Supplemental material for:

Total Syntheses of Atropodiastereomers of Heterodimeric *Amaryllidaceae* Alkaloids: Narcipavline and Narcikachnine

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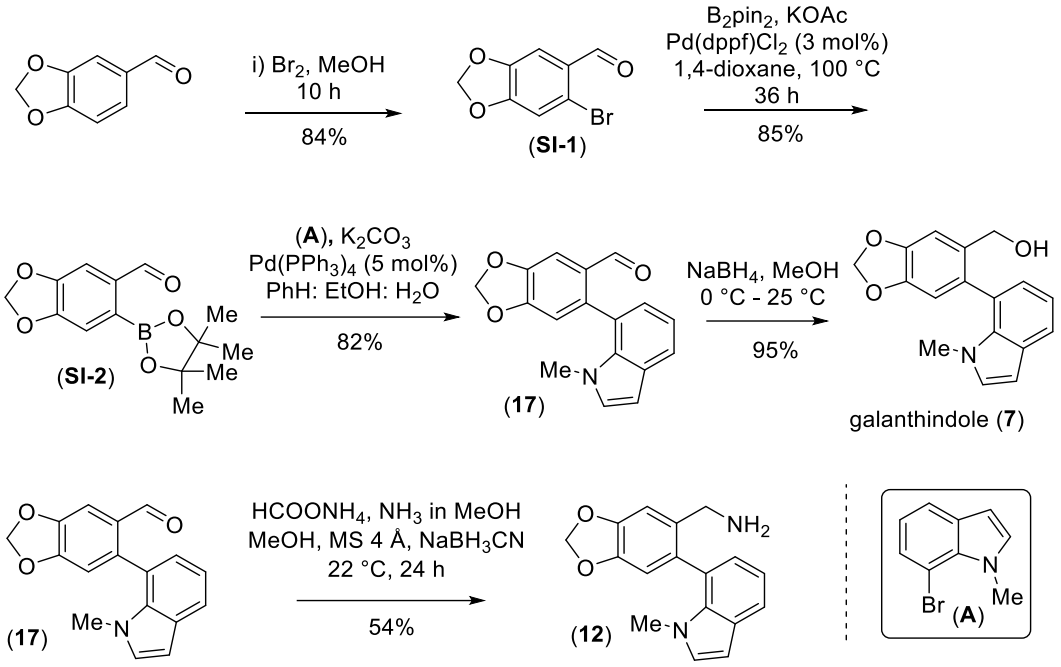
Materials and Methods

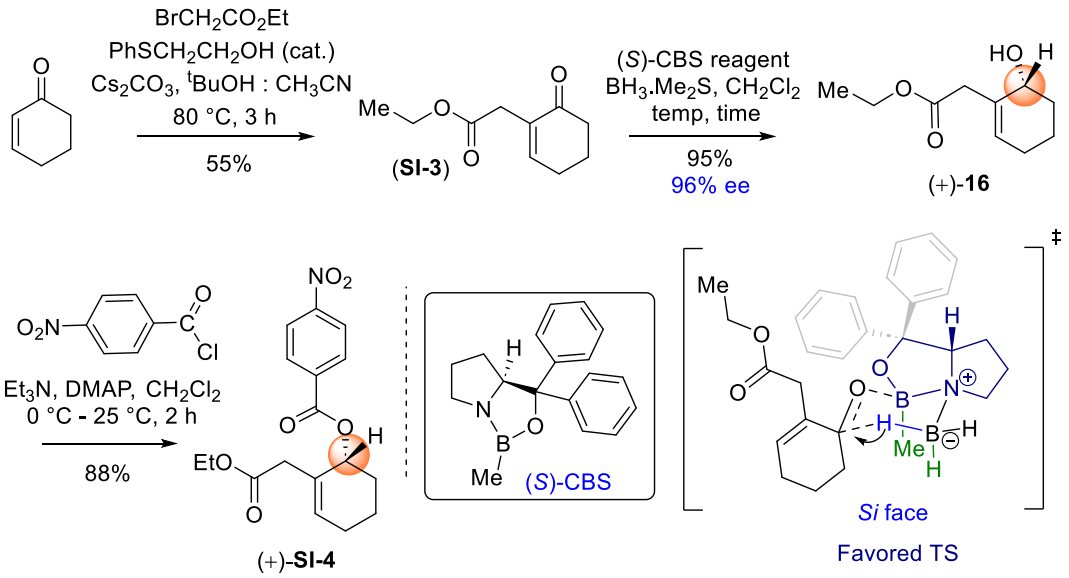
Unless otherwise stated, reactions were carried out using oven dried glass ware with Teflon coated magnetic stirring bars were used to stir the reactions. The Syringe was used to transfer the solvents and liquid reagents. Tetrahydrofuran (THF), Diethyl ether (Et_2O), PhMe was distilled over sodium/benzophenone ketyl. Dichloromethane (CH_2Cl_2) was distilled over calcium hydride. All other solvents like MeOH, EtOAc, DMF, Dichloroethane (DCE) and reagents were used as received. Reaction temperatures above 25 °C were maintained by using oil bath on a magnetic stirrer. Thin layer chromatography (TLC) analysis was performed by using silica gel precoated plates (0.25 mm) 60 (F-254), Visualized by UV irradiation, yellow dip stain and other stains. Silica gel of particle size 230-400 and 100-200 mesh were used to perform flash chromatography. Digital melting point apparatus is used to record the melting points. ^{1}H-NMR spectra were recorded by using 400, 500 MHz spectrometers, ^{13}C-NMR operating frequencies are 101 MHz, 126 MHz respectively. Chemical shifts (δ) are reported in ppm relative to the residual solvents ($CDCl_3$) signal (δ = 7.29 ppm for ^{1}H NMR and δ = 77.0 ppm for ^{13}C NMR) and (CD_3OD) signal (δ = 3.33 for ^{1}H NMR and δ = 49.0 for ^{13}C NMR). Data for ^{1}H NMR spectra are reported as follows: chemical shift (multiplicity, coupling constants, and number of hydrogen). Abbreviations are as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), br (broad). IR spectra were recorded on a FT-IR system (Spectrum BX) and are reported in frequency of absorption (cm^{-1}). Only selected IR absorbencies are reported. High Resolution Mass Spectrometry (HRMS) data was recorded on MicrOTOF-Q-II mass spectrometer using methanol as solvent. Optical rotations were measured on an automatic polarimeter. Enantiomeric excess was determined by chiral HPLC analysis performed on HPLC system with Daicel Chiralpak IA, IC-3, OD-H column.

Synthesis of galanthindole and corresponding benzylamine:



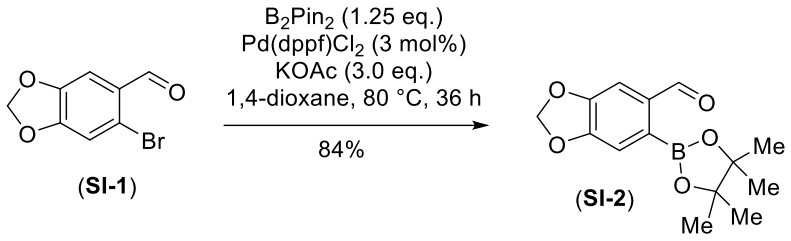
For the synthesis of galanthindole, we followed Hsieh's procedure.[1a] However, we have modified the procedure a bit where **SI-2** was converted to **17** under Suzuki coupling uding $Pd(PPh_3)_4$ as catalyst [as compared to the literature use of Pd(II)]. Further, compound **17** was reduced to galanthindole **7** just by $NaBH_4$ reduction [as compared to the literature use of $LiAlH_4$ reduction]. Overall yield of galanthindole **7** from piperonal is 56% over 4 steps. Further, the reductive amination of aldehyde **17** afforded benzyl amine **12** in 54% yield.

Preparation of α-substituted enone (SI-3) via Trost's procedure:

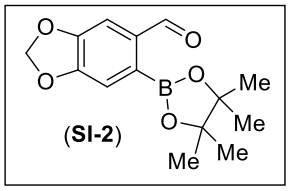


- Trost have prepared SI-3 in three steps from cyclohexanone.
- Our developed methodology can access SI-3 in only 1 step with good yield.
- Asymmetric reduction of SI-3 was done using (*S*)-CBS reagent.

Preparation of pinacolato borane compound (**SI-2**)**:**



Bis(pinacolato)diboron (2.66 g, 10.46 mmol, 1.2 equiv.), 6-bromobenzo[*d*][1,3]dioxole-5-carbaldehyde (**SI-1**) (2 gm, 8.72 mmol, 1.0 equiv), $PdCl_2$(dppf) (192 mg, 0.26 mmol, 3 mol %) and KOAc (2.56 g, 26 mmol, 3.0 equiv) were stirred in a sealed tube in dry 1,4-dioxane (25 mL) under N_2 atmosphere at 80 °C for 36 h. Upon completion of the reaction (as judged by running TLC), the reaction mixture was diluted with water (20 mL) and extracted with EtOAc (20 mL X 2). The combined organic layers were dried over Na_2SO_4 and concentrated under the reduced pressure. Next, purification through a column chromatography (10% EtOAc in hexane)] to afford **SI-2** (2.02 g, 84%) as a white solid.



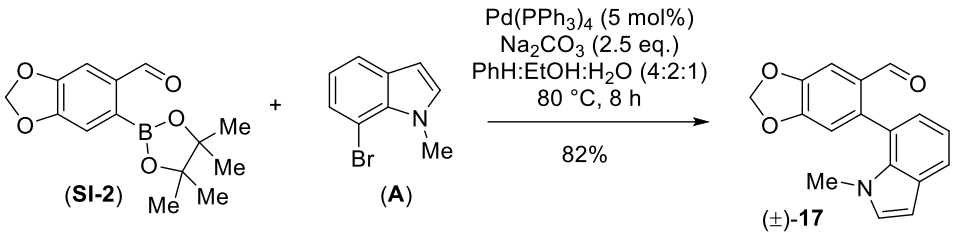
6-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzo[*d*][1,3]dioxole-5-carbaldehyde (**SI-2**): Compound **SI-2** was obtained as a white solid (8.72 mmol scale of reaction, 2.02 gm of product, 84% yield); R_f = 0.6 (20% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 10.41 (s, 1H), 7.35 (s, 1H), 7.21 (s, 1H), 5.95 (s, 2H), 1.27 (s, 12H).

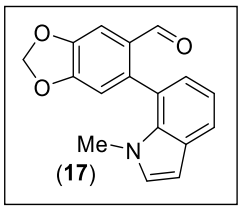
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 192.8, 151.8, 150.3, 138.1, 114.7, 108.3, 106.66, 101.9, 84.4, 24.8.

IR (film)υ_{max}: 3450, 2970, 2925, 2900, 1696, 1600, 1252 cm^{-1}.

Suzuki coupling between 7-bromo *N*-methyl indole and pinacolatoborane compound (**SI-2**)**:**



Pinacolato-borane derivative **SI-2** (1.97 mg, 7.54 mmol, 1.25 equiv.), and 7-bromo *N*-methyl indole (**A**) (1.2 g, 5.72 mmol, 1.0 equiv.), and Na_2CO_3 (1.5 g, 14.3 mmol, 2.5 equiv.) were stirred in a sealed tube in PhH: EtOH: H_2O (4:2:1) (15 mL) under N_2 atmosphere and degassed for 10 min. Next, $Pd(PPh_3)_4$ (165 mg, 0.143 mmol, 5 mol %) was added to the reaction mixture under inert atmosphere. Then, capped the sealed tube and heated at 80 °C for 12 h. Upon complete consumption of starting materials, the organic layers were separated and washed with brine. The combined organic layers were dried over Na_2SO_4 and the organic layers were concentrated under reduced pressure. Purification through a column chromatography (10% EtOAc in hexane)] afforded **17** (1.3 gm, 82% yield) as a yellow gel.



6-(1-Methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxole-5-carbaldehyde [(±)-**17**]: Compound **17** was obtained as a yellow gel (5.72 mmol scale of reaction, 1.3 g of product, 82% yield); R_f = 0.45 (20% EtOAc in *n*-hexane).

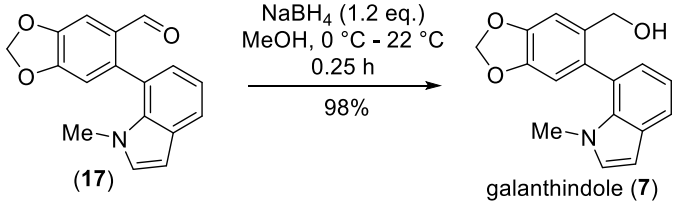
^{1}H NMR (500 MHz, $CDCl_3$): δ 9.56 (d, *J* = 1.8 Hz, 1H), 7.70 (d, *J* = 7.9 Hz, 1H), 7.51 (s, 1H), 7.15 (t, *J* = 7.6 Hz, 1H), 7.05 – 6.98 (m, 2H), 6.93 (s, 1H), 6.58 (dd, *J* = 3.4, 1.6 Hz, 1H), 6.16 (d, *J* = 8.0 Hz, 2H), 3.33 (s, 2H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 190.7, 151.7, 148.2, 141.3, 134.8, 131.2, 130.4, 129.7, 125.0, 121.3, 120.8, 119.0, 111.4, 105.5, 102.2, 101.4, 36.2.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$Calcd for $[C_{17}H_{13}NO_3 + H]^+$ 280.0974; Found 280.0984.

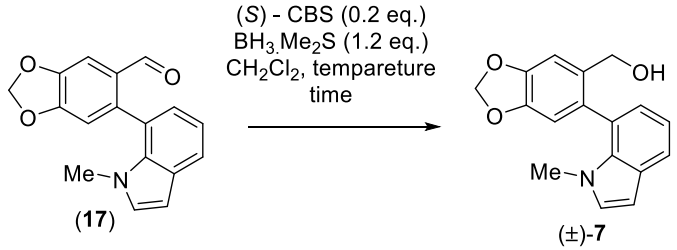
IR (film)υ_{max}: 2927, 1683, 1600, 1509, 1353, 1266, 1137, 1061 cm^{-1}.

Synthesis of galanthindole [(±)-**7**]**:**



Compound **17** (1 gm, 3.58 mmol, 1.0 equiv.) was dissolved in MeOH and stirred it in 0 °C. Then, $NaBH_4$ (162 mg, 4.3 mmol, 1.2 equiv.) was added portion wise to the reaction mixture at 0 °C. Then ice bath was removed and stirred the reaction mixture for another 20 minutes. Upon completion of the reaction, it was quenched with saturated NH_4Cl solution and the organic layer was extracted with EtOAc (20 mL X 2). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude reaction mixture was purified using column chromatography (22% EtOAc/*n*-hexane) to afford **7** (986 mg, 98% yield), as a white solid.

Attempts towards asymmetric reduction of 17 using (*S*)-CBS and Borane.DMS:

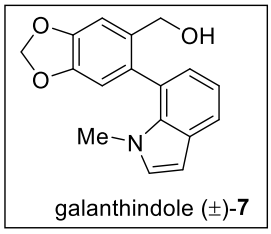


(*S*)-CBS	Solvent	Temp	Time	Yield[b]	*ee*[c]
20 mol%	CH_2Cl_2	22 ºC	1 h	85%	0
20 mol%	CH_2Cl_2	0 ºC	3 h	78%	0

20 mol%	CH_2Cl_2	–78 ºC	3 h	60%	0

[a]All reactions were carried out using 0.18 mmol of **17** with 1.2 eqiv. Of $BH_3.Me_2S$.
[b]Yields are reported after column chromatography. [c]HPLC analysis were done using ChiralPak IA column.

To a stirred solution of (*S*)-CBS [36 μL (1*M* in toluene), 0.036 mmol, 0.2 equiv.] in dry CH_2Cl_2 (3 mL) was added $BH_3.Me_2S$ [22 μL (1*M* in THF), 0.22 mmol, 1.2 equiv.] dropwise at 25 °C. After 10 min of stirring at this temperature, the reaction mixture transferred to 0 °C chiller, then a solution of aldehyde **13** (50 mg, 0.18 mmol, 1.0 equiv.) in CH_2Cl_2 (2 mL) was added slowly to the mixture. Following completion of the reaction, the reaction mixture was quenched with 2(*M*) HCl (1 mL) and extracted with CH_2Cl_2 (5 mL X 2). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo under reduced pressure. The crude reaction mixture was purified using column chromatography (22% EtOAc/n-hexane) to afford **7** (986 mg, 98% yield), as a white solid.



galanthindole (±)-**7**

(6-(1-Methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methanol [(±)-**7**]: Compound **7** was obtained as a white solid (3.58 mmol scale of reaction, 986 mg of product, 98% yield); R_f = 0.4 (30% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.65 (d, *J* = 7.9 Hz, 1H), 7.12 (t, *J* = 7.5 Hz, 1H), 7.07 (s, 1H), 7.00 – 6.93 (m, 2H), 6.85 (s, 1H), 6.55 (d, *J* = 3.1 Hz, 1H), 6.06 (d, *J* = 8.9 Hz, 2H), 4.32 (d, *J* = 3.5 Hz, 2H), 3.31 (s, 3H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 147.6, 146.4, 134.3, 133.8, 132.3, 131.0, 129.8, 124.0, 123.9, 120.7, 119.3, 111.1, 108.1, 101.4, 101.3, 63.3, 35.9.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$Calcd for $[C_{17}H_{15}NO_3 + H]^+$ 282.1130; Found 282.1136.

