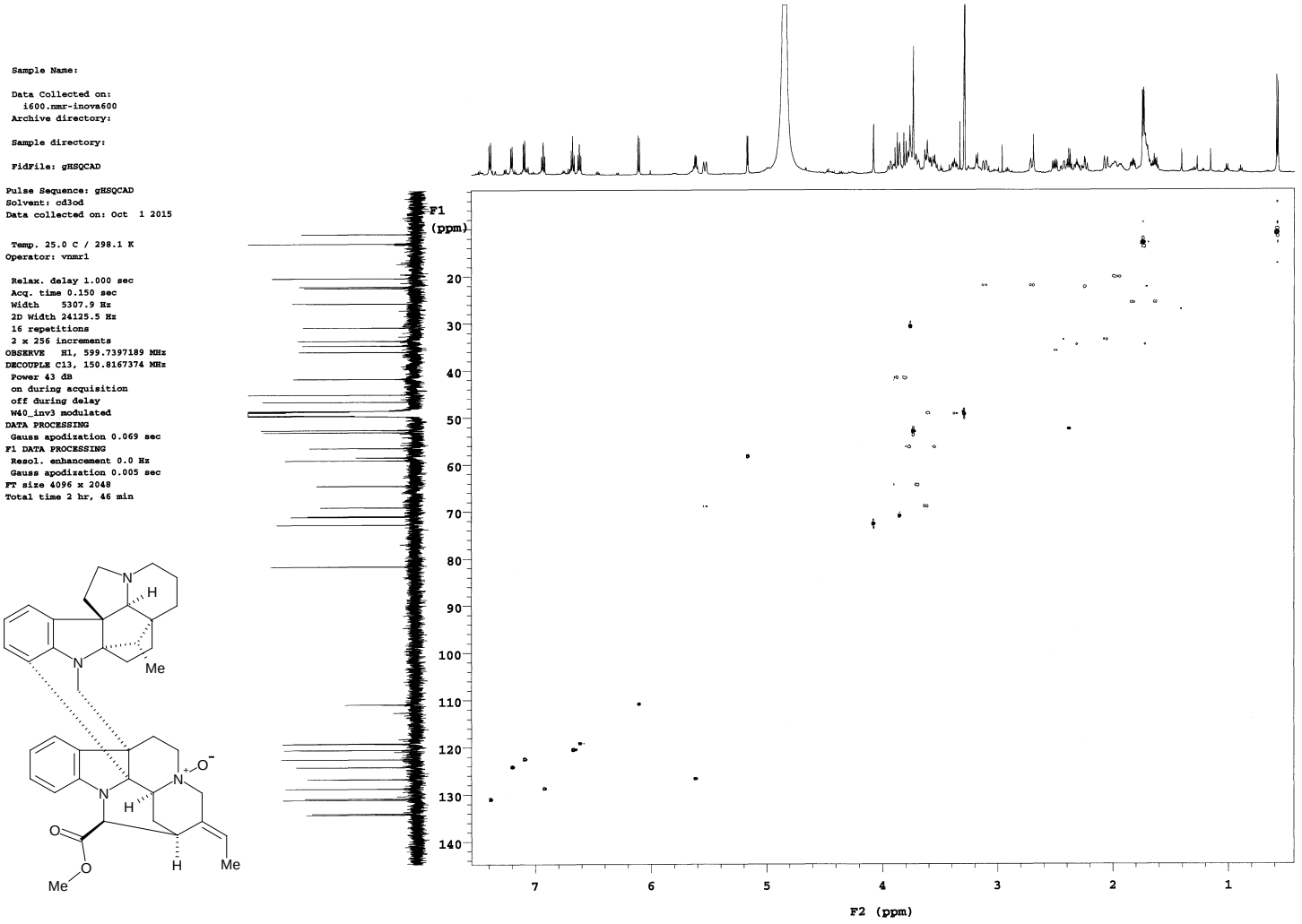

Figure S31: HSQC spectrum (600 MHz, Methanol-d_4) of **3a.**