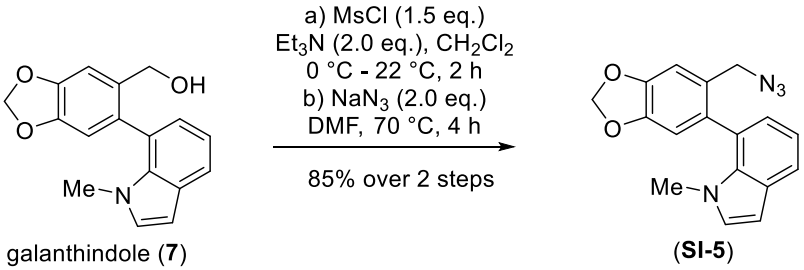
IR (film)υ_{max}: 3357, 2935, 1481, 1021 cm^{-1}.

Melting point: 128-130 ºC.

HPLC analysis was done using a Chiralpak IA column [*n*-hexane/2-propanol = 85/15; flow rate: 1.0 mL/min; detection: at 254 nm, t_R = 8.376 min, t_R = 9.699 min, (50:50)].

HPLC data of (±)-**7** [reaction using *S*-CBS at 22 ºC]: t_R = 8.409 min, t_R = 9.788 min, (50:50)
HPLC data of (±)-**7** [reaction using *S*-CBS at 0 ºC], t_R = 8.391 min, t_R = 9.721 min, (50:50)
HPLC data of (±)-**7** [reaction using *S*-CBS at –78 ºC], t_R = 8.374 min, t_R = 9.792 min, (50:50)

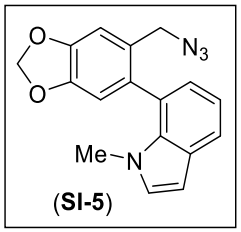
Alternative approach to galanthindolyl benzylic amine (12) from galanthindole (7): Synthesis of azide compound (**SI-5**)**:**



galanthindole (**7**) (**SI-5**)

An oven dried round bottom flask charged with **7** (900 mg, 3.2 mmol, 1.0 equiv.) in CH_2Cl_2 followed by addition of triethylamine (TEA) (900 μL, 6.4 mmol, 2.0 equiv.) at 0 ºC. After 5-minute of stirring, methane sulfonyl chloride (372 μL, 4.8 mmol, 1.5 equiv.) was added at 0 ºC over 2 minutes and allowed to stir the reaction mixture for 2 h. Upon complete consumption of starting materials (monitored by TLC analysis), the reaction mixture was quenched with water and it was extracted with dichloromethane (30 mL X 2). Next, organic layers were dried over Na_2SO_4 and concentrated under reduced pressure, to afford the crude mesylate derivative.

The crude product was taken in a 50 mL RB and dissolved in DMF (5 mL) under N_2 atmosphere. Sodium azide (208 mg, 6.4 mmol, 2.0 equiv.) was added to it and the reaction mixture was warm at 70 ºC for 4 h. Upon complete consumption of starting materials (as monitored by TLC analysis), organic layer was extracted with 40% EtOAc in hexane and concentrated under reduced pressure. The crude reaction mixture was purified using column chromatography (6% EtOAc/*n*-hexane) to afford **SI-5** (830 mg, 85%), as a colorless gel.



(**SI-5**)

7-(6-(Azidomethyl) benzo[*d*][1,3]dioxol-5-yl)-1-methyl-1*H*-indole (**SI-5**): Compound **SI-5** was obtained as a colorless gel (3.2 mmol scale of reaction, 830 mg of product, 85% yield); R_f = 0.65 (10% EtOAc in *n*-hexane).

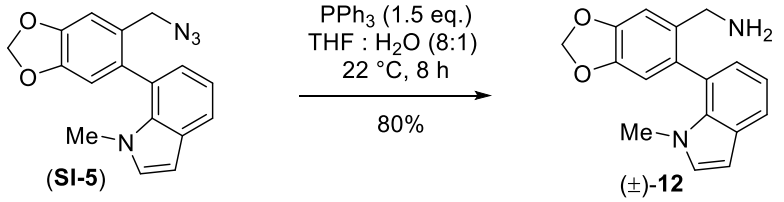
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.67 (dd, *J* = 7.9, 1.1 Hz, 1H), 7.14 (t, *J* = 7.5 Hz, 1H), 6.99 (s, 2H), 6.95 (d, J = 6.7 Hz, 1H), 6.88 (s, 1H), 6.56 (d, *J* = 3.2 Hz, 1H), 6.08 (dd, *J* = 8.5, 1.3 Hz, 2H), 4.07 (s, 2H), 3.32 (s, 3H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 147.8, 147.0, 134.2, 133.4, 131.0, 129.9, 128.6, 124.33, 123.4, 120.9, 119.3, 111.3, 108.6, 101.6, 101.4, 52.7, 36.0.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$Calcd for $[C_{17}H_{14}N_4O_2 + H]^+$ 307.1195; Found 307.1197.

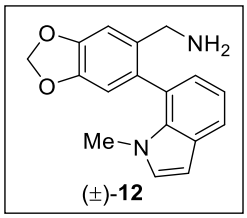
IR (film)υ_{max}: 2294, 1723, 1536, 1156, 856 cm^{-1}.

Synthesis of benzylic amine (**12**)**:**



(**SI-5**) (±)-**12**

In a 50 mL round bottom flask, compound **SI-5** (800 mg, 2.6 mmol, 1.0 equiv.) was dissolved in THF: H_2O (8:1) (20 mL), and triphenyl phosphine (1.2 gm, 3.9 mmol, 1.5 equiv.) was added and stirred the reaction mixtures for 8 h. After complete consumption of the starting material (monitored by TLC analysis) the reaction mixture was diluted with EtOAc (5 mL). Then the organic layer was extracted with EtOAc (10 mL X 3). Next, the crude product was purified *via* column chromatography (with basic alumina using 40% EtOAC in hexane to 10% MeOH in CH_2Cl_2) to afford benzyl amine **12** in 80% yield (590 mg) as yellow gel.



(±)-**12**

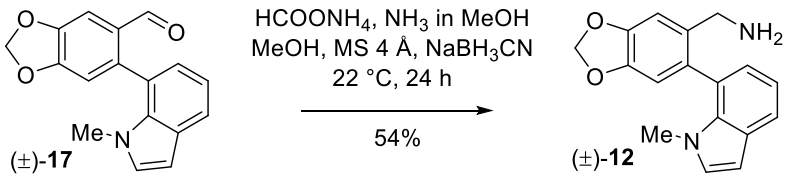
(6-(1-Methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methanamine [(±)-**12**]: Compound **12** was obtained as a yellow semi-solid (2.6 mmol scale of reaction, 590 mg of product, 80% yield); R_f = 0.35 (70% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.64 (d, *J* = 8.1 Hz, 1H), 7.12 (t, *J* = 7.8 Hz, 1H), 7.01 (s, 1H), 6.98 – 6.95 (m, 2H), 6.84 (s, 1H), 6.55 (dd, *J* = 3.1, 1.3 Hz, 1H), 6.12 – 5.96 (m, 2H), 3.50 (s, 2H), 3.31 (s, 3H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 147.6, 145.8, 136.1, 134.3, 132.1, 130.9, 129.8, 124.4, 124.1, 120.5, 119.3, 111.2, 107.9, 101.3, 44.4, 35.8.

IR (film)υ_{max}: 3512, 3380, 1150, 1091, 812 cm^{-1}.

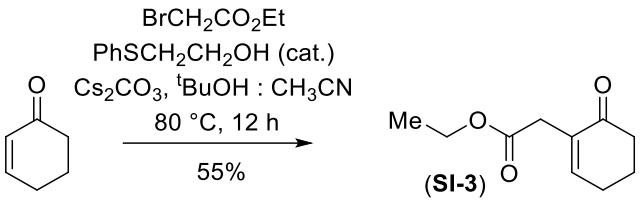
Synthesis of benzylic amine [(±)-**12**]**:**



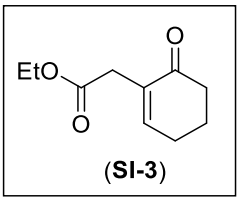
An oven dried round bottom flask was charged with aldehyde compound **17** (200 mg, 0.716 mmol, 1.0 equiv.), and ammonium formate (451 mg, 7.16 mmol, 10 equiv.), 4 Å MS in anhydrous MeOH under inert atmosphere along with 1 mL NH_3 in MeOH. Then $NaBH_3CN$ (136 mg, 2.15 mmol, 3.0 equiv.) was added to the reaction mixture at 0 °C, followed by addition of catalytic amount of TFA (20 μL). Then the reaction mixture stirred at 22 °C for 12 h. After complete consumption of starting material (monitored by TLC analysis) the crude reaction mixture was filtered and evaporated to dryness. Then, it was diluted with EtOAc (20 mL), and quenched with saturated $NaHCO_3$ solution. The organic layer was extracted with EtOAc (20 mL X 2) and concentrated in rotary evaporator. The crude product was purified by flash

chromatography using 70% (EtOAc/hexaneas) - 5% (MeOH/CH_2Cl_2) eluent to afford of the pure desired product **12** (108 mg, 54%).

Preparation of α-Substituted enone (SI-3) *via* a One-Pot Protocol:



In a 100 mL oven dried round bottom flask, 2-cyclohexenone (1 gm, 10.4 mmol, 1.0 equiv.) was dissolved in 1:1 mixture of CH_3CN: ^tBuOH 20 mL. Then, $PhSCH_2CH_2OH$ (320 mg, 2.08 mmol, 0.2 equiv.) was added to the reaction mixture followed by addition of $BrCH_2COOEt$ (1.3 mL, 15.6 mmol, 1.5 equiv.) and Cs_2CO_3 (6.8 gm, 20.8 mmol, 2.0 equiv.). Then the reaction mixture placed in a pre-heated oil bath at 80 ºC, and stirring was continued at that temperature for 12 h. After complete consumption of starting material, the reaction mixture cooled down to room temperature and removed the solvent under reduced pressure. the reaction mixture was quenched with saturated NH_4Cl and was extracted with EtOAc (30 mL X 2) and washed with brine (5 mL X 1). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by column chromatography (100−200 silica, 4-8% EtOAc/*n*-hexane) to furnish pure **SI-3** (10.4 mmol scale of reaction, 1.04 g of product, 55% yield).

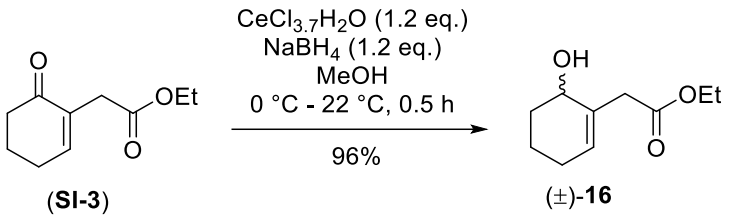


Ethyl 2-(6-oxocyclohex-1-en-1-yl)acetate (**SI-3**): Compound **SI-3** was obtained as a colorless oil (101 mmol scale of reaction, 10 gm of product, 70% yield); R_f = 0.5 (20% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.88 (t, *J* = 4.3 Hz, 1H), 4.14 (q, *J* = 7.1 Hz, 2H), 3.20 (s, 2H), 2.52 – 2.45 (m, 2H), 2.43 (h, *J* = 4.5 Hz, 2H), 2.05 (p, *J* = 6.3 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H).

^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$): δ 198.4, 171.5, 148.3, 133.7, 60.8, 38.1, 35.5, 26.2, 23.1, 14.3.

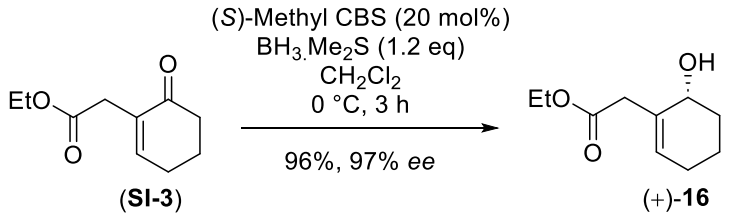
Luche Reduction of α-substituted cyclohexanone (SI-3):



(**SI-3**) (±)-**16**

In an oven-dried round-bottom flask, enone **SI-3** (100 mg, 0.55 mmol, 1.0 equiv) was taken in MeOH (3 mL) and cooled to 0 °C. After 10 min of stirring, $CeCl_3.7H_2O$ (246 mg, 0.66 mmol, 1.2 equiv) was added portion-wise to the reaction mixture followed by slow addition of $NaBH_4$ (25 mg, 0.66 mmol, 1.2 equiv.). After complete consumption of starting materials (confirmed by TLC analysis), the reaction mixture was quenched with saturated NH_4Cl and was extracted with EtOAc (5 mL X 2) and washed with brine (5 mL X 1). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by column chromatography (100−200 silica, 8% EtOAc/*n*-hexane) to furnish pure **16** (0.55 mmol scale of reaction, 99 mg of product, 98% yield).

Catalytic Enatioselective Reduction of Enone (SI-3) using CBS Catalyst:



(**SI-3**) (+)-**16**

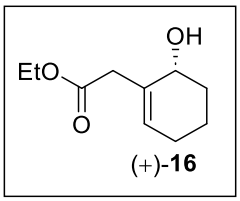
To a stirred solution of (*S*)-CBS [1.1 mL (1M in toluene), 1.092 mmol, 0.2 equiv.] in dry CH_2Cl_2 (15 mL) was added $BH_3.Me_2S$ [1.93 mL (1M in THF), 6.576 mmol, 1.2 equiv] dropwise at 25 °C. After 10 min of stirring at this temperature, the reaction mixture transferred to 0 °C chiller, then a solution of enone **SI-3** (1 gm, 5.48 mmol, 1.0 equiv.) in CH_2Cl_2 (5 mL) was added slowly by a syringe pump over 3 h. Following completion of the reaction, the reaction mixture was quenched with 2(*M*) HCl (10 mL) and extracted with CH_2Cl_2 (15 mL X 2). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo under

reduced pressure. The crude mixture was purified by chromatography (100−200 mesh silica, 8% EtOAc/n-hexane) to give enantiopure compound (+)-**16** as a colourless gel (969 mg, 96% yield, 96% *ee*). [The catalytic enantioselective reduction of 11b with (*S*)-CBS in 2.5 gm scale afforded product in 91% yield and 94% ee]. As this is compound is not UV active HPLC done after making benzoate derivative.

Detail Optimization Table for enantioselective CBS Reduction of Enone:[a]

(S)-CBS	Solvent	Temp	Time	Yield[b]	*ee*[c]
50 mol%	THF	22 ºC	4 h	92%	84%
20 mol%	THF	22 ºC	6 h	90%	86%
20 mol%	THF	0 ºC	9 h	85%	88%
20 mol%	CH_2Cl_2	22 ºC	3 h	96%	93%
20 mol%	**CH_2Cl_2**	**0 ºC**	**3 h**	**95%**	**96%**
20 mol%	CH_2Cl_2	–10 ºC	12 h	90%	94%
10 mol%	CH_2Cl_2	0 ºC	5 h	93%	94%

[a]All reactions were carried out using 0.25 mmol of **SI-3** with 1.2 eqiv. Of $BH_3.Me_2S$.
[b]Yields are reported after column chromatography. [c]HPLC analysis were done using ChiralPak IC-3 column, after making 4-Nitrobenzoate derivative.



(+)-**16**

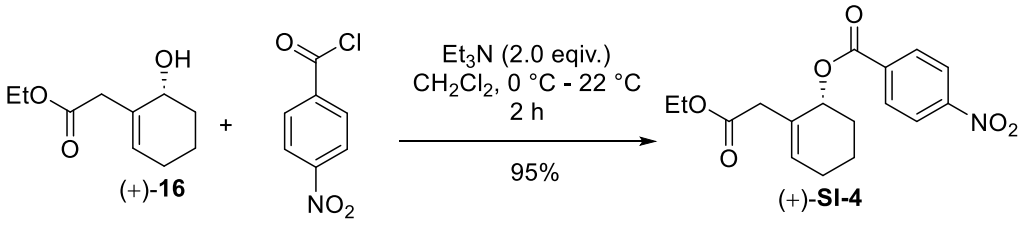
Ethyl (*R*)-2-(6-hydroxycyclohex-1-en-1-yl)acetate [(+)-**16**]: Compound (+)-**16** was obtained as a colorless oil (5.48 mmol scale of reaction, 969 mg of product, 96% yield); R_f = 0.47 (20% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 5.70 (d, *J* = 4.1 Hz, 1H), 4.15 (p, *J* = 7.7 Hz, 3H), 3.25 (d, *J* = 15.9 Hz, 1H), 3.04 (d, *J* = 15.9 Hz, 1H), 2.29 – 1.98 (m, 1H), 1.98 (s, 1H), 1.82 – 1.71 (m, 3H), 1.60 (dd, *J* = 9.8, 4.6 Hz, 1H), 1.28 (t, *J* = 7.2 Hz, 3H).

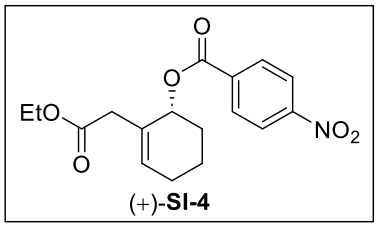
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$): δ 173.6, 132.9, 130.3, 67.5, 61.1, 40.9, 32.0, 25.7, 18.1, 14.3.

$[\alpha]_D^{25.0}$ = +94.60 (*c* = 0.05 g/mL, $CHCl_3$)

Preaparation of 4-nitro benzoate Derivative (SI-4):



In an oven-dried round-bottom flask, enol (+)-**16** (50 mg, 0.274 mmol, 1.0 equiv.) was taken in CH_2Cl_2 (3 mL) and cooled to 0 °C. Triethylamine (76 µL, 0.548 mmol, 2.0 equiv.) was added to the reaction mixture. After 5 min of stirring, 4-nitro benzoyl chloride (76 mg, 0.411 mmol, 1.5 equiv.) was added to the reaction mixture and stirred the reaction mixture further 2 h at 22 °C. After complete consumption of starting materials (confirmed by TLC), the reaction mixture was quenched with saturated NH_4Cl and was extracted with CH_2Cl_2 (5 mL X 2) and washed with brine (5 mL X 1). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by column chromatography (100−200 silica, 5% EtOAc/n-hexane) to furnish pure (+)-**SI-4** (0.274 mmol scale of reaction, 86 mg of product, 95% yield).



(*R*)-2-(2-Ethoxy-2-oxoethyl)cyclohex-2-en-1-yl 4-nitrobenzoate [(+)-**SI-4**]: Compound (+)-**SI-4** was obtained as a yellowish semi solid (0.274 mmol scale of reaction, 86 mg of product, 95% yield); R_f = 0.55 (20% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.30 (d, *J* = 8.8 Hz, 2H), 8.23 (d, *J* = 8.9 Hz, 2H), 6.00 (t, *J* = 3.9 Hz, 1H), 5.67 (d, t = 4.8 Hz, 2H), 4.15 – 3.94 (m, 2H), 3.14 (dd, *J* = 15.8, 1.9 Hz, 1H), 3.02 (d, *J* = 15.6 Hz, 1H), 2.34 – 2.21 (m, 1H), 2.14 (d, *J* = 17.4 Hz, 1H), 2.02 – 1.97 (m, 2H), 1.80 – 1.70 (m, 2H), 1.18 (t, *J* = 7.1 Hz, 3H).

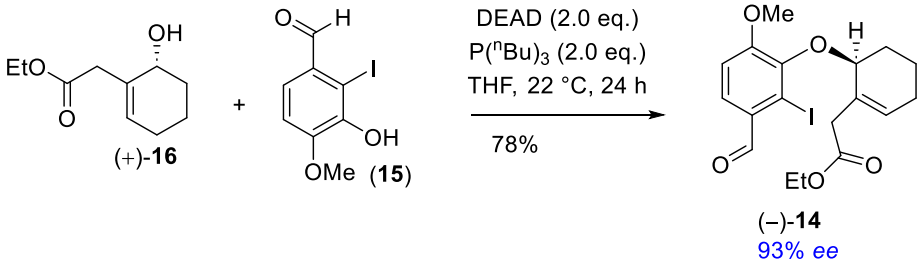
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) δ 171.4, 164.3, 150.6, 136.0, 133.1, 130.7, 128.9, 123.5, 71.3, 60.7, 40.0, 28.8, 25.29, 18.1, 14.1.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{17}H_{19}NO_6 + Na]^+$ 356.1105; Found 356.1088.

$[\alpha]_D^{25.0}$ = +114.00 (*c* = 0.05 g/mL, $CHCl_3$)

Enantiomeric excess of pure compound was determined via HPLC analysis using a Chiralpak IC-3 column; solvent: hexane/2-propanol = 85/15; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 15.760 min, t_R major = 18.118 min. $[\alpha]_D^{25.0}$ = +114.00 (*c* = 0.05 g/ml, $CHCl_3$) for 96% ee).

Mitsunobu Reaction of enantioenriched enol (+)-16 with iodo compound (15):



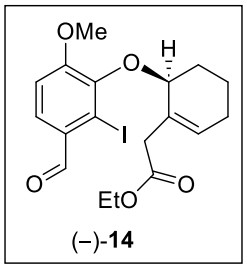
An oven-dried round bottom flask was charged with compound **15** (1.54 gm, 6.34 mmol, 1.3 equiv.) and tributyl phosphine (2.45 ml, 9.76 mmol, 2.0 equiv.) in 20 mL of dry THF under nitrogen atmosphere. To this, a solution of compound (+)-**16** (900 mg, 4.88 mmol, 1.0 equiv.) in dry THF (10 mL), was added dropwise at 0 °C. After 10 min of stirring, DEAD (1.53 mL, 9.76 mmol, 2.0 equiv.) was added to the reaction mixture dropwise at 0 °C. Then the resulting yellow solution was allowed to warm to room temperature and stirred in the same temperature for 26 h. After completion of the starting material, the reaction mixture concentrated under reduced pressure. The resulting mixture was extracted with EtOAc (2 X 50 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The residue thus obtained was subjected to flash chromatography (silica; 4% EtOAc/hexane to 12% EtOAc/hexane) and (–)-**14** (1.69 g, 78 %) was obtained as colour less oil after concentration of the appropriate fraction.

Compound (–)-**14** was crystalized via slow evaporation for 7 days in $CDCl_3$ and *i*-PrOH solvent.

Optimization Table for Mitsunobu reaction:[a]

Entry	**15** (equiv.)	Azo dicarboxylate	Phosphine	Solvent	Temp.	Time	Yield[b]	*ee*[c]
1.	1.0	DIAD	PPh_3	THF	22 ºC	48 h	20%	
2.	2.0	DIAD	PPh_3	THF	65 ºC	36 h	52%	82%
3.	2.0	DIAD	PCy_3	THF	22 ºC	30 h	55%	90%
4.	1.2	DEAD	PPh_3	THF	22 ºC	48 h	65%	84%
5.	1.2	DEAD	$P(^nBu)_3$	THF	22 ºC	24 h	78%	93%
6.	1.2	DEAD	$P(^nBu)_3$	THF	0 ºC	40 h	58%	93%
7.	1.2	DEAD	$P(^nBu)_3$	PhMe	22 ºC	30 h	70%	91%
8.	1.2	DEAD	$P(^nBu)_3$	PhMe: THF(1:1)	22 ºC	30 h	70%	92%
9.	1.2	DBAD	$P(^nBu)_3$	THF	22 ºC	36 h	62%	88%
10.	1.2	D^{t}BAD	PPh_3	THF	22 ºC	48 h	47%	

[a]Reactions were carried out with 0.3 mmol (1.0 eqiv.) of **16**. [b]Yields are reported after purification. [c]Enantiomeric excess was determined using chiralpak OD-H column of pure (–)-**16**.



(–)-**14**

Ethyl (*S*)-2-(6-(3-formyl-2-iodo-6-methoxyphenoxy)cyclohex-1-en-1-yl)acetate [**(–)-14**]: Compound (–)-**14** [CCDC: **2384521**] was obtained as colourless liquid [4.88 mmol scale of reaction, 1.69 g of product, 78% yield; R_f = 0.5 (20% EtOAc in hexane].

^{1}H NMR (500 MHz, $CDCl_3$): δ 10.08 (s, 1H), 7.70 (d, *J* = 8.4 Hz, 1H), 6.98 (d, *J* = 8.6 Hz, 1H), 5.92 (t, *J* = 3.7 Hz, 1H), 5.04 (d, *J* = 4.4 Hz, 1H), 4.36 – 4.08 (m, 2H), 3.92 (s, 3H), 3.58 (d, *J* = 16.4 Hz, 1H), 3.14 (d, *J* = 16.4 Hz, 1H), 2.30 – 2.07 (m, 3H), 1.98 (m, 1H), 1.62 (m, 1H), 1.60 – 1.55 (m, 1H), 1.29 (t, *J* = 7.1 Hz, 3H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 191.1, 170.8, 149.8, 148.6, 132.9, 130.2, 128.5, 128.3, 126.9, 110.2, 86.0, 60.2, 56.0, 48.6, 41.1, 23.7, 18.9, 14.0.

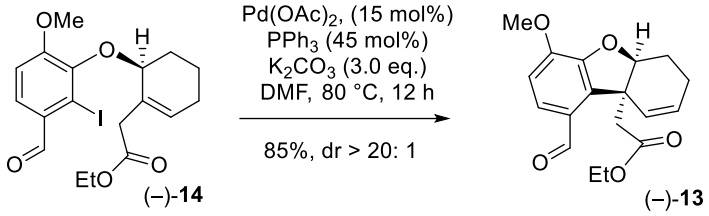
IR (film)υ_{max}: 2940, 2902, 1742, 1683, 1580, 1321, 1026, 928 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{18}H_{21}IO_5 + H]^+$ 467.0331; Found 467.0330.

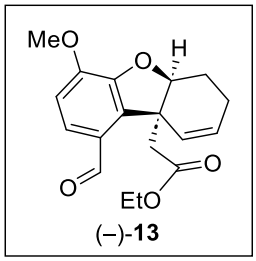
$[\alpha]_D^{25.0}$ = –77.00 (*c* = 0.02 g/ml, $CHCl_3$)

Enantiomeric excess of was determined via HPLC analysis using a Chiralpak OD-H column; [solvent: hexane/2-propanol = 90/10; flow rate: 1.0 mL/min; detection: at 254 nm): t_R minor = 11.843 min, t_R major = 12.995 min. $[\alpha]_D^{25.0}$ = –77.00 (*c* = 0.02 g/ml, $CHCl_3$) for 93% ee].

Intramolecular Heck Coupling of Compound [(–)-**14**]:



Compound (–)-**14** (1.3 g, 2.93 mmol, 1.0 equiv.) and K_2CO_3 (1.21 g, 8.79 mmol, 3.0 equiv.) was taken in a sealed tube and 10 mL of anhydrous DMF was added to it under nitrogen atmosphere. Then the reaction mixture was degassed with N_2-balloon for 10 min. Next, $Pd(OAc)_2$ (98 mg, 0.439 mmol, 0.15 equiv.) and PPh_3 (346 mg, 1.319 mmol, 0.45 equiv.) were added to the reaction mixture under nitrogen atmosphere. Next, the sealed tube was capped and heated the reaction mixture at 80 °C for 12 h. Upon completion of the reaction (judged by TLC analysis), it was diluted with 40% EtOAc in *n*-hexane (10 mL) and 25 mL H_2O. The resulting mixture was extracted with 40% EtOAc in hexane (2 X 30 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography using EtOAc/*n*-hexane as eluents to afford (–)-**13** as a yellowish liquid (787 mg, 85% yield).



(–)-**13**

Ethyl 2-((5a*S*,9a*S*)**-1-formyl-4-methoxy-6,7-dihydrodibenzo[*b*,*d*]furan-9a(5a*H*)-yl)acetate** [(–)-**13**]: Compound (–)-**13** was obtained as yellowish liquid (2.39 mmol scale of reaction, 787 mg of product, 85% yield); R_f = 0.48 (20% EtOAc in hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 9.84 (s, 1H), 7.33 (d, *J* = 8.4 Hz, 1H), 6.88 (d, *J* = 8.3 Hz, 1H), 6.08 (ddt, *J* = 10.2, 2.5, 1.2 Hz, 1H), 5.89 – 5.83 (m, 1H), 5.17 (t, *J* = 3.6 Hz, 1H), 3.98 (q, *J* = 7.1 Hz, 2H), 3.95 (s, 3H), 3.40 (d, *J* = 15.1 Hz, 1H), 2.85 (d, *J* = 15.2 Hz, 1H), 2.31 – 2.24 (m, 1H), 2.20 (m, 1H), 2.02 – 1.95 (m, 1H), 1.88 (m, 1H), 1.09 (t, *J* = 7.1 Hz, 3H).

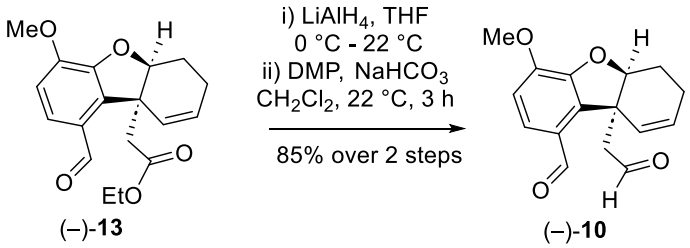
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 191.1, 171.0, 149.9, 148.7, 133.1, 130.3, 128.6, 128.45, 127.0, 110.4, 86.1, 60.3, 56.2, 48.7, 41.3, 23.9, 19.1, 14.2.

IR (film)υ_{max}: 2942, 1740, 1682, 1576, 1286, 1205, 928, 732 cm^{-1}.

HRMS (ESI-TOF) *m*/*z*: $[M+Na]^+$ Calcd for $[C_{18}H_{20}O_5 + Na]^+$ 339.1208; Found 339.1224.

$[\alpha]_D^{25.0}$ = –72.50 (*c* = 0.025 g/ml, $CHCl_3$)

Preparation of bis-aldehyde compound [(–)-**10**]:

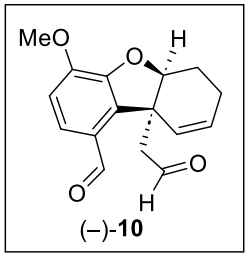


(–)-**13** (–)-**10**

In an oven dried round bottom flask, compound (–)-**13** (300 mg, 0.948 mmol, 1.0 equiv.) was dissolved in dry THF (10 mL) under nitrogen atmosphere. To this solution, $LiAlH_4$ (72 mg, 1.9 mmol, 2.0 equiv.) was added slowly at 0 ºC. After stirring 30 minutes at 0 ºC, the reaction

mixture was diluted with EtOAc (10 mL), and quenched with 10% aq. NaOH solution. The organic layer was extracted with EtOAc (2 X 20 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was directly charged for next steps.

The crude product was dissolved in CH_2Cl_2 (10 mL) in a round bottom flask and DMP (Dess-Martin Periodinane reagent) (456 mg, 0.948 mmol, 1.0 equiv.) and $NaHCO_3$ (90 mg, 0.948 mmol, 1.0 equiv.) was added to the reaction mixture and stirring continued for 2.5 h at room temperature. After complete consumption of starting material (TLC analysis), the reaction mixture diluted with CH_2Cl_2 (10 mL) and quenched with saturated $Na_2S_2O_3$ solution. The organic layer was extracted with CH_2Cl_2 (2 X 10 mL) and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography using 12% EtOAc/hexane as eluent to afford desired product (–)-**10** (219 mg, 85%).



(–)-**10**

(5a*S*,9a*S***)-4-Methoxy-9a-(2-oxoethyl)-5a,6,7,9a-tetrahydrodibenzo[*b*,*d*]furan-1-carbaldehyde** [(–)-**10**]: Compound (–)-**10** was obtained as yellowish liquid (0.948 mmol scale of reaction, 219 mg of product, 85% yield); R_f = 0.5 (30% EtOAc in hexane).

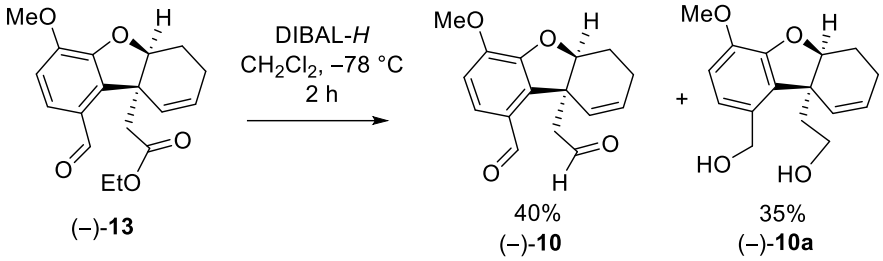
^{1}H NMR (500 MHz, $CDCl_3$): δ 9.82 (s, 1H), 9.67 (t, *J* = 2.4 Hz, 1H), 7.37 (d, *J* = 8.4 Hz, 1H), 6.93 (d, *J* = 8.3 Hz, 1H), 6.11 (ddt, *J* = 10.0, 2.5, 1.1 Hz, 1H), 5.89 (ddd, *J* = 9.8, 5.4, 2.3 Hz, 1H), 4.92 (t, *J* = 3.6 Hz, 1H), 3.98 (s, 3H), 3.48 (dd, *J* = 16.3, 2.4 Hz, 1H), 3.05 (dd, *J* = 16.3, 2.4 Hz, 1H), 2.39 – 2.19 (m, 2H), 2.08 – 1.98 (m, 1H), 1.93 – 1.80 (m, 1H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 201.4, 191.5, 150.3, 148.9, 132.3, 131.5, 128.6, 127.93, 126.8, 110.6, 86.6, 56.2, 50.1, 48.0, 23.4, 19.0.

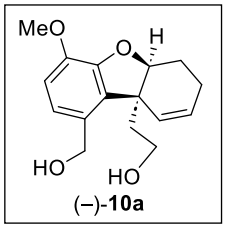
IR (film)υ_{max}: 2904, 1682, 1670, 1452, 1321 cm^{-1}.

$[\alpha]_D^{25.0} = -62.50$ (c = 0.025 g/ml, $CHCl_3$)

DIBAL-H Reduction (–)-13:



In an oven dried round bottom flask compound (–)-**13** (100 mg, 0.316 mmol, 1.0 equiv.) was dissolved in dry CH_2Cl_2 (3 mL) under nitrogen atmosphere. To that solution 1(*M*) DIBAL-H in PhMe (316 μL mg, 0.316 mmol, 1.0 equiv.) was added slowly at –78 ºC. After stirring 2 h at –78 ºC the reaction mixture was diluted with CH_2Cl_2 (3 mL), and quenched with aq. Rochelle's salt solution. The organic layer was extracted with CH_2Cl_2 (2 X 10 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography to afford 40% yield of (–)-**10** and 35% yield of (–)-**10a** (30 mg).



2-((5a*S*,9a*S*)**-1-(Hydroxymethyl)-4-methoxy-6,7-dihydrodibenzo[b,d]furan-9a(5a*H*)-yl)ethan-1-ol** [(–)-**10a**]: Compound (–)-**10a** was obtained as colourless gel (0.316 mmol scale of reaction, 30 mg of product, 35% yield); R_f = 0.1 (30% EtOAc in *n*-hexane).