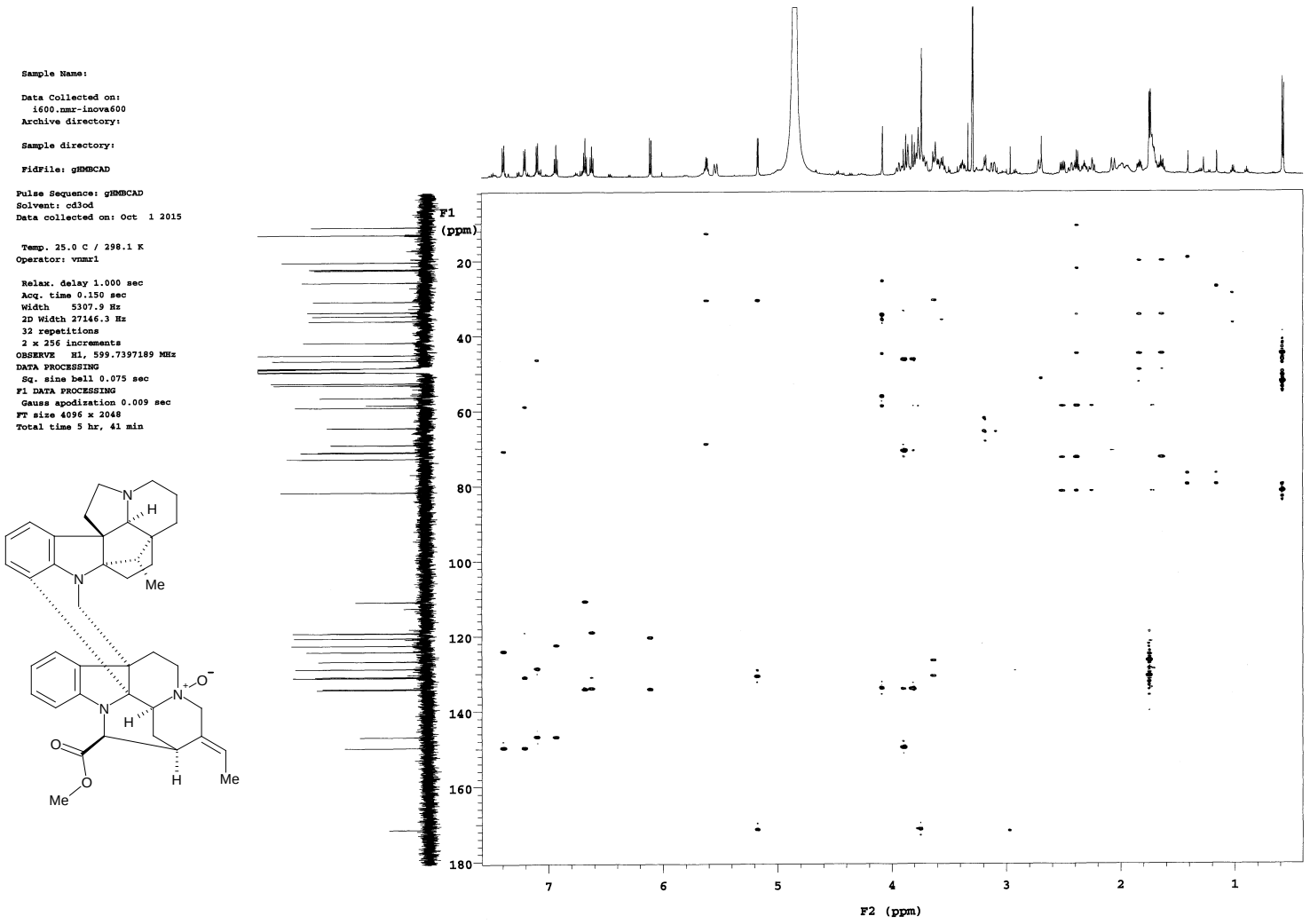

Figure S32: HMBC spectrum (600 MHz, Methanol-d_4) of **3a.**

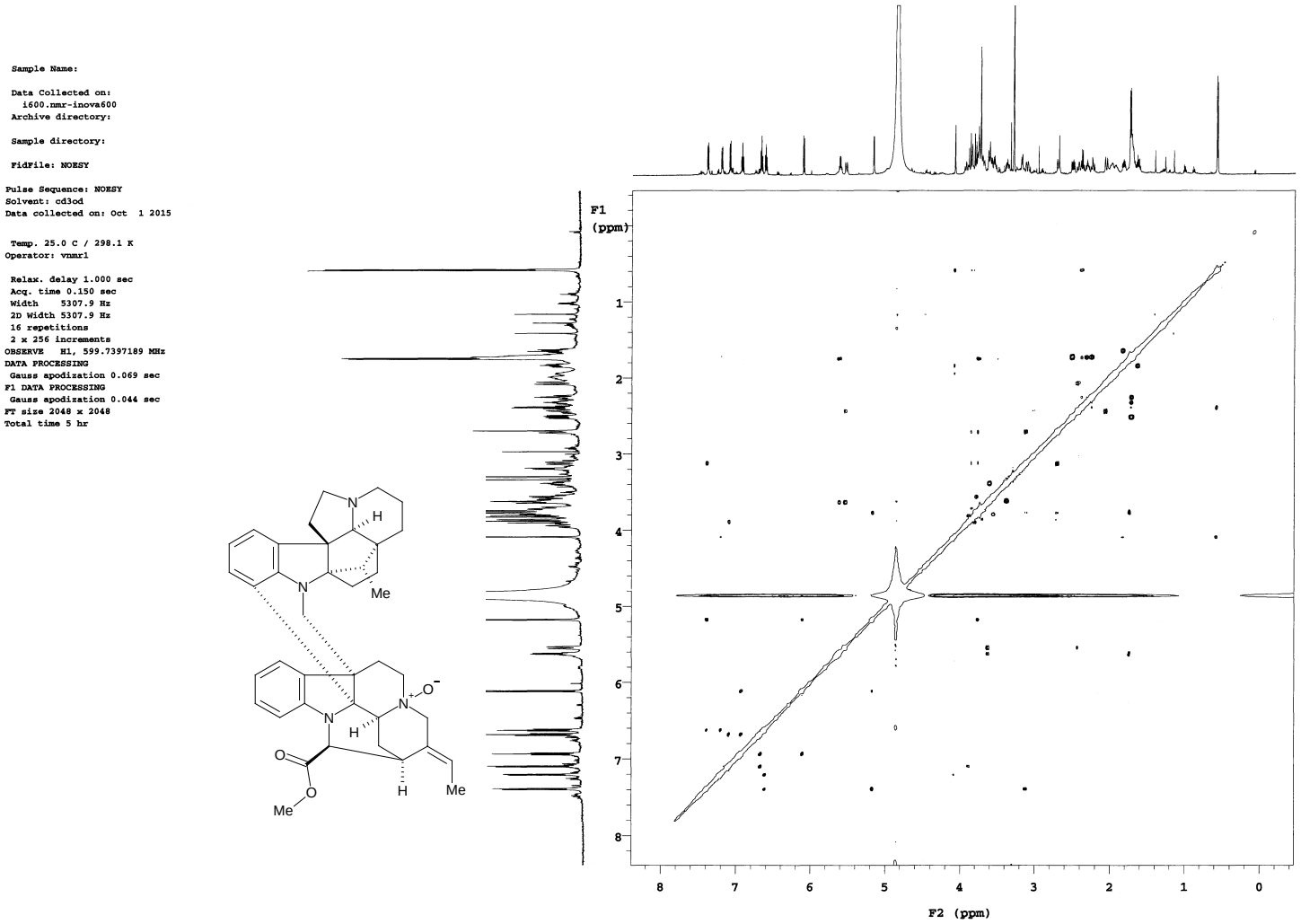