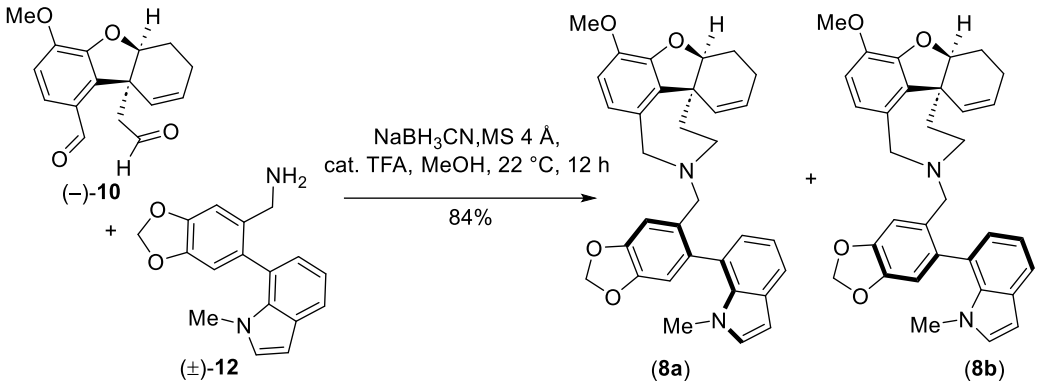
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.78 (d, J = 8.3 Hz, 1H), 6.69 (d, J = 8.3 Hz, 1H), 5.79 (d, J = 1.4 Hz, 2H), 4.78 – 4.75 (m, 1H), 4.66 (d, J = 12.1 Hz, 1H), 4.52 (dd, J = 12.1, 0.5 Hz, 1H), 3.83 (s, 3H), 3.64 (td, J = 6.6, 2.7 Hz, 2H), 2.23 – 2.14 (m, 3H), 2.05 – 1.99 (m, 1H), 1.98 – 1.91 (m, 1H), 1.83 – 1.74 (m, 1H).

^{13}C {^{1}H} NMR (101 MHz, $CDCl_3$): δ 147.4, 144.8, 131.8, 130.1, 129.3, 127.8, 122.7, 111.1, 85.1, 61.9, 59.4, 55.9, 49.1, 40.5, 24.1, 19.6.

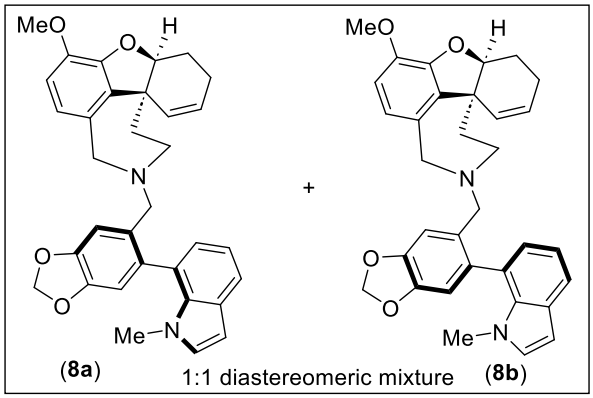
IR (film)υ_{max}: 3560, 2982, 1470, 1281, 1084, 760 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+Na]^+$ Calcd for $[C_{16}H_{20}O_4 + Na]^+$ 299.1259; Found 299.1263.

Sequential double reductive amination of bis-aldehyde [(**–**)-**10**] **with galanthindolyl benzylic amine** (±)-**12**:



An oven dried round bottom flask was charged with bis-aldehyde compound (–)-**10** (200 mg, 0.734 mmol, 1.0 equiv.), and benzylic amine (±)-**12** (206 mg, 0.734 mmol, 1.0 equiv.), 4 Å MS in anhydrous MeOH under inert atmosphere. Then, $NaBH_3CN$ (139 mg, 2.2 mmol, 3.0 equiv.) was added to the reaction mixture at 0 °C, followed by addition of catalytic amount of TFA (20 μL). Then the reaction mixture stirred at 22 °C for 12 h. After complete consumption of starting material (monitored by TLC analysis), the crude reaction mixture was filtered and evaporated to dryness. Then it was diluted with EtOAc (20 mL), and quenched with saturated $NaHCO_3$ solution. The organic layer was extracted with EtOAc (20 mL X 2) and concentrated in rotary evaporator. The crude product was purified by flash chromatography using 12% (EtOAc/hexaneas) eluent to afford of the pure desired product (–)-**8** (321 mg, 84%) as a 1:1 diastereomeric mixtures (**8a** and **8b**). The diastereomeric mixture is inseparable in column chromatography (TLC showed single spot).



(4a*S*,8a*S*)**-3-Methoxy-11-((6-(1-methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,9,10,11,12-hexahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepine** [(–)-**8**]: Compound (–)-**8** was obtained as 1:1 diastereomeric ratio, yellowish liquid (0.734 mmol scale of reaction, 321 mg of product, 84% yield); R_f = 0.48 (20% EtOAc in hexane). NMR is reported as 1:1 diastreomeric mixtures.

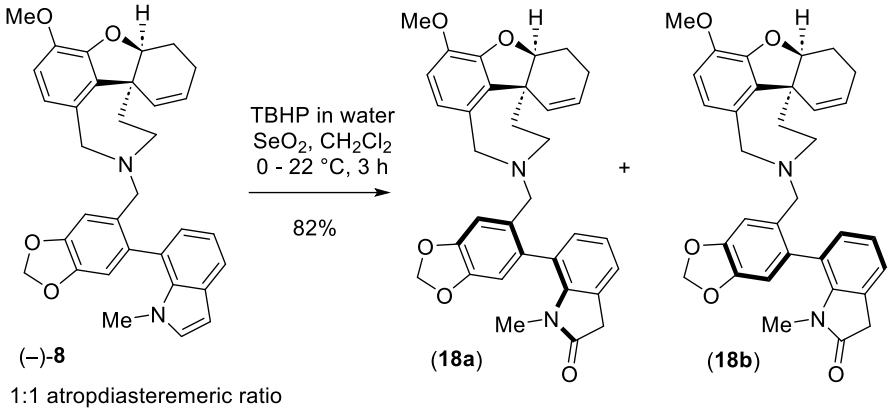
^{1}H NMR (500 MHz, $CDCl_3$) [1:1 dr of **8a** and **8b**]: δ 7.59 (t, *J* = 7.6 Hz, 2H), 7.09 (d, *J* = 7.5 Hz, 1H), 7.07 – 7.03 (m, 2H), 7.01 (d, *J* = 7.5 Hz, 1H), 6.95 (d, *J* = 3.1 Hz, 1H), 6.92 (d, *J* = 7.0 Hz, 1H), 6.90 (d, *J* = 3.1 Hz, 1H), 6.83 (s, 2H), 6.79 (d, *J* = 7.3 Hz, 1H), 6.63 (d, *J* = 8.1 Hz, 1H), 6.55 (d, *J* = 8.1 Hz, 1H), 6.51 (dd, *J* = 7.8, 3.1 Hz, 2H), 6.43 (d, *J* = 8.1 Hz, 1H), 6.34 (d, *J* = 8.1 Hz, 1H), 6.09 – 6.01 (m, 4H), 5.91 (t, *J* = 8.2 Hz, 2H), 5.74 (dt, *J* = 10.8, 5.6 Hz, 2H), 4.43 (d, *J* = 14.4 Hz, 2H), 3.87 (s, 3H), 3.84 (s, 3H), 3.53 (d, *J* = 14.7 Hz, 1H), 3.46 (d, *J* = 16.4 Hz, 1H), 3.31 (s, 3H), 3.29 – 3.23 (m, 2H), 3.21 (s, 3H), 3.09 – 2.93 (m, 2H), 2.70 (d, *J* = 14.1 Hz, 1H), 2.55 (d, *J* = 14.8 Hz, 1H), 2.35 (tq, *J* = 13.8, 8.1, 6.2 Hz, 5H), 2.02 – 1.90 (m, 3H), 1.82 – 1.65 (m, 4H), 1.47 – 1.36 (m, 2H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) [1:1 dr of **8a** and **8b**]: δ 147.2, 147.0, 145.7, 141.6, 140.7, 134.7, 134.6,134.0, 133.5, 130.53, 130.49, 129.6, 126.9, 126.3, 124.8, 124.1, 123.9, 121.2, 121.0, 120.2, 120.1, 119.0, 111.1, 110.8, 110.7, 109.2, 109.1, 101.2, 101.0, 100.95, 88.86, 88.84, 58.3, 57.5, 56.00, 55.96, 54.4, 52.1, 48.1, 48.0, 35.77, 35.75, 22.51, 22.45, 19.81.

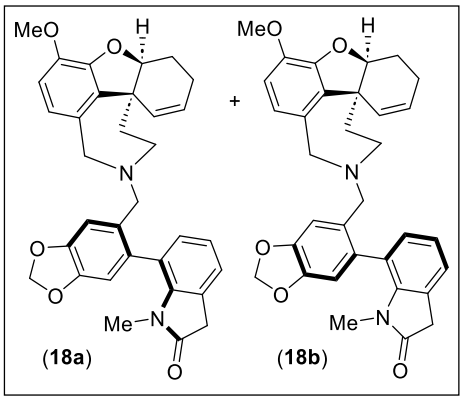
IR (film)υ_{max}: 2942, 1740, 1682, 1576, 1286, 1205, 928, 732 cm^{-1}.

HRMS (ESI-TOF) *m*/*z*: $[M+H]^+$ Calcd for $[C_{33}H_{32}N_2O_4 + H]^+$ 521.2440; Found 537.2448.

Riley oxidation of indole ring of compound [(–)-**8**]:



In an oven-dried round bottom flask was charged with compound (–)-**8** (1:1 diastereomeric mixtures), (250 mg, 0.48 mmol, 1.0 equiv.) and SeO_2 (54 mg, 0.48 mmol, 1.0 equiv.) and TBHP in water (2 mL, 1.44 mmol, 3.0 equiv.) in 10 mL of CH_2Cl_2 under nitrogen atmosphere. Then the reaction mixture was allowed to stir in room temperature for 3 h. After completion the reaction, it was quenched with saturated NH_4Cl solution and diluted with CH_2Cl_2 (10 mL). The organic layer was extracted with CH_2Cl_2 (10 mL X 2), and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography using EtOAc/*n*-hexane as eluent to afford (–)-**18** as the desired product as a reddish liquid (210 mg, 82%) as 1:1 diastereomeric mixtures of **18a** and **18b**.



7-(6-(((4a*S*,8a*R*)**-3-Methoxy-4a,5,9,10-tetrahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-11(12*H*)-yl)methyl)benzo[*d*][1,3]dioxol-5-yl)-1-methylindolin-2-one** [(–)-**18**]: Compound

(−)-**18** was obtained as 1:1 diastereomeric ratio, yellowish liquid (0.48 mmol scale of reaction, 210 mg of product, 82% yield); R_f = 0.35 (30% EtOAc in hexane).

^{1}H NMR (500 MHz, $CDCl_3$) [1:1 dr of **18a** and **18b**]: δ 7.59 (td, *J* = 7.5, 1.4 Hz, 2H), 7.37 – 7.33 (m, 1H), 7.19 (d, *J* = 7.0 Hz, 1H), 7.10 (t, *J* = 7.5 Hz, 1H), 7.03 (t, *J* = 7.5 Hz, 1H), 6.93 (q, *J* = 4.7, 3.9 Hz, 1H), 6.87 (s, 1H), 6.77 (d, *J* = 3.2 Hz, 2H), 6.64 (d, *J* = 8.1 Hz, 1H), 6.58 (d, *J* = 8.2 Hz, 1H), 6.41 (d, *J* = 8.1 Hz, 1H), 6.37 (d, *J* = 8.1 Hz, 1H), 6.09 – 6.05 (m, 4H), 5.94 (t, *J* = 9.7 Hz, 2H), 5.78 (dd, *J* = 10.6, 5.4 Hz, 2H), 4.51 (d, *J* = 11.9 Hz, 2H), 4.07 – 3.93 (m, 2H), 3.88 (s, 3H), 3.86 (s, 3H), 3.43 (d, *J* = 15.5 Hz, 2H), 3.35 – 3.16 (m, 6H), 2.80 (s, 3H), 2.74 (s, 3H), 2.65 (s, 2H), 2.37 (q, *J* = 7.9, 5.3 Hz, 5H), 2.11 – 1.96 (m, 3H), 1.89 (td, *J* = 13.1, 3.0 Hz, 2H), 1.73 (dddd, *J* = 16.2, 10.8, 5.7, 3.1 Hz, 4H), 1.50 – 1.42 (m, 2H).

Total number of hydrogens counts for 1:1 dr of **18a** and **18b**:

[{δ 7.59 (td, *J* = 7.5, 1.4 Hz, 2H), 7.37 – 7.33 (m, 1H), 7.19 (d, *J* = 7.0 Hz, 1H), 7.10 (t, *J* = 7.5 Hz, 1H), 7.03 (t, *J* = 7.5 Hz, 1H), 6.93 (q, *J* = 4.7, 3.9 Hz, 1H), 6.87 (s, 1H), 6.77 (d, *J* = 3.2 Hz, 2H), 6.64 (d, *J* = 8.1 Hz, 1H), 6.58 (d, *J* = 8.2 Hz, 1H), 6.41 (d, *J* = 8.1 Hz, 1H), 6.37 (d, *J* = 8.1 Hz, 1H)}-14 aromatic proton,
{6.09 – 6.05 (m, 4H)}-methylene dioxy CH_2-proton,
{4.51 (d, *J* = 11.9 Hz, 2H)}-hydrodibenzofuran core, *cis*-junction proton,
{3.88 (s, 3H), 3.86 (s, 3H)}-OMe-protons,
{2.80 (s, 3H), 2.74 (s, 3H)}-*N*-Me protons, which shows the environment of aromatic indole ring has been changed,
{4.07 – 3.93 (m, 2H), 3.46 (dd, *J* = 30.1, 14.8 Hz, 2H), 3.35 – 3.16 (m, 6H), 2.65 (s, 2H), 2.37 (q, *J* = 7.9, 5.3 Hz, 5H), 2.11 – 1.96 (m, 3H), 1.89 (td, *J* = 13.1, 3.0 Hz, 2H), 1.73 (dddd, *J* = 16.2, 10.8, 5.7, 3.1 Hz, 4H), 1.50 – 1.42 (m, 2H)}-28 aliphatic protons]

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) [1:1 dr of **18a** and **18b**]: δ 162.6, 159.2, 159.1, 148.9, 146.9, 141.0, 139.3, 137.9, 133.9, 129.0, 128.2, 125.3, 124.7, 123.1, 118.5, 114.1, 110.6, 109.9, 101.7, 88.8, 88.5, 56.0, 55.9, 52.4, 46.1, 40.9, 39.3, 36.6, 36.5, 33.8, 31.9, 29.4, 29.0, 27.4, 24.7, 23.3, 22.7, 22.3, 21.5, 19.6, 19.4.

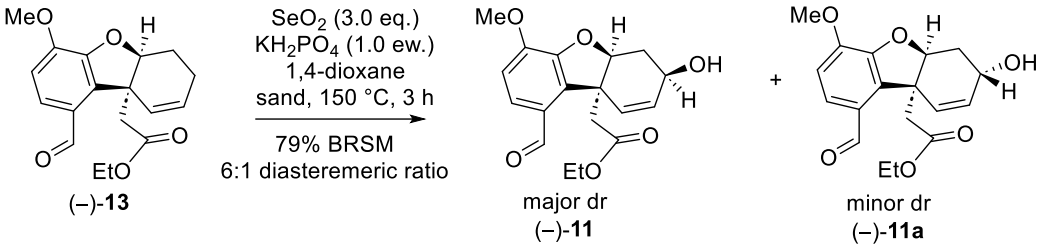
DEPT-135 spectra shows 8 methylene (-CH_2) carbon peaks.

IR (film)υ_{max}: 2942, 1740, 1682, 1576, 1286, 1205, 928, 732 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{33}H_{32}N_2O_5 + H]^+$ 537.2390; Found 537.2380.

$[\alpha]_D^{25.0} = -22.50$ (*c* = 0.025 g/mL, $CHCl_3$)

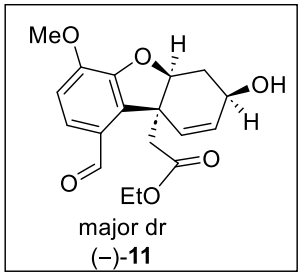
Allylic Oxidation of Compound (–)-**13**:



An oven dried sealed tube was charged with alkene (–)-**13** (400 mg, 1.26 mmol, 1.0 equiv.), anhydrous monobasic potassium hydrogen phosphate (171 mg, 1.26 mmol, 1.0 equiv.), oven dried quartz sand (700 mg) and anhydrous dioxane (4 mL) under N_2 atmosphere. Degassed the solution for 10 min using N_2-balloon. Then finely grounded selenium dioxide (140 mg, 1.26 mmol, 1.0 equiv.), was added to the solution and it was immersed in a 150 °C oil bath. After stirring for 1 h, more selenium dioxide (140 mg, 1.26 mmol, 1.0 equiv.) and quartz sand (700 mg) was added under N_2 atmosphere. The solution was stirred for an additional 1 h. Then again to the solution was added more selenium dioxide (140 mg, 1.26 mmol, 1.0 equiv.) and quartz sand (700 mg). The solution was stirred for an additional 1 h and was filtered through a short silica gel path and washed with ethyl acetate. The organic solvent was evacuated under vacuum and the resulting yellow oil was dissolved in ethyl acetate and washed with 1*N* aqueous NaOH. The aqueous layer was extracted with ethyl acetate. The combined organic layers were dried over sodium sulfate and concentrated in vacuo. The resulting slightly yellow oil was purified by flash chromatography (40% to 60% EtOAc in *n*-hexane) to give 130 mg (30% yield) of the starting material followed by 248 mg (60% yield, dr ~6:1) of the allylic alcohol. The SM further charge for recycle and BRSM yield up to 79% yield.

Reaction Condition	

SeO_2 (1.2 equiv.), CH_3COOH, 100 ºC, 8 h	SM decomposed
SeO_2 (1.5 equiv.), 1,4-dioxane, 100 ºC, 12 h	No reaction
SeO_2 (1.0 equiv.), TBHP (2.5 eqiv.), CH_2Cl_2, 24 h	No reaction
SeO_2 (1.5 equiv.), 150 ºC, 1,4-dioxane	30% product + SM recovered



Ethyl 2-((5a*S*,7*R*,9a*S*)**-1-formyl-7-hydroxy-4-methoxy-6,7-dihydrodibenzo[*b*,*d*]furan-9a(5a*H*)-yl)acetate** [**(–)-11**]: Compound (–)-**11** was obtained as colourless liquid [1.26 mmol scale of reaction, 330 mg of product, 79% yield (BRSM)], 6:1 inseparable diastereomeric mixture; R_f = 0.35 (40% EtOAc in *n*-hexane). NMR is reported for the major diastereomer.

^{1}H NMR (500 MHz, $CDCl_3$): δ 9.86 (s, 1H), 7.41 (d, *J* = 8.4 Hz, 1H), 6.93 (d, *J* = 8.3 Hz, 1H), 6.21 (dt, *J* = 10.2, 1.1 Hz, 1H), 6.01 (dd, *J* = 10.2, 4.6 Hz, 1H), 5.23 – 5.17 (m, 1H), 4.24 (q, *J* = 4.4 Hz, 1H), 4.00 (q, *J* = 7.1 Hz, 2H), 3.96 (s, 3H), 3.41 (d, *J* = 15.4 Hz, 1H), 2.80 (d, *J* = 15.5 Hz, 1H), 2.51 – 2.38 (m, 1H), 2.21 (m, 1H), 1.12 (t, *J* = 7.1 Hz, 3H).

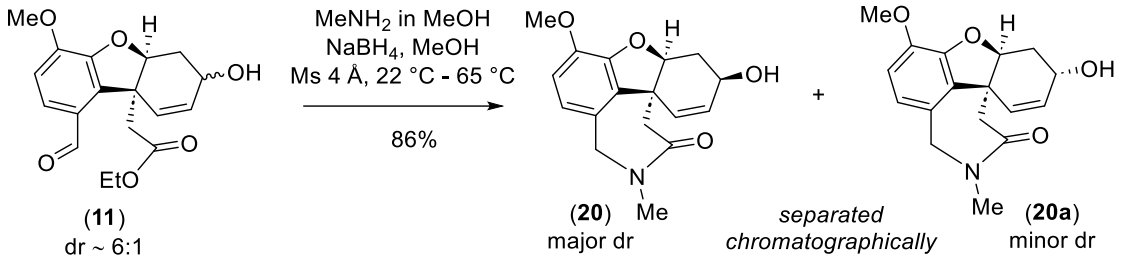
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 191.2, 170.5, 150.1, 147.6, 131.9, 131.2, 129.5, 128.54, 126.9, 110.5, 85.3, 62.2, 60.4, 56.1, 48.8, 39.6, 31.6, 14.0.

IR (film)υ_{max}: 3423, 2902, 1738, 1684, 1600, 1508, 1432. 1285, 1110, 976, 762 cm^{-1}.

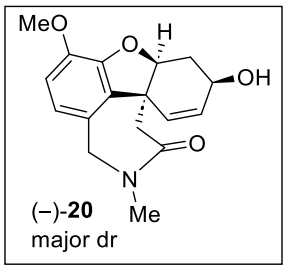
HRMS (ESI-TOF) *m*/*z*: $[M+Na]^+$ Calcd for $[C_{18}H_{20}O_6 + Na]^+$ 355.1152; Found 355.1136.

$[\alpha]_D^{25.0}$ = –38.25 (*c* = 0.04 g/ml, $CHCl_3$)

Reductive amination and Lactamization cascade of ester-aldehyde (11) with $MeNH_2$:



An oven dried round bottom flask was charged with ester-aldehyde compound (–)-**11** (200 mg, 0.601 mmol, 1.0 equiv.), and $MeNH_2$ in MeOH (25%) (3 mL, 6.01 mmol, 10.0 equiv.), 4 Å MS in anhydrous MeOH under inert atmosphere. Next, the reaction mixture allowed to stir at room temperature for 12 h, for complete formation of imine. Then, $NaBH_4$ (169 mg, 1.202 mmol, 2.0 equiv.) was added to the reaction mixture at 0 °C, followed by addition of catalytic amount of TFA (20 μL). Then the reaction mixture stirred at 22 °C for 6 h, followed by heating at 60 ºC, for 2 h in a pre-heated oil bath. After complete consumption of starting material (monitored by TLC analysis) the crude reaction mixture was filtered and evaporated to dryness. Then it was diluted with EtOAc (20 mL), and quenched with saturated $NaHCO_3$ solution (20 mL). The organic layer was extracted with EtOAc (20 mL X 2), dried over Na_2SO_4 and concentrated in rotary evaporator. The crude product was purified by flash chromatography using 12% EtOAc/hexane as eluent to afford desired product in 6:1 dr [(–)-**20** as major diastereomer and (–)-**20a** as minor diastereomer].



(4a*S*,6*R*,8a*S***)-6-Hydroxy-3-methoxy-11-methyl-4a,5,11,12-tetrahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-10(9*H*)-one [**(–)-**20**]: Compound (–)-**20** was obtained as white foam (0.601 mmol scale of reaction, 135 mg of product, 74% yield); R_f = 0.0.4 (70% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.73 (s, 1H), 6.05 (dd, *J* = 10.2, 5.1 Hz, 1H), 5.52 (d, *J* = 10.1 Hz, 1H), 4.77 (s, 1H), 4.49 (d, *J* = 16.1 Hz, 1H), 4.36 (d, *J* = 16.1 Hz, 1H), 4.18 (s, 1H), 3.87 (s, 3H), 3.04 (s, 3H), 2.81 (q, *J* = 13.8 Hz, 2H), 2.77 – 2.65 (m, 1H), 2.19 – 2.01 (m, 1H).

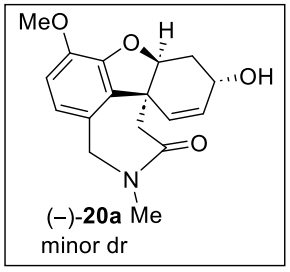
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 170.9, 146.6, 144.9, 132.1, 128.4, 125.2, 120.1, 112.0, 88.4, 61.6, 56.2, 52.0, 43.3, 41.6, 35.9, 29.3.

IR (film)υ_{max}: 2927, 1476, 748, 583 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{17}H_{19}NO_4 + H]^+$ 302.1392; Found 302.1396.

$[\alpha]_D^{25.0}$ = –78.25 (*c* = 0.04 g/ml, $CHCl_3$).

SCXRD data of **20** is given in the CCDC **2333542**. This X-ray structure was obtained from a racemic reaction that was carried out initially. This confirms the structure of major diastereomer [diastereoselectivity at the -OH group].

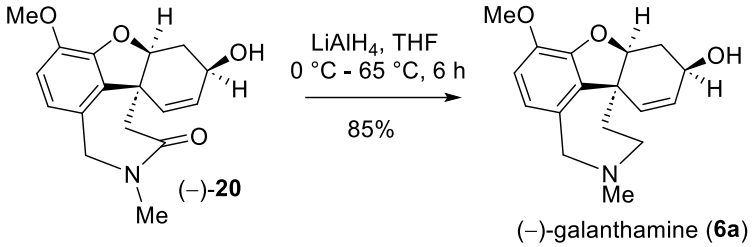


(–)-**20a**
minor dr

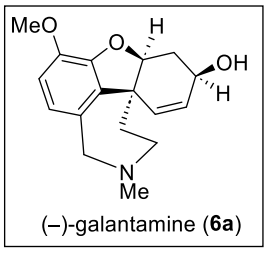
(4a*S*,6*S*,8a*S***)-6-Hydroxy-3-methoxy-11-methyl-4a,5,11,12-tetrahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-10(9*H*)-one** [(–)-**20a**]: Compound (–)-**20a** (minor diastereomer) was obtained as white foam (0.601 mmol scale of reaction, 22 mg of product, 12% yield); R_f = 0.47 (70% EtOAc in hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.69 (q, *J* = 8.2 Hz, 2H), 5.86 (d, *J* = 10.3 Hz, 1H), 5.48 (d, *J* = 10.0 Hz, 1H), 4.71 (dd, *J* = 17.3, 6.0 Hz, 2H), 4.52 (d, *J* = 15.9 Hz, 1H), 4.25 (d, *J* = 15.9 Hz, 1H), 3.88 (s, 3H), 3.01 (s, 3H), 2.87 (s, 3H), 1.96 – 1.73 (m, 1H).

Total Synthesis of galantamine [(–)-**6a**]:



In an oven dried round bottom flask, lactam (–)-**20** (180 mg, 0.597 mmol, 1.0 equiv.) was dissolved in dry THF (10 mL) under nitrogen atmosphere. To this solution, $LiAlH_4$ (114 mg, 2.98 mmol, 5.0 equiv.) was added slowly at 0 ºC. Then, the reaction mixture was placed in a pre-heated oil bath at 65 ºC and the stirring was continued for 6 h. After complete consumption of starting material, the reaction mixture was cooled in an ice bath and diluted with EtOAc (10 mL), and quenched with 10% aq. NaOH solution. The organic layer was extracted with EtOAc (2 X 20 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was purified via column chromatography (neutral alumina) with 3% MeOH in CH_2Cl_2, to afford (–)-galantamine (**6a**) in 85% yield (146 mg).



(4a*S*,6*R*,8a*S*)**-3-Methoxy-11-methyl-4a,5,9,10,11,12-hexahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(–)-**6a**]: galantamine (–)-**6a** was obtained as yellow semi-solid (0.597 mmol scale of reaction, 146 mg of product, 85% yield); R_f = 0.35 (10% MeOH in CH_2Cl_2).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.68 (d, *J* = 8.2 Hz, 1H), 6.65 (d, *J* = 8.2 Hz, 1H), 6.08 (d, *J* = 10.3 Hz, 1H), 6.02 (dd, *J* = 10.2, 4.9 Hz, 1H), 4.63 (d, *J* = 3.5 Hz, 1H), 4.19 – 4.08 (m, 2H), 3.85 (s, 3H), 3.72 (d, *J* = 14.9 Hz, 1H), 3.31 (t, *J* = 13.7 Hz, 1H), 3.09 (d, *J* = 14.3 Hz, 1H), 2.77 – 2.67 (m, 1H), 2.43 (s, 3H), 2.20 – 2.08 (m, 1H), 2.03 (ddd, *J* = 15.6, 4.9, 2.3 Hz, 1H), 1.73 – 1.56 (m, 1H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 145.9, 144.2, 133.1, 128.7, 127.7, 126.8, 122.2, 111.3, 88.7, 62.1, 60.6, 55.9, 53.8, 48.2, 42.0, 33.8, 30.0.

IR (film)υ_{max}: 2942, 1740, 1682, 1576, 1286, 1205, 928, 732 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{17}H_{21}NO_3 + H]^+$ 288.1600; Found 288.1588.

$[\alpha]_D^{25.0} = -82.50$ (*c* = 0.025 g/ml, $CHCl_3$)

Comparison of ^{1}H-NMR Data of Galantamine:

Zhou's Synthesis of (–)-Galantamine (**6a**) (^{1}H-NMR, 400 MHz, $CDCl_3$)[1]			
δ (ppm)	Int.	mult.	*J* (Hz)
6.63	2H	dd	*J* = 16.0, 8.0 Hz
6.06	1H	d	*J* = 10.4 Hz
5.99	1H	dd	*J* = 10.2, 4.8 Hz
4.60	1H	s	-
4.13	1H	br	-
4.07	1H	d	*J* = 15.2 Hz
3.82	3H	s	-
3.67	1H	d	*J* = 15.2 Hz
3.25	1H	t	*J* = 13.6 Hz
3.04	1H	d	*J* = 14.4 Hz
2.67	1H	dd	*J* = 15.6, 1.6 Hz
2.39	3H	s	-
2.07	1H	td	*J* = 13.4, 2.8 Hz
2.00	1H	ddd	*J* = 15.6, 4.8, 2.2 Hz
1.56	1H	dd	*J* =13.6, 2.2 Hz
Trost's Synthesis of (–)-Galantamine (**6a**) (^{1}H-NMR, 500 MHz, $CDCl_3$)[2]			
δ (ppm)	Int.	mult.	*J* (Hz)

6.64	1H	d	*J* = 8.3 Hz
6.60	1H	d	*J* = 8.3 Hz
6.04	1H	d	*J* = 10.2 Hz
5.98	1H	ddd	*J* = 10.2, 5.1, 1.0 Hz
4.59	1H	s	-
4.12	1H	br s	-
4.07	1H	d	*J* = 15.1 Hz
3.81	3H	s	-
3.66	1H	d	*J* = 15.1 Hz
3.25	1H	t	*J* = 13.0 Hz
3.03	1H	br d	*J* = 13.9 Hz
2.67	1H	ddt	*J* = 15.9, 3.7, 1.2 Hz
2.38	3H	s	-
2.06	1H	td	*J* = 13.2, 2.0 Hz
1.98	1H	ddd	*J* = 15.9, 4.1, 2.4 Hz
1.67	1H	br s	-
1.55	1H	ddd	*J* = 13.6, 3.6, 1.1 Hz

This Synthesis of (–)-Galantamine (**6a**) (^{1}H-NMR, 500 MHz, $CDCl_3$)

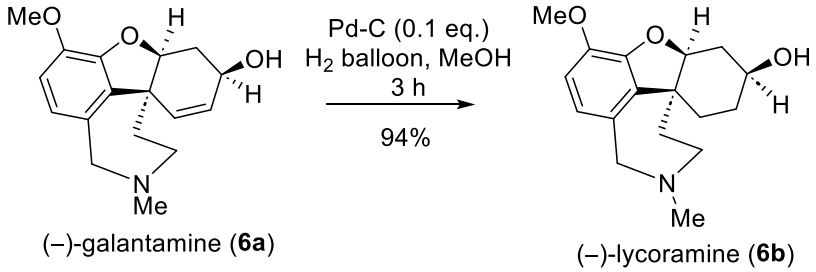
δ (ppm)	Int.	mult.	*J* (Hz)
6.68	1H	d	*J* = 8.2 Hz
6.65	1H	d	*J* = 8.2 Hz
6.08	1H	d	*J* = 10.3 Hz
6.02	1H	dd	*J* = 10.2, 4.9 Hz
4.63	1H	d	*J* = 3.5 Hz
4.19-4.08	2H	m	-
3.85	3H	s	-
3.72	1H	d	*J* = 14.9 Hz
3.31	1H	t	*J* = 13.7 Hz
3.09	1H	d	*J* = 14.3 Hz
2.77 – 2.67	1H	m	-
2.43	3H	s	-

2.20 – 2.08	1H	m	-
2.03	1H	ddd	J = 15.6, 4.9, 2.3 Hz
1.73 – 1.56	1H	m	-

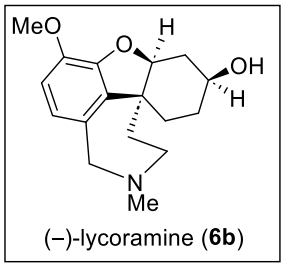
Comparison of ^{13}C-NMR Data of Galantamine:

Zhou's Synthesis of (–)-Galantamine (**6a**) (^{13}C-NMR, 100 MHz, $CDCl_3$)[1]	Trost's Synthesis of (–)-Galantamine (**6a**) (^{13}C-NMR, 125 MHz, $CDCl_3$)[2]	This Synthesis of (–)-Galantamine (**6a**) (^{13}C-NMR, 126 MHz, $CDCl_3$)
145.8	145.7	145.9
144.1	144.1	144.2
133.0	133.0	133.1
129.4	129.3	128.7
127.6	127.6	127.7
126.9	126.8	126.8
122.1	122.0	122.2
111.1	111.1	111.3
88.7	88.7	88.7
62.1	62.1	62.1
60.7	60.6	60.6
55.9	55.9	55.9
53.9	53.8	53.8
48.2	48.2	48.2
42.2	42.1	42.0
33.8	33.8	33.8
30.0	29.9	30.0

Hydrogenation of galantamine [(–)-**6a**]:



An oven-dried round bottom flask was charged with galantamine (–)-**6a** (50 mg, 0.173 mmol, 1.0 equiv.) in 3 mL of MeOH under nitrogen atmosphere. Next, the reaction vessel was degassed with N_2-balloon for about 10 minutes. Then, Pd-C (5 mg, 10 vol% wt/wt) was added and H_2-balloon was purged into the solution and stirring was continued for 3 h at 22 °C. Upon complete consumption of the starting material (judged by TLC analysis), H_2-balloon was removed. Next, the reaction mixture was filtered and washed with MeOH, and evaporated the solvent under reduced pressure. The crude product was purified by flash chromatography (neutral alumina) with 3% MeOH in CH_2Cl_2, to afford (–)-lycoramine (**6b**) in 94% yield (47 mg).



(4a*S*,6*S*,8a*R*)**-3-Methoxy-11-methyl-4a,5,7,8,9,10,11,12-octahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(–)-**6b**]: Lycoramine (–)-**6b** was obtained as pale yellow semi-solid (0.173 mmol scale of reaction, 47 mg of product, 92% yield); R_f = 0.33 (10% MeOH in CH_2Cl_2).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.73 (d, *J* = 8.1 Hz, 1H), 6.69 (d, *J* = 8.2 Hz, 1H), 4.43 (d, *J* = 3.4 Hz, 1H), 4.29 (d, *J* = 14.8 Hz, 1H), 4.13 (s, 1H), 3.89 (s, 3H), 3.49 (t, *J* = 13.5 Hz, 1H), 3.26 (d, *J* = 14.3 Hz, 1H), 3.13 (q, *J* = 7.5 Hz, 1H), 2.57 (d, *J* = 13.5 Hz, 1H), 2.53 (s, 3H), 2.06 (t, *J* = 14.5 Hz, 1H), 1.94 (d, *J* = 16.7 Hz, 1H), 1.87 (d, *J* = 12.8 Hz, 1H), 1.75 (dd, *J* = 13.8, 8.5 Hz, 2H), 1.48 – 1.41 (m, 1H), 1.33 – 1.26 (m, 1H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 146.4, 145.2, 135.7, 130.6, 123.0, 111.4, 89.7, 65.1, 58.6, 56.0, 55.4, 45.9, 40.0, 31.5, 29.9, 27.6, 23.9.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{17}H_{23}NO_3 + H]^+$ 290.1751; Found 290.1750.