Figure S33: NOESY spectrum (600 MHz, Methanol-d_4) of **3a.**

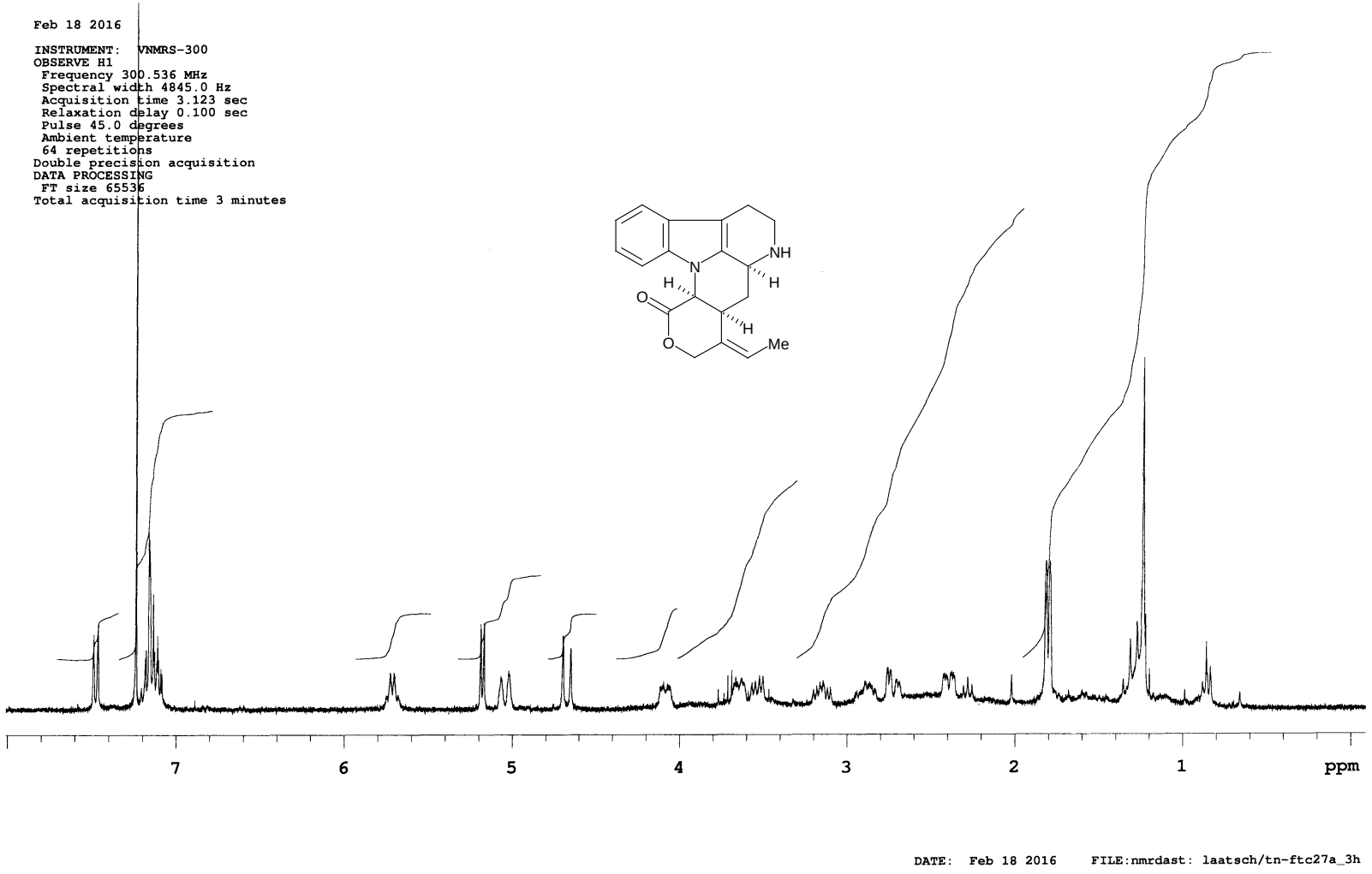

Figure S34: ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of **6.**

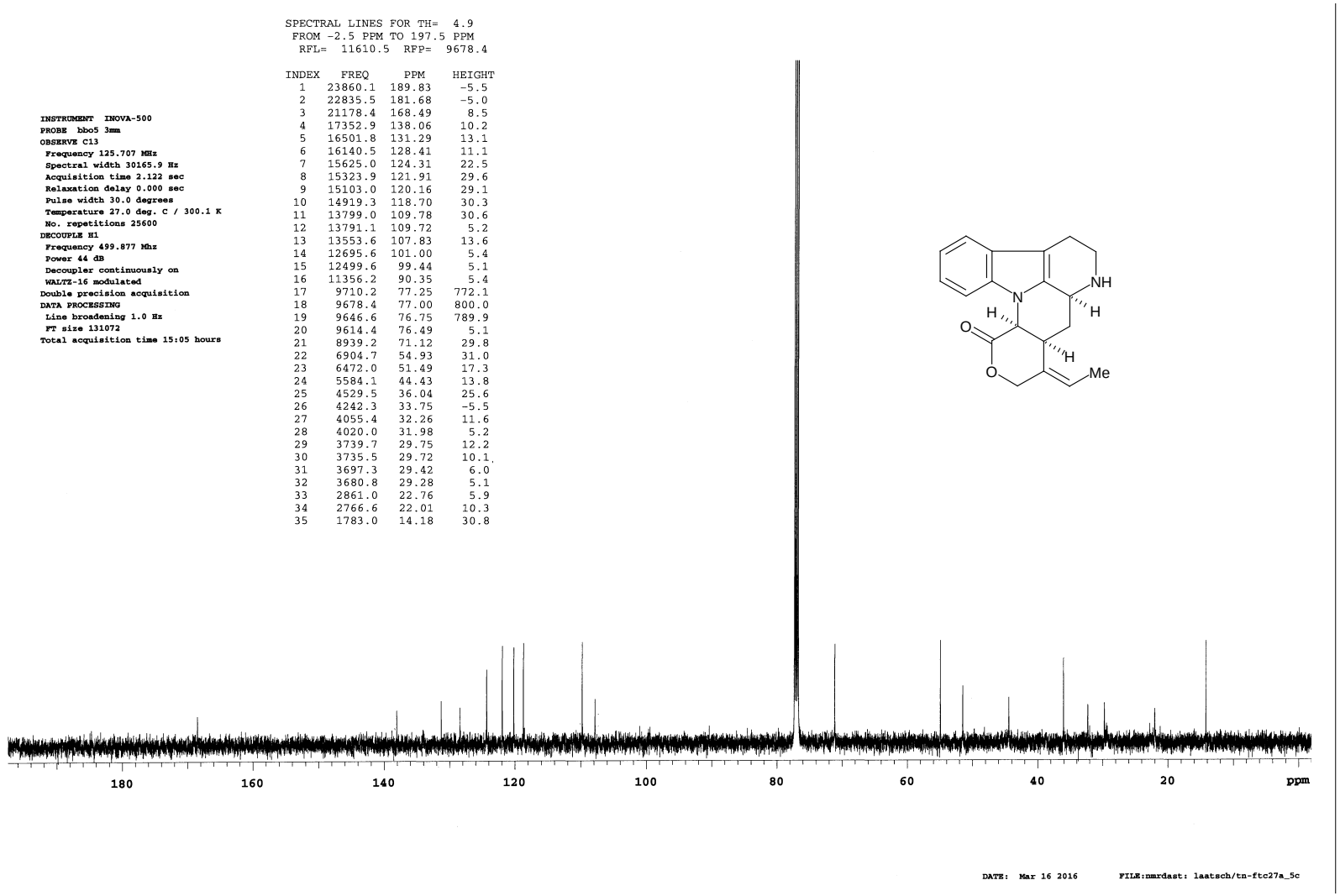