IR (film)υ_{max}: 2942, 1740, 1682, 1576, 1286, 1205, 928, 732 cm^{-1}.

$[\alpha]_D^{25.0}$ = –91.76 (*c* = 0.025 g/ml, $CHCl_3$)

Comparison of ^{1}H-NMR Data of Lycoramine:

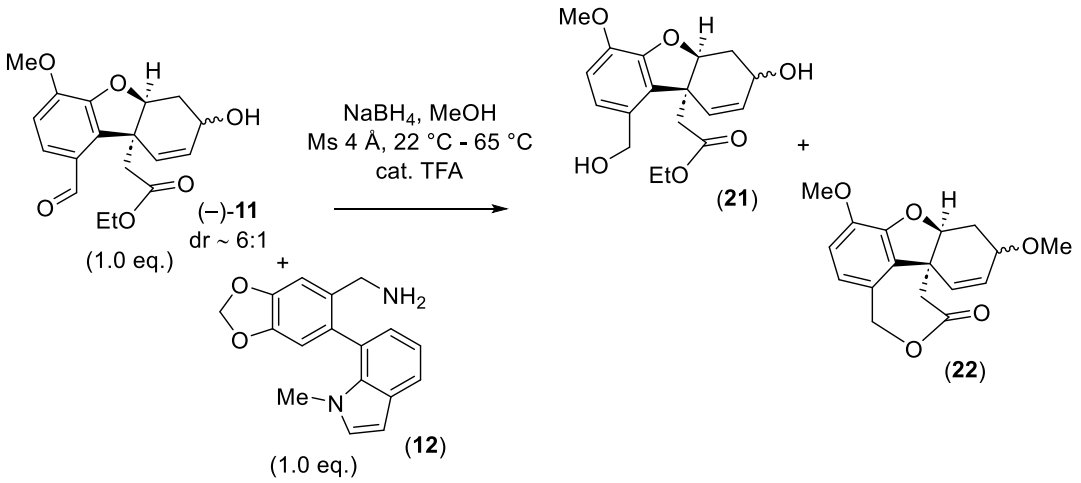
Zhou's report (–)-lycoramine (**6b**) (^{1}H-NMR, 400 MHz, $CDCl_3$)[1]			
δ (ppm)	Int.	mult.	*J* (Hz)
6.59	2H	dd	*J* = 21.6, 8.0 Hz
4.34	1H	br	-
4.08 – 4.02	1H	m	-
3.98	1H	d	*J* = 15.2 Hz
3.82	3H	s	-
3.65 – 3.59	2H	m	-
3.18	1H	t	*J* = 12.8 Hz
3.03 – 3.00	1H	m	-
2.48 – 2.43	1H	m	-
2.33	3H	s	-
2.01 – 1.58	8H	m	-
1.58 – 1.48	1H	m	-
Xu's report (±)-lycoramine (**6b**) (^{1}H-NMR, 400 MHz, $CDCl_3$)[3]			
δ (ppm)	Int.	mult.	*J* (Hz)
6.65	1H	d	*J* = 8.2 Hz
6.60	1H	d	*J* = 8.2 Hz
4.37	1H	t	*J* = 3.2 Hz

4.08	1H	dd	*J* = 4.8, 2.4 Hz
4.03	1H	d	*J* = 15.0 Hz
3.85	3H	s	-
3.64	1H	dd	*J* = 14.8, 1.2 Hz
3.23	1H	ddd	*J* = 14.5, 12.6, 1.9 Hz
3.13 – 3.01	1H	m	-
2.50	1H	dd	*J* = 16.0, 2.2 Hz
2.38	3H	s	-
2.02 – 1.94	1H	m	-
1.94 – 1.84	2H	m	-
1.83 – 1.75	2H	m	-
1.75 – 1.62	2H	m	-
1.62 – 1.52	1H	m	-
This Synthesis of (–)-Lycoramine (**6b**) (^{1}H-NMR, 400 MHz, $CDCl_3$)			
δ (ppm)	Int.	mult.	*J* (Hz)
6.73	1H	d	*J* = 8.1 Hz
6.69	1H	d	*J* = 8.2 Hz
4.43	1H	d	*J* = 3.4 Hz
4.29	1H	d	*J* = 14.8 Hz
4.13	1H	s	-
3.89	3H	s	-
3.49	1H	t	*J* = 13.5 Hz
3.26	1H	d	*J* = 14.3 Hz
3.13	1H	q	*J* = 7.5 Hz
2.57	1H	d	*J* = 13.5 Hz
2.53	3H	s	-
2.06	1H	t	*J* = 14.5 Hz
1.94	1H	d	*J* = 16.7 Hz
1.87	1H	d	*J* = 12.8 Hz
1.75	2H	dd	*J* = 13.8 Hz, 8.5 Hz
1.48-1.41	1H	m	-

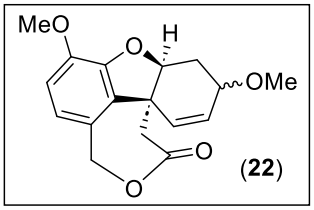
Comparison of ^{13}C-NMR Data Comparison of ^{1}H-NMR Data of Lycoramine:

Zhou's Synthesis of (–)-Lycoramine (**6b**) (^{13}C-NMR, 100 MHz, $CDCl_3$)[1]	Xu's Synthesis of (±)-Lycoramine (**6b**) (^{13}C-NMR, 100 MHz, $CDCl_3$)[3]	This Synthesis of (–)-Lycoramine (**6b**) (^{13}C-NMR, 126 MHz, $CDCl_3$)
146.0	146.0	146.4
144.1	144.3	145.2
136.3	136.4	135.7
128.6		130.6
121.9	122.1	123.0
110.7	110.7	111.4
89.9	90.1	89.7
65.4	65.5	65.1
60.4	60.4	58.6
55.9	56.0	56.0
54.0	54.1	53.4
46.7	46.8	45.9
41.8	41.7	40.0
31.6	31.6	31.5
31.2	31.1	29.9
27.6	27.7	27.6
23.7	23.7	23.7

Reductive amination and lactamization of ester aldehyde (11) with benzylic amine (12):



An oven dried round bottom flask was charged with ester-aldehyde compound (–)-**11** (200 mg, 0.601 mmol, 1.0 equiv.), and benzyl amine (**12**) (168 mg, 0.601 mmol, 1.0 equiv.), 4 Å MS in anhydrous MeOH under inert atmosphere. Then the reaction mixture was allowed to stir at room temperature for 12 h. Next, $NaBH_4$ (46 mg, 1.2 mmol, 2.0 equiv.) was added to the reaction mixture at 0 °C, followed by addition of catalytic amount of TFA (20 μL). Then the reaction mixture stirred at 22 °C for 6 h, followed by heating at 60 ºC, for 2 h in a pre-heated oil bath. After complete consumption of starting material (monitored by TLC) the crude reaction mixture was filtered and evaporated to dryness. Then it was diluted with EtOAc (20 mL), and quenched with saturated $NaHCO_3$ solution. The organic layer was extracted with EtOAc (20 mL X 2) dried with Na_2SO_4 and concentrated in rotary evaporator. The crude product was purified by flash chromatography using 12% EtOAc/hexane as eluent to afford 26% yield of (–)-**21** along with 42% yield of (–)-**22**.



(4a*S*,8a*S***)-3,6-dimethoxy-4a,5-dihydro-6*H*,12*H*-benzo[*b*]oxepino[5,4,3-*cd*]benzofuran-10(9*H*)-one [**(–)-**22**]: Compound (–)-**22** was obtained as colorless gel (0.601 mmol scale of reaction, 76 mg of product, 42% yield); R_f = 0.55 (40% EtOAc in hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 6.88 (d, *J* = 8.3 Hz, 1H), 6.78 (d, *J* = 8.3 Hz, 1H), 5.99 (s, 2H), 5.11 (dd, *J* = 6.1, 3.4 Hz, 1H), 4.76 (d, *J* = 12.1 Hz, 1H), 4.67 (d, *J* = 12.1 Hz, 1H), 4.24 (q, *J*

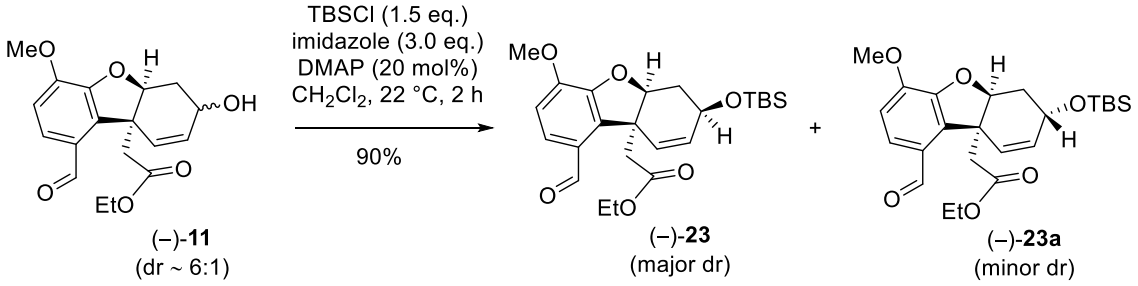
= 4.3 Hz, 1H), 3.87 (s, 3H), 3.63 (s, 3H), 3.05 (d, *J* = 14.8 Hz, 1H), 2.80 (d, *J* = 14.8 Hz, 1H), 2.39 (ddd, *J* = 14.6, 6.2, 4.5 Hz, 1H), 2.20 (ddd, *J* = 14.6, 5.0, 3.5 Hz, 1H).

^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 171.0, 146.6, 145.2, 130.2, 129.9, 129.2, 128.9, 123.5, 111.7, 84.2, 62.7, 62.6, 55.9, 51.8, 49.0, 40.8, 31.8.

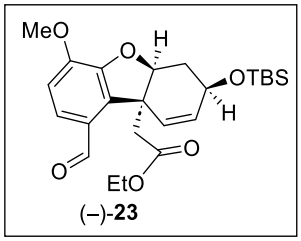
IR (film)υ_{max}: 2927, 1476, 748, 583cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{17}H_{18}O_5 + H]^+$ 303.1232; Found 303.1227.

TBS-protection of compound [**(–)-11**]:



In an oven-dried round bottom flask, allylic alcohol (–)-**11** (500 mg, dr ~6:1, 1.5 mmol, 1.0 equiv.), was taken in CH_2Cl_2 (10 mL). The reaction mixture placed in an ice bath at 0 °C. To this solution was added imidazole (306 mg, 4.5 mmol, 3.0 equiv.), DMAP (37 mg, 0.3 mmol, 0.2 equiv.) and TBSCl (340 mg, 2.25 mmol, 1.5 equiv.) successively and the reaction mixtures allowed to stir at room temperature for 2 h. After complete consumption of starting material (monitored by TLC analysis) the reaction mixture was diluted with CH_2Cl_2 (10 mL) and quenched with H_2O (15 mL). The resulting mixture was extracted with CH_2Cl_2 (2 X 20 mL) and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography using 8% EtOAc in *n*-hexane to afford desired product (–)-**23** (major diastereomer) in 77% yield (502 mg), and the minor diastereomer **23a** in 13% yield.



(–)-**23**

Ethyl 2-((5a*S*,7*R*,9a*S*)**-7-((tert-butyldimethylsilyl)oxy)-1-formyl-4-methoxy-6,7-dihydrodibenzo[*b,d*]furan-9a(5a*H*)-yl)acetate** [(–)-**23**]: Compound (–)-**23** was obtained as colourless liquid (1.5 mmol scale of reaction, 502 mg of product, 77% yield of major diastereomer); R_f = 0.45 (20% EtOAc in hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 9.87 (s, 1H), 7.38 (d, *J* = 8.4 Hz, 1H), 6.91 (d, *J* = 8.4 Hz, 1H), 6.53 (dd, *J* = 10.3, 1.9 Hz, 1H), 5.84 (ddd, *J* = 10.3, 2.3, 1.2 Hz, 1H), 5.37 (dd, *J* = 10.5, 5.3 Hz, 1H), 4.37 (ddt, *J* = 9.1, 4.6, 2.1 Hz, 1H), 4.07 (q, *J* = 7.1 Hz, 2H), 3.97 (s, 3H), 3.00 (d, *J* = 14.8 Hz, 1H), 2.80 (d, *J* = 14.8 Hz, 1H), 2.34 (m, 1H), 1.91 – 1.74 (m, 1H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.86 (s, 9H), 0.06 (d, *J* = 9.1 Hz, 6H).

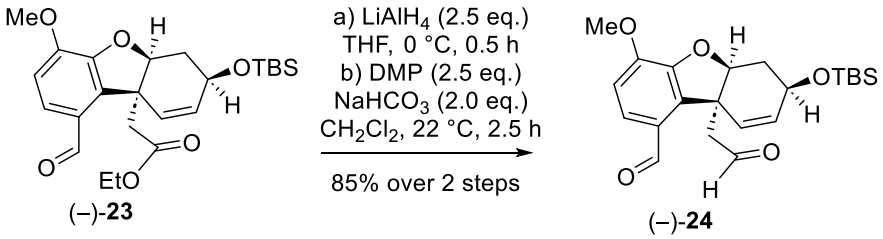
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 191.0, 170.6, 150.4, 147.9, 134.2, 131.7, 130.6, 127.1, 126.8, 110.5, 84.7, 64.7, 60.4, 56.1, 49.9, 42.0, 36.8, 29.7, 25.7, 18.0, 14.1, -4.7, -4.8.

IR (film)υ_{max}: 2902, 1738, 1680. 1589, 1452, 1321 cm^{-1}.

HRMS (ESI-TOF) *m/z*: $[M+Na]^+$ Calcd for $[C_{24}H_{34}O_6Si + Na]^+$ 469.2022; Found 469.2025.

$[\alpha]_D^{24.0}$ = –65.11 (*c* = 0.025 g/mL, EtOH)

Synthesis of di-aldehyde compound [(–)-**24**]**:**

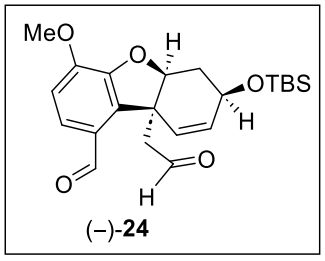


(–)-**23** (–)-**24**

In an oven dried round bottom flask, compound (–)-**23** (480 mg, 1.074 mmol, 1.0 equiv.) was dissolved in dry THF (10 mL) under nitrogen atmosphere. To this solution was added $LiAlH_4$

(82 mg, 2.14 mmol, 2.0 equiv.) slowly at 0 ºC for 3 minutes. After stirring 30 minutes at 0 ºC the reaction mixture was diluted with EtOAc (10 mL), and quenched with 10% aq. NaOH solution. The organic layer was extracted with EtOAc (2 X 20 mL), dried over Na_2SO_4 and the combined organic layers were dried over anhydrous Na_2SO_4, filtered, and concentrated in a rotary evaporator under reduced pressure. The crude product was directly charged for next steps.

The crude product was dissolved in CH_2Cl_2 10 mL in a round bottom flask and DMP [Dess-Martin Periodinane] (456 mg, 1.074 mmol, 1.0 equiv.) and $NaHCO_3$ (90 mg, 1.074 mmol, 1.0 equiv.) was added to the reaction mixture and stirring continued for 2.5 h at room temperature. After complete consumption of starting material, the reaction mixture diluted with CH_2Cl_2 (10 mL) and quenched with saturated $Na_2S_2O_3$ solution. The organic layer was extracted with CH_2Cl_2 (2 X 10 mL) and concentrated in a rotary evaporator under reduced pressure. The crude product was purified by flash chromatography using 12% EtOAc/hexane as eluent to afford of the pure desired product (–)-**24** (367 mg, 90% yield).



(–)-**24**

(5a*S*,7*R*,9a*S*)**-7-((*tert*-butyldimethylsilyl)oxy)-4-Methoxy-9a-(2-oxoethyl)-5a,6,7,9a-tetrahydrodibenzo[*b,d*]furan-1-carbaldehyde** [(–)-**24**]: Compound (–)-**32** was obtained as colourless liquid (1.074 mmol scale of reaction, 367 mg of product, 85% yield); R_f = 0.50 (20% EtOAc in *n*-hexane).

^{1}H NMR (500 MHz, $CDCl_3$): δ 9.84 (s, 1H), 9.62 (t, *J* = 2.3 Hz, 1H), 7.39 (d, *J* = 8.3 Hz, 1H), 6.93 (d, *J* = 8.4 Hz, 1H), 6.55 (dd, *J* = 10.3, 1.9 Hz, 1H), 5.85 (ddd, *J* = 10.4, 2.3, 1.2 Hz, 1H), 5.01 (dd, *J* = 10.3, 5.2 Hz, 1H), 4.37 (ddt, *J* = 9.0, 4.6, 2.1 Hz, 1H), 3.97 (s, 3H), 3.16 (dd, *J* = 16.0, 2.2 Hz, 1H), 2.91 (dd, *J* = 16.0, 2.4 Hz, 1H), 2.38 – 2.29 (m, 1H), 1.86 – 1.76 (m, 1H), 0.85 (s, 9H), 0.06 (d, *J* = 8.9 Hz, 6H).