Figure S35: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **6.**

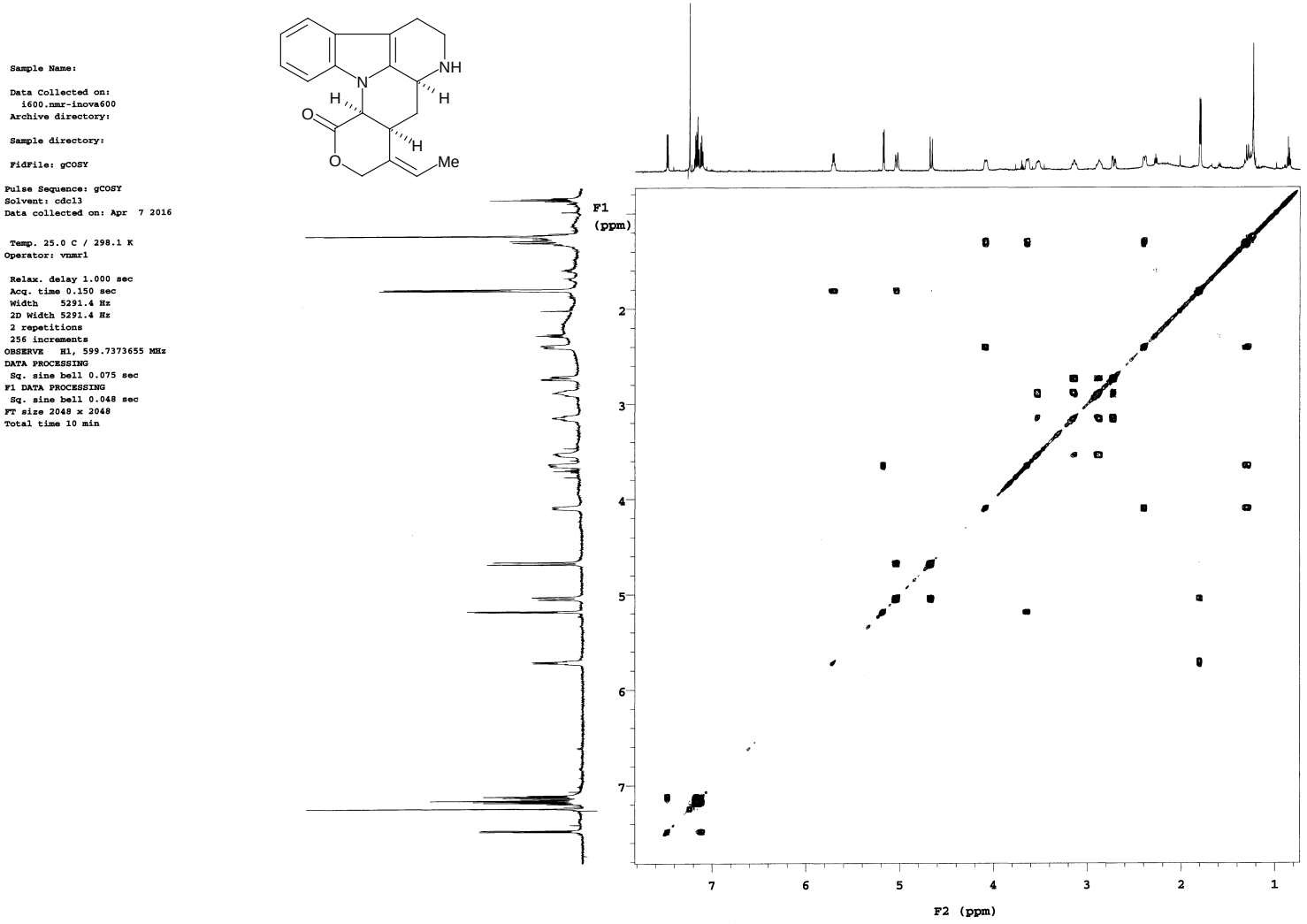

Figure S36: ^{1}H, ^{1}H COSY spectrum (600 MHz, $CDCl_3$) of **6.**

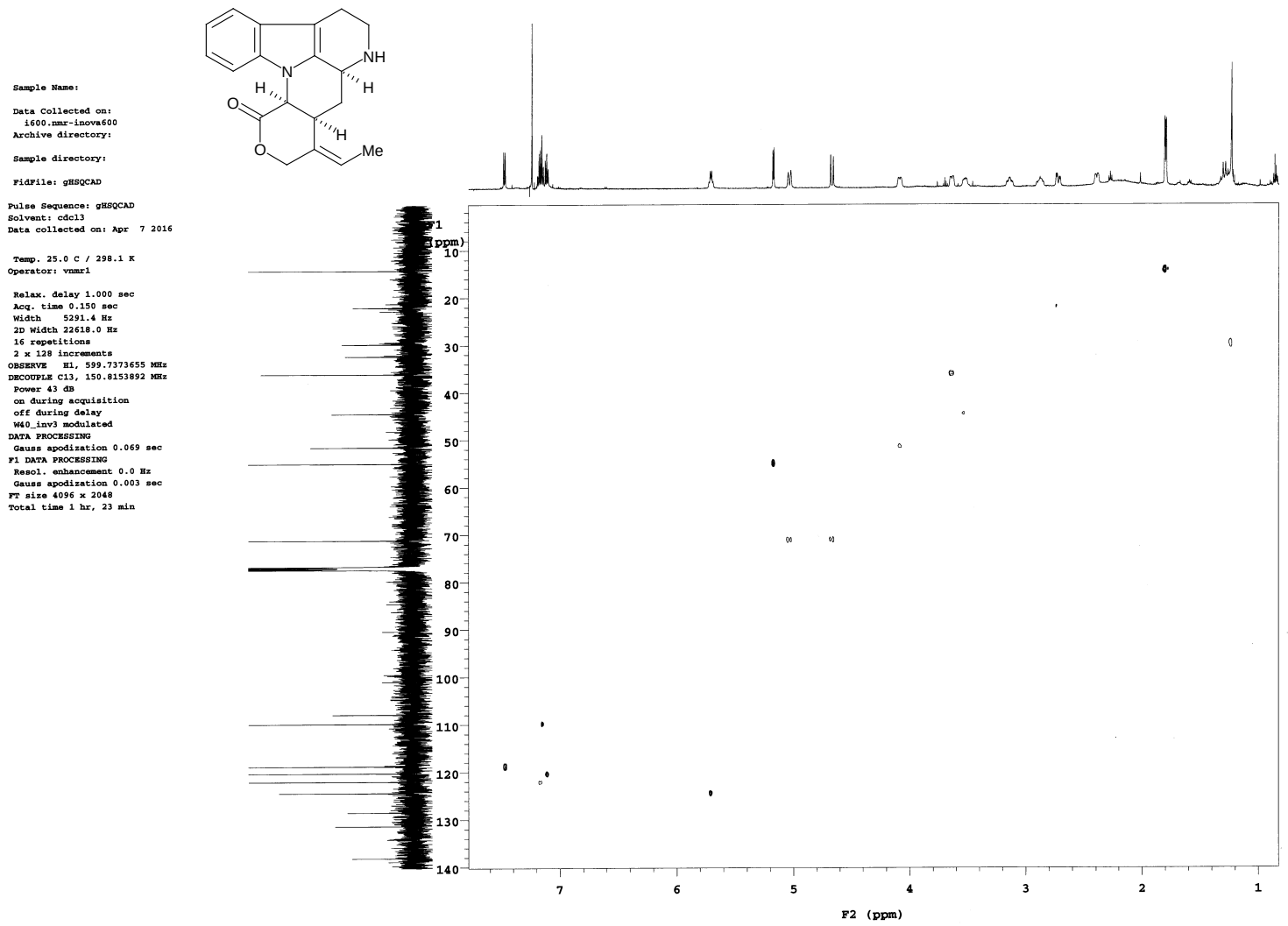