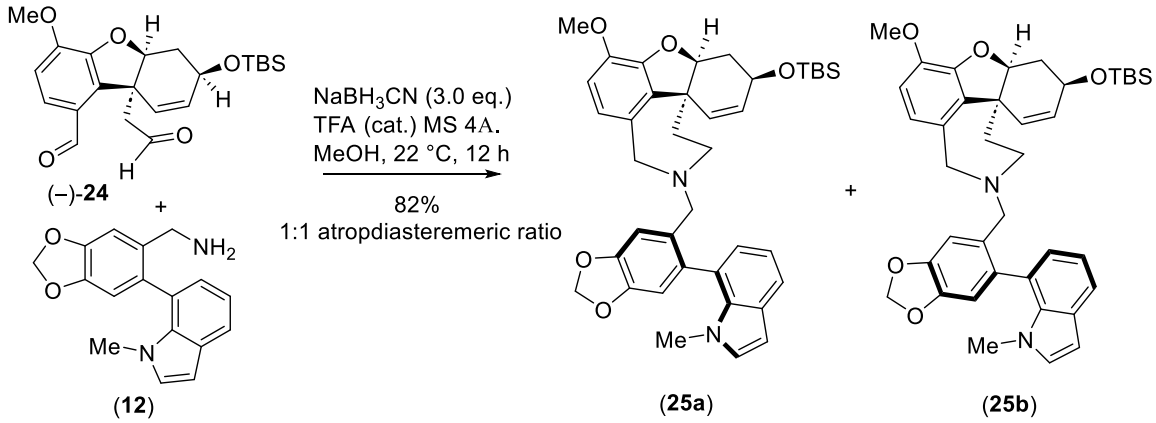
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$): δ 200.9, 191.3, 150.5, 147.9, 134.1, 131.4, 131.1, 126.8, 126.6, 110.7, 85.4, 64.6, 56.1, 50.8, 49.1, 36.4, 25.7, 18.0, -4.7, -4.7.

IR (film)υ_{max}: 2904, 1682, 1670, 1452, 1321 cm^{-1}.

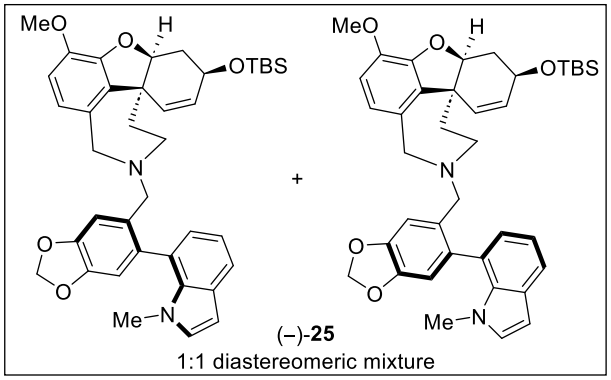
HRMS (ESI-TOF) *m/z*: $[M+Na]^+$ Calcd for $[C_{22}H_{30}O_5Si + Na]^+$ 425.1760; Found 425.1781.

$[\alpha]_D^{25.0} = -71.20$ (*c* = 0.025 g/mL, $CHCl_3$)

Double reductive amination of dialdehyde (–)-**24 with benzylic amine** (±)-**12 formation of 7-member azepine core:**



An oven dried round bottom flask was charged with di-aldehyde compound (–)-**24** (359 mg, 0.891 mmol, 1.0 equiv.), and benzyl amine (±)-**12** (250 mg, 0.891 mmol, 1.0 equiv.), 4 Å MS in anhydrous MeOH under inert atmosphere. Then $NaBH_3CN$ (169 mg, 2.673 mmol, 3.0 equiv.) was added to the reaction mixture at 0 °C, followed by addition of catalytic amount of TFA (20 μL). Then the reaction mixture stirred at 22 °C for 12 h. After complete consumption of starting material (monitored by TLC analysis) the crude reaction mixture was filtered and evaporated to dryness. Then it was diluted with EtOAc (20 mL), and quenched with saturated $NaHCO_3$ solution (15 mL). The organic layer was extracted with EtOAc (20 mL X 2), dried over Na_2SO_4 and concentrated in rotary evaporator. The crude product was purified by flash chromatography using 12% EtOAc/hexane as eluent to afford of the pure desired product (–)-**25** in 82% yield (475 mg) as a 1:1 diastereomeric mixtures.



(4a*S*,6*R*,8a*S*)**-6-((*tert*-butyldimethylsilyl)oxy)-3-methoxy-11-((6-(1-methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,9,10,11,12-hexahydro-6*H* benzo[2,3]benzofuro[4,3-*cd*]azepine [**(–)-**25**]**: Compound (–)-**25** was obtained as white foam as 1:1 dr (0.891 mmol scale of reaction, 475 mg of product, 82% yield); R_f = 0.55 (30% EtOAc in *n*-hexane).

^{1}H NMR [1:1 dr of **25a** and **25b**] (500 MHz, $CDCl_3$): δ 7.59 (t, *J* = 8.4 Hz, 2H), 7.05 (td, *J* = 17.4, 16.7, 7.5 Hz, 4H), 6.97 – 6.87 (m, 3H), 6.83 (s, 2H), 6.79 (d, *J* = 7.4 Hz, 1H), 6.63 (d, *J* = 8.1 Hz, 1H), 6.55 (d, *J* = 8.1 Hz, 1H), 6.52 – 6.47 (m, 2H), 6.42 (d, *J* = 8.1 Hz, 1H), 6.33 (d, *J* = 8.3 Hz, 1H), 6.04 (d, *J* = 8.1 Hz, 4H), 5.97 (dd, *J* = 10.4, 5.8 Hz, 2H), 5.77 (dt, *J* = 10.3, 5.0 Hz, 2H), 4.40 (d, *J* = 14.5 Hz, 2H), 4.22 (s, 2H), 3.96 – 3.87 (m, 2H), 3.85 (s, 3H), 3.82 (s, 3H), 3.50 (dd, *J* = 33.3, 14.7 Hz, 2H), 3.33 (m, 2H), 3.31 (s, 3H), 3.28 – 3.22 (m, 2H), 3.20 (s, 3H), 2.96 (dd, *J* = 36.1, 13.7 Hz, 2H), 2.65 (d, *J* = 14.2 Hz, 1H), 2.51 (d, *J* = 14.0 Hz, 1H), 2.37 (d, *J* = 15.1 Hz, 2H), 2.00 (t, *J* = 15.6 Hz, 2H), 1.71-1.62 (m, 4H), 1.33-1.25 (m, 2H), 0.88 (s, 18H), 0.08 (s, 6H), 0.03 (s, 6H).

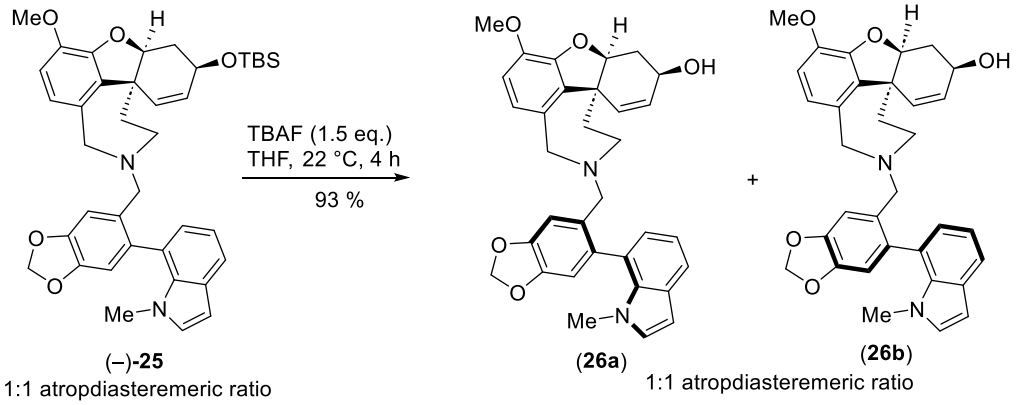
^{13}C {^{1}H} NMR [1:1 dr of **25a** and **25b**] (126 MHz, $CDCl_3$): δ 147.2, 147.1, 147.0, 145.6, 143.9, 134.6, 134.5, 133.4, 133.3, 132.8, 130.4, 130.4, 129.4, 128.9, 127.6, 124.7, 123.9, 123.7, 120.9, 120.6, 120.1, 120.0, 118.8, 118.8, 111.9, 111.7, 110.9, 109.1, 109.0, 101.1, 101.1, 100.9, 100.8, 88.7, 86.9, 86.9, 63.7, 62.1, 62.0, 58.2, 57.3, 56.4, 56.3, 54.3, 52.2, 48.2, 48.1, 35.9, 35.6, 32.8, 32.7, 25.8, 18.1, -4.5, -4.6.

IR (film)υ_{max}: 2927, 1476, 748, 583cm^{-1}.

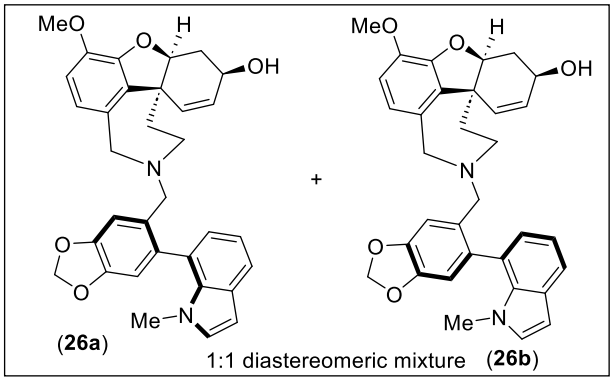
HRMS (ESI-TOF) *m*/*z*: $[M+H]^+$ Calcd for $[C_{39}H_{46}N_2O_5Si + H]^+$ 651.3254; Found 651.3267.

$[\alpha]_D^{25.0} = -38.25$ (c = 0.04 g/ml, $CHCl_3$)

Synthesis of dehydro narcipavline [(–)-26]:



In a round bottom flask compound, (–)-**25** (dr ~ 1:1) (400 mg, 0.614 mmol, 1.0 equiv.) was dissolved in 4 mL of dry THF under nitrogen atmosphere. The reaction mixture placed in an ice bath. Then, 1(*M*) solution TBAF in THF (920 μL, 0.921 mmol, 1.5 equiv.) was added dropwise at 0 °C. Further the reaction mixture allowed to stir at 22 °C for 4 h. After complete conversion of the starting material (monitored by TLC analysis), reaction mixture diluted with 10 mL EtOAc and quenched with H_2O 15 mL. The organic layer extracted with EtOAc (20 mL X 2) and washed with brine solution and concentrated in rotary evaporator. The crude product was purified by flash chromatography using 30% EtOAc/hexane as eluent to afford desired product (–)-**26** (306 mg, 83%) as a 1:1 diastereomeric mixtures which shows single spot in TLC and inseparable *via* column chromatography. [N. B.: Racemic (±)-**26** was crystalized in *i*-PrOH by keeping it in room temperature for 21 days.]



(4a*S*,6*R*,8a*S*)**-3-methoxy-11-((6-(1-methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,9,10,11,12-hexahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(–)-**26**]: Compound (–)-**26** [dr ~ 1:1] was obtained as yellow semi-solid. (0.6 mmol scale of reaction, 300 mg of product, 90% yield); R_f = 0.35 (60% EtOAc in *n*-hexane).

^{1}H NMR [1:1 dr of **26a** and **26b**] (500 MHz, $CDCl_3$): δ 7.59 (td, *J* = 8.2, 1.2 Hz, 2H), 7.08 (d, *J* = 7.3 Hz, 1H), 7.05 (t, *J* = 4.5 Hz, 2H), 7.00 (t, *J* = 7.5 Hz, 1H), 6.95 (d, *J* = 3.1 Hz, 1H), 6.92 (dd, *J* = 7.2, 1.2 Hz, 1H), 6.89 (d, *J* = 3.1 Hz, 1H), 6.83 (d, *J* = 1.7 Hz, 2H), 6.78 (d, *J* = 6.0 Hz, 1H), 6.66 (d, *J* = 8.1 Hz, 1H), 6.58 (d, *J* = 8.1 Hz, 1H), 6.50 (dd, *J* = 8.8, 3.2 Hz, 3H), 6.42 (d, *J* = 8.1 Hz, 1H), 6.04 (dd, *J* = 3.0, 1.4 Hz, 2H), 6.03 (d, *J* = 1.5 Hz, 2H), 6.00 – 5.91 (m, 4H), 4.42 (d, *J* = 15.4 Hz, 2H), 4.10 (q, *J* = 5.1 Hz, 2H), 3.89 (d, *J* = 5.6 Hz, 1H), 3.86 (s, 3H), 3.83 (d, *J* = 15.7 Hz, 1H), 3.83 (s, 3H), 3.59 (d, *J* = 15.3 Hz, 1H), 3.53 (d, *J* = 15.4 Hz, 1H), 3.34 (dd, *J* = 13.9, 5.8 Hz, 2H), 3.30 (s, *J* = 10.3 Hz, 3H), 3.29 – 3.23 (m, 2H), 3.20 (s, 3H), 3.06 – 2.91 (m, 2H), 2.74 – 2.56 (m, 2H), 1.96-1.88 (m, 2H), 1.73-1.64 (m, 2H), 1.62-1.55 (m, 2H), 1.38 – 1.31 (m, 2H).

^{13}C {^{1}H} NMR [1:1 dr of **26a** and **26b**] (126 MHz, $CDCl_3$): δ 147.2, 145.9, 145.8, 145.7, 144.0, 134.6, 134.5, 133.3, 133.3, 130.5, 130.4, 129.4, 127.4, 127.1, 124.6, 123.9, 123.7, 122.0, 121.7, 120.1, 120.1, 118.8, 111.2, 111.1, 111.0, 111.0, 109.0, 109.0, 101.1, 101.1, 100.9, 100.9, 88.6, 88.6, 62.1, 61.5, 58.4, 57.5, 56.0, 55.9, 54.3, 51.9, 48.2, 48.1, 35.7, 35.6, 31.9, 29.9, 29.9, 29.7, 22.7.

IR (film)υ_{max}: 3423, 2902, 1589, 1452, 1321 cm^{-1}.

HRMS (ESI-TOF) *m*/*z*: $[M+H]^+$ Calcd for $[C_{33}H_{32}N_2O_5 + H]^+$ 537.2390; Found 537.2391.

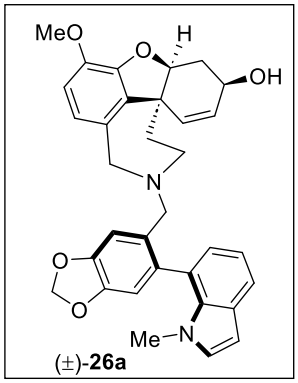
$[\alpha]_D^{25.0}$ = –36.2 (*c* = 0.04 g/ml, $CHCl_3$)

Enantiomeric excess of pure compound was determined via HPLC analysis using a Chiralpak OD-H column [solvent: hexane/2-propanol = 70/30; flow rate: 1.0 mL/min; detection: at 254 nm, 93% ee]: t_R major = 14.370 min, t_R minor = 18.857 min, for one of the diastereomer, and t_R major = 23.586 min, t_R minor = 29.402 min, for the other diastereomer.

Compound (±)-**26 (**8-10 mg) was dissolved in 1 mL of *i*-PrOH and allowed for slow evaporation at 22 ºC for 21 days. This resulted yellow crystal grow for one of the diastereomers. Crystal data (CCDC: **2363948**) given later part of the supporting information.

The ^{1}H NMR analysis of yellow solid crystals of **26b** in $CDCl_3$ showed the data for single atropodiastereomer. However, when ^{13}C NMR of **26b** was recorded after 24 h, we observed the generation of double peaks for each carbon, clearly indicting single diastereomer converting to a mixture of atropodiastereomers at room temperature within a day. To confirm this, we immediately recorded ^{1}H NMR spectra of the same sample of **26b** and confirmed this fact.

The 1H-NMR characterization data of **26b** given below and all the NMR spectra of diastereomeric mixtures have been given in spectral traces.

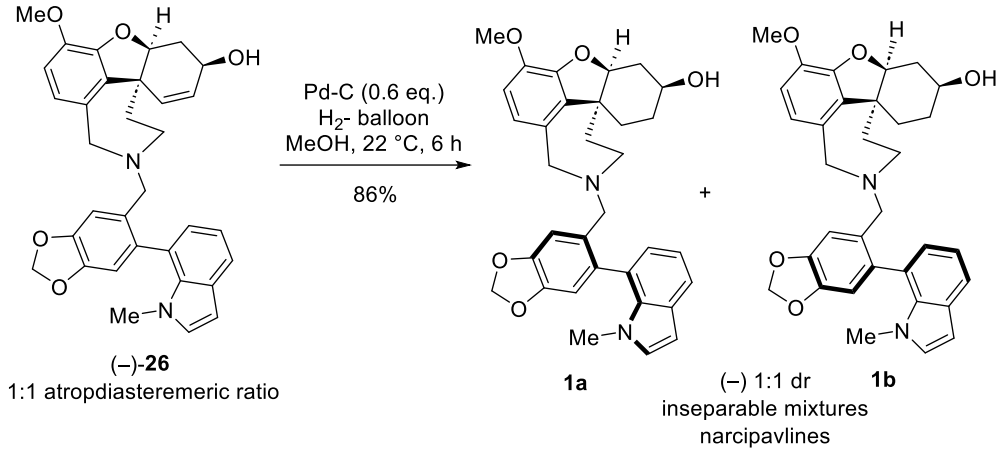


(±)-**26a**

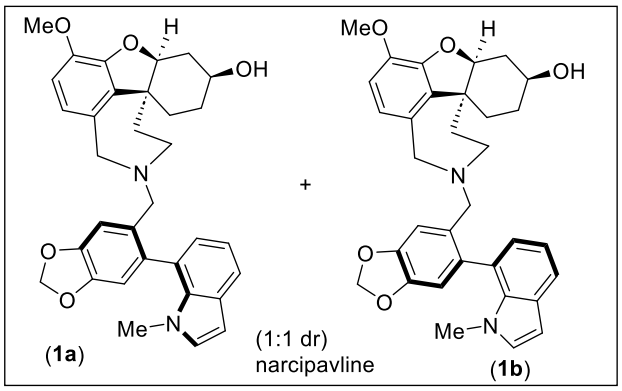
(4a*S*,6*R*,8a*S***)-3-methoxy-11-((6-(1-methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,9,10,11,12-hexahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(±)-**26**]: Yellow crystalline solid.