Figure S37: HSQC spectrum (600 MHz, $CDCl_3$) of **6.**

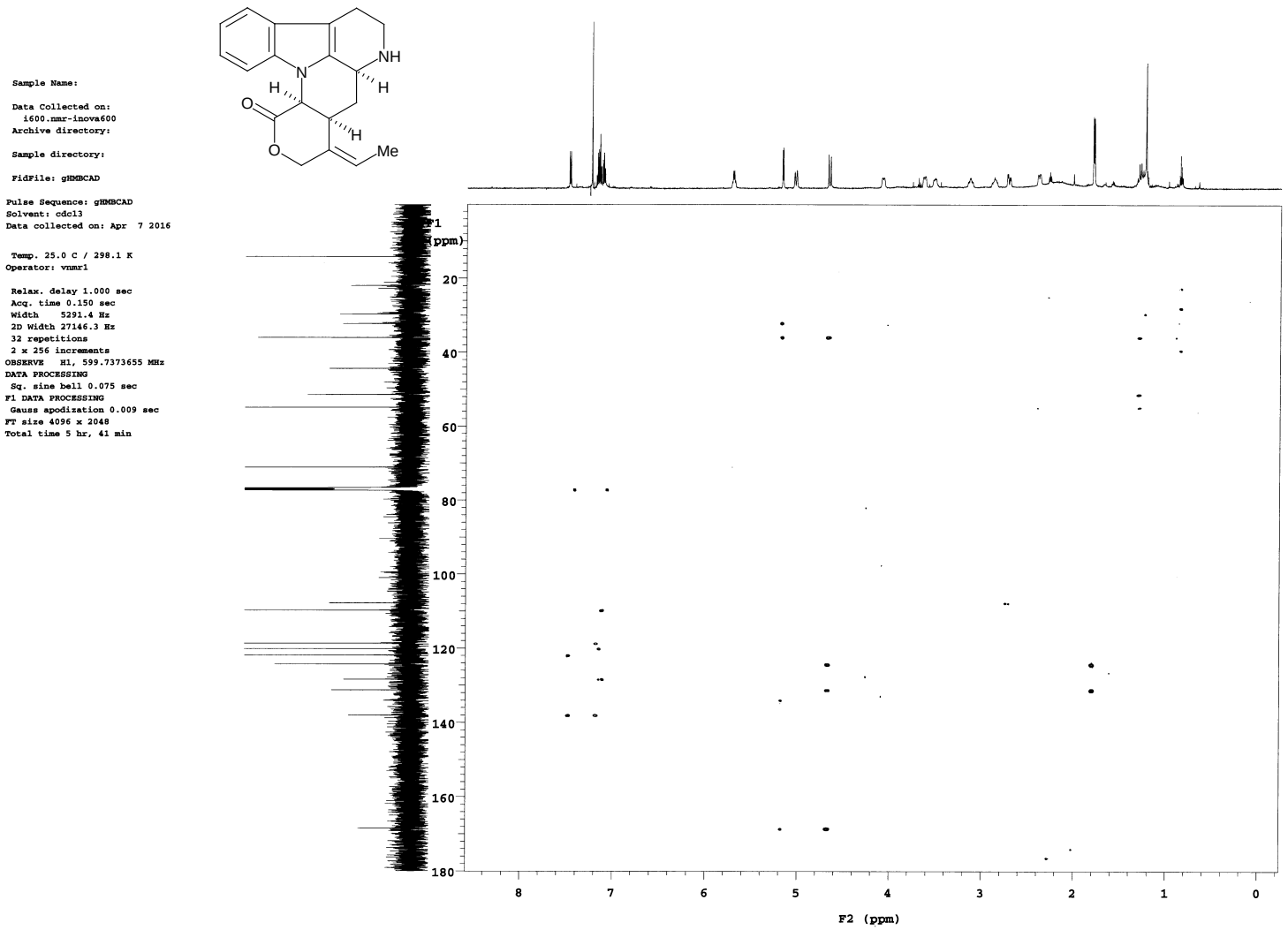

Figure S38: HMBC spectrum (600 MHz, $CDCl_3$) of **6.**

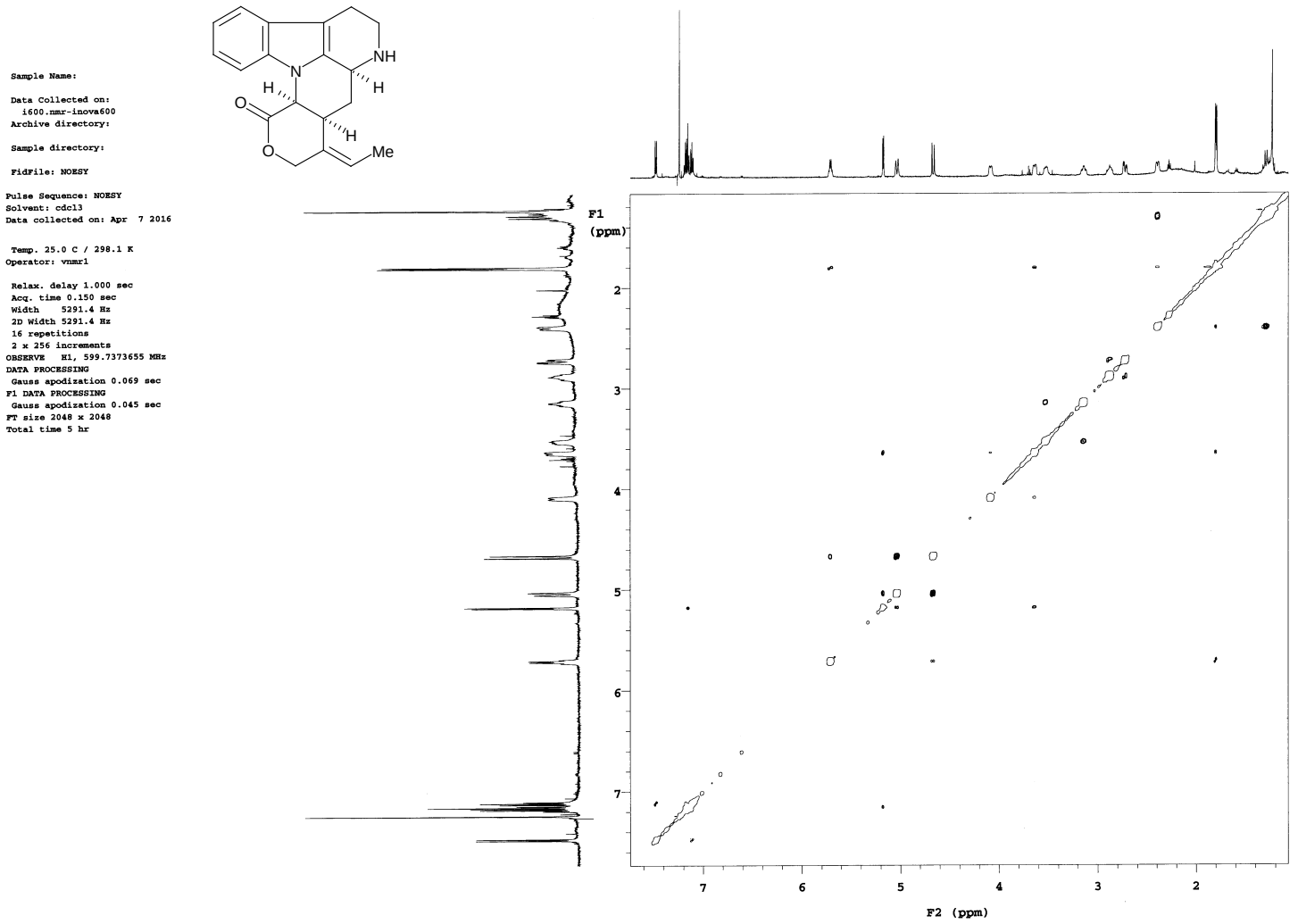

Figure S39: NOESY spectrum (600 MHz, $CDCl_3$) of **6**.