^{1}H NMR (400 MHz, $CDCl_3$) (mixed with ^{i}PrOH): δ 7.56 (dd, *J* = 7.9, 1.2 Hz, 1H), 7.04 (dd, *J* = 7.9, 7.1 Hz, 1H), 6.99 (s, 1H), 6.89 (d, *J* = 1.2 Hz, 1H), 6.85 (d, *J* = 3.1 Hz, 1H), 6.79 (s, 1H), 6.55 (d, *J* = 8.2 Hz, 1H), 6.46 (d, *J* = 3.1 Hz, 1H), 6.39 (d, *J* = 8.2 Hz, 1H), 6.04 – 5.96 (m, 2H), 5.95 – 5.86 (m, 2H), 4.40 (s, 1H), 4.04 (br s, 1H), [4.06 – 3.93 (m, 1H), ^{i}PrOH, C-H proton], 3.79 (s, 3H), 3.49 (d, *J* = 15.3 Hz, 1H), 3.29 (q, 3H), 3.16 (s, 3H), 2.96 (t, *J* = 13.3 Hz, 1H), 2.70 – 2.56 (m, 2H), 2.36 (d, *J* = 11.3 Hz, 1H), 1.90 (ddd, *J* = 15.7, 4.9, 2.3 Hz, 1H), 1.53 (dd, *J* = 13.1, 3.2 Hz, 1H), 1.33 – 1.28 (m, 1H), [1.20 (s, 3H), 1.19 (s, 3H) for ^{i}PrOH].

Hydrogenation of dehydro narcipavline synthesis of narcipavline [(–)-**1**]**:**



An oven-dried round bottom flask was charged with compound (–)-**26** (1:1 dr of **26a** and **26b**) (250 mg, 0.465 mmol, 1.0 equiv.) in 4 mL of MeOH under nitrogen atmosphere. Next, the reaction mixture was degassed for 10 min using N_2-balloon. Then, Pd-C (150 mg, 60 vol% wt/wt) was added and H_2-balloon was purged into the solution and stirring was continued for 6 h at 22 °C. Upon complete consumption of the starting materials (monitored by TLC analysis), H_2-balloon was removed. The reaction mixture was filtered and washed with MeOH, and evaporated the solvent under reduced pressure. The crude product was purified by flash chromatography using 50% EtOAc/hexane as eluent to afford (–)-narcipavline (**1**) (215 mg, 86%) as a 1:1 diastereomeric mixtures [single spot on the TLC and are inseparable by column chromatography].



(4a*S*,6*S*,8a*R*)**-3-Methoxy-11-((6-(1-methyl-1*H*-indol-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,7,8,9,10,11,12-octahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(–)-**1**]: Compound (–)-**1** was obtained as yellow gummy mass as 1:1 diastreomeric ratio of **1a**

and **1b**. (0.465 mmol scale of reaction, 215 mg of product, 86% yield); R_f = 0.35 (70% EtOAc in *n*-hexane). This showed single spot on TLC and are inseparable by column chromatography.

^{1}H NMR [1:1 dr of **1a** and **1b**] (400 MHz, $CDCl_3$): δ 7.46 (td, *J* = 7.7, 1.2 Hz, 2H), 7.03 (s, 1H), 7.01 (s, 1H), 7.03 – 6.96 (m, 1H), 6.97 (d, *J* = 7.9 Hz, 1H), 6.92 (d, *J* = 3.2 Hz, 1H), 6.88 (dd, *J* = 7.9, 7.1 Hz, 1H), 6.83 (dd, *J* = 7.2, 1.2 Hz, 1H), 6.75 (s, 1H), 6.74 (s, 1H), 6.64 (d, *J* = 1.6 Hz, 1H), 6.62 (d, *J* = 2.7 Hz, 1H), 6.55 (d, *J* = 8.2 Hz, 1H), 6.42 (d, *J* = 3.1 Hz, 1H), 6.38 (d, *J* = 3.2 Hz, 1H), 6.33 (d, *J* = 8.1 Hz, 1H), 6.29 (d, *J* = 8.2 Hz, 1H), 6.02 – 5.95 (m, 4H), 4.59 (br s, 1H), 3.98-3.93 (m, 4H), 3.84 (d, *J* = 6.3 Hz, 2H), 3.78 (s, 3H), 3.75 (s, 3H), 3.53 (d, *J* = 8.0 Hz, 1H), 3.49 (d, *J* = 7.9 Hz, 1H), 3.34 (t, *J* = 14.7 Hz, 2H), 3.25 (s, 3H), 3.26 – 3.14 (m, 2H), 3.14 (s, 3H), 2.92 (dd, *J* = 14.9, 10.8 Hz, 2H), 2.69 (dd, *J* = 14.5, 4.4 Hz, 2H), 2.25 – 2.12 (m, 2H), 1.88–1.76 (m, 2H), 1.72 – 1.49 (m, 8H), 1.36 – 1.27 (m, 4H).

^{13}C {^{1}H} NMR [1:1 dr of **1a** and **1b**] (126 MHz, $CDCl_3$): δ 148.9, 148.8, 147.84, 147.77, 147.7, 147.4, 145.4, 145.3, 137.3, 137.2, 135.9, 135.8, 135.2, 134.8, 132.5, 131.84, 131.79, 131.2, 131.1, 129.7, 125.9, 125.7, 124.9, 122.7, 122.5, 121.1, 121.0, 119.7, 119.6, 112.8, 112.6, 111.9, 111.8, 110.1, 109.9, 102.63, 102.59, 101.87, 101.85, 90.4, 90.3, 65.88, 65.86, 59.2, 58.8, 56.71, 56.67, 55.5, 54.3, 52.6, 52.5, 47.9, 47.8, 36.1, 35.8, 33.1, 32.9, 32.74, 32.68, 27.9, 27.8, 25.3, 25.2.

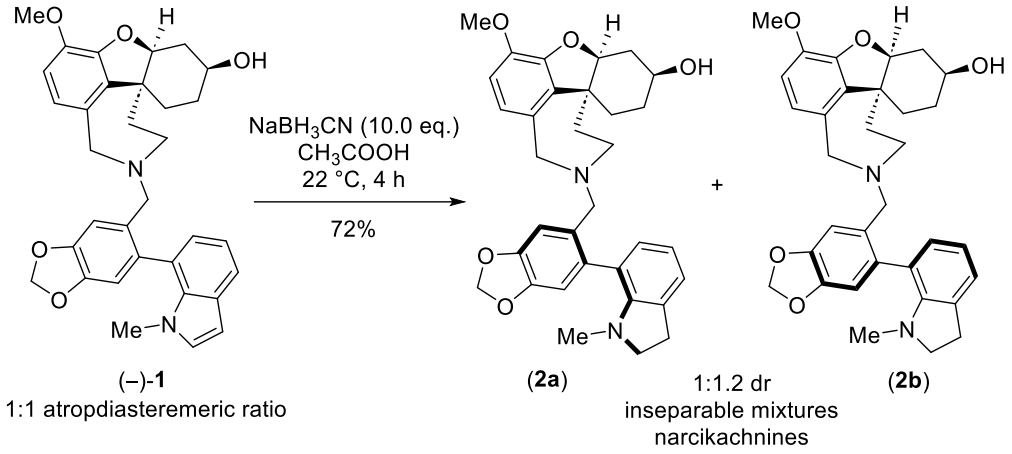
IR (film)υ_{max}: 3406, 2927, 1684, 1446, 1222, 1039, 933 cm^{-1}.

HRMS (ESI-TOF) *m*/*z*: $[M+H]^+$ Calcd for $[C_{33}H_{34}N_2O_5 + H]^+$ 539.2546; Found 539.2560.

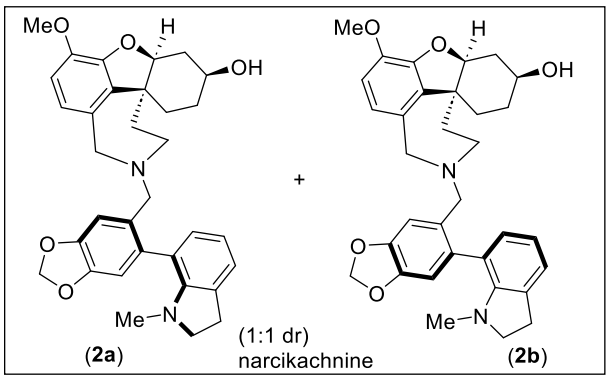
$[\alpha]_D^{25.0}$ = –34.00 (*c* = 0.0025 g/ml, $CHCl_3$) for 1:1 atropdiastereomeric mixture.

Enantiomeric excess of pure compound was determined via HPLC analysis using a Chiralpak OD-H column [solvent: hexane/2-propanol = 60/40; flow rate: 1.0 mL/min; detection at 254 nm; 94% ee,]: t_R major = 11.579 min, t_R minor = 12.634 min for one of the diastereomers and t_R major = 14.898 min, t_R minor = 20.023 min for the other diastereomer [dr was found to be ~ 1:1].

Synthesis of Narcikachnine (2) from Narcipavline (1):



In a 25 ml round bottom flask, narcipavlines (–)-**1** (dr ~ 1:1) (150 mg, 0.278 mmol, 1.0 equiv.) was dissolved in 2 mL of AcOH and the reaction mixture placed in an ice bath. Then, $NaBH_3CN$ (175 mg, 2.78 mmol, 10.0 equiv.) was added to the residue at 0 °C portion wise and the stirring was continued at room temperature for 4 h. After complete consumption of starting material (monitored by TLC in 5% MeOH in CH_2Cl_2), the reaction was quenched by adding water (2 mL). Next, most of the AcOH was removed under vacuum and the residue was treated with NaOH aqueous solution. Next, the reaction was extracted with CH_2Cl_2 (10 mL X 2) by maintaining the pH 8-10. The organic layers were combined and dried over Na_2SO_4 and the solvent was removed under the reduced pressure. Finally, the residual raw product was purified by chromatography (neutral alumina, 60% EtOAc/*n*-hexane to 5% MeOH/CH_2Cl_2) obtain (–)-narcikachnine (**2**) (108 mg, 72%) as dr ~ 1:1 for **2a** and **2b**. These diastereomers showed single spot-on TLC and were found to be inseparable in column chromatography.



(4a*S*,6*S*,8a*R*)**-3-Methoxy-11-((6-(1-methylindolin-7-yl)benzo[*d*][1,3]dioxol-5-yl)methyl)-4a,5,7,8,9,10,11,12-octahydro-6*H*-benzo[2,3]benzofuro[4,3-*cd*]azepin-6-ol** [(–)-**2**]:

Compound (–)-**2** was obtained as white solid. (0.278 mmol scale of reaction, 107 mg of product, 90% yield) as 1: 1 (**2a**: **2b**) atropdiastreomeric mixture; R_f = 0.3 (5% MeOH in CH_2Cl_2). For comparision of ^{1}H-NMR and ^{13}C-{^{1}H} NMR with the isolation paper, the NMRs of **2** were recorded in CD_3OD and $CDCl_3$.

^{1}H NMR (400 MHz, CD_3OD) [~1:1 dr of **2a**: **2b**]: δ 7.04 (dd, *J* = 9.1, 2.7 Hz, 4H), 6.83 (d, *J* = 7.5 Hz, 1H), 6.78 – 6.67 (m, 7H), 6.55 (d, *J* = 8.6 Hz, 1H), 6.41 (s, 1H), 6.00 (dd, *J* = 10.1, 3.3 Hz, 4H), 4.59 (s, 2H), 4.24 (s, 1H), 4.13 – 3.96 (m, 5H), 3.84 (s, 3H), 3.84 (s, 3H), 3.79 (d, *J* = 15.4 Hz, 2H), 3.61 (d, *J* = 35.8 Hz, 2H), 3.53 – 3.41 (m, 2H), 3.29 – 3.18 (m, 2H), 3.08 (d, *J* = 14.1 Hz, 2H), 2.98 – 2.89 (m, 4H), 2.87 – 2.76 (m, 2H), 2.70 (m, 2H), 2.31 (d, *J* = 16.3 Hz, 1H), 2.24 (d, *J* = 10.5 Hz, 1H), 2.24 (s, 3H), 2.14 (s, 3H), 1.98 (dt, *J* = 15.8, 4.5 Hz, 1H), 1.89 (dd, *J* = 16.0, 4.4 Hz, 1H), 1.85 – 1.60 (m, 8H), 1.50 – 1.40 (m, 2H), 1.37 – 1.32 (m, 2H).

^{1}H NMR (400 MHz, $CDCl_3$) [~1:1 dr of **2a**: **2b**]: δ 7.06 (d, *J* = 2.0 Hz, 1H), 7.01 (s, 1H), 6.99 (s, 1H), 6.84 – 6.76 (m, 1H), 6.74 (s, 1H), 6.71 (s, 1H), 6.70 – 6.60 (m, 3H), 6.64 – 6.54 (m, 3H), 6.52 (d, *J* = 8.2 Hz, 1H), 6.39 (d, *J* = 8.3 Hz, 1H), 5.97 – 5.96 (m, 4H), 4.26 – 4.25 (m, 1H), 4.12 – 3.99 (m, 5H), 3.85 (s, 3H), 3.84 (s, 3H), 3.80 – 3.61 (m, 2H), 3.55 – 3.36 (m, 4H), 3.26 – 3.21 (m, 2H), 3.04 – 3.02 (m, 2H), 2.95 – 2.86 (m, 4H), 2.83 – 2.74 (m, 2H), 2.44 (t, *J* = 15.3 Hz, 2H), 2.22 (s, 3H), 2.15 (s, 3H), 1.87 – 1.58 (m, 14H), 1.36 – 1.28 (m, 3H).

^{13}C {^{1}H} NMR (126 MHz, CD_3OD) [~1:1 dr of **2a**: **2b**]: δ 150.5, 149.8, 147.3, 146.8, 146.6, 146.41, 144.1, 135.9, 135.7, 134.20, 131.2, 130.2, 129.9, 123.3, 123.1, 121.4, 118.4, 111.5, 111.3, 110.1, 109.7, 108.5, 101.24, 101.19, 89.1, 88.9, 64.5, 58.3, 56.7, 56.4, 55.3, 51.7, 49.8, 46.6, 46.5, 31.38, 31.35, 30.82, 30.75, 28.2, 28.0, 26.5, 24.0, 23.9.

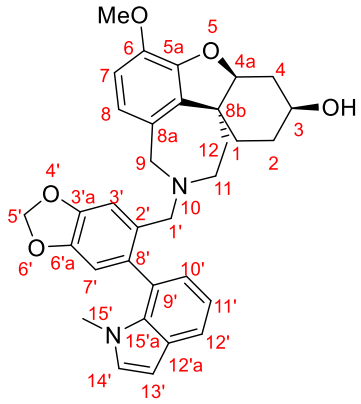
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) [~1:1 dr of **2a**: **2b**]: δ 150.6, 150.4, 146.9, 145.9, 144.0, 136.6, 133.5, 131.1, 130.5, 130.2, 124.1, 123.5, 123.3, 123.0, 121.8, 118.0, 115.9, 110.6, 110.4, 110.3, 108.9, 108.5, 101.1, 101.0, 90.0, 89.8, 65.5, 65.4, 58.5, 57.1, 56.9, 56.0, 55.9, 52.3, 46.7, 46.6, 38.8, 38.7, 31.9, 31.6, 31.5, 31.4, 28.7, 28.5, 27.68, 27.65, 23.8.

IR (film)υ_{max}: 3385, 2925, 1462, 1264, 1040 cm^{-1}.

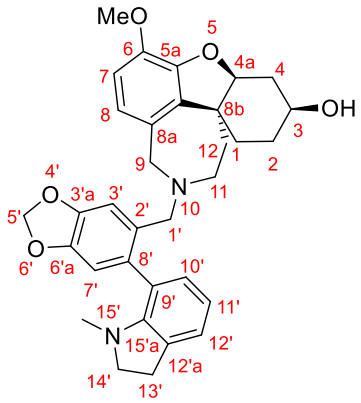
HRMS (ESI-TOF) *m/z*: $[M+H]^+$ Calcd for $[C_{33}H_{36}N_2O_5 + H]^+$ 541.2703; Found 541.2691.

$[\alpha]_D^{25.0} = -31.40$ (c = 0.0025 g/ml, $CHCl_3$) for atropdiastereomeric mixtures.

VT experiment shows remarkable change in different temperature. At the higher experimental temperature, the proton resonances towards coalesced for both diastereomers. Although we can achieve only up to 65 ºC, still the changes are clear, which proves that **2a** and **2b** are the atropodiastereomers. The peak near 4.15 coalesced, and the *N*-methyl peak 2.0, and 2.1 changes happened. After cooling back to RT (298 K), we observed 1:1 ratio of atropodiastereomeric mixtures along with decomposition.



narcipavline (**4**)



narcikachnine (**5**)

Comparison of ^{1}H-NMR Data of (–)-narcipavline [(–)-**1**] of this report with natural (**1**) by Cahlíková:[4]

	Cahlíková's isolation report (^{1}H-NMR, 500 MHz, CD_3OD)[4]	This report (^{1}H-NMR, 500 MHz, CD_3OD)
1	1.72-1.53 m	1.72–1.49 (m, 4H)
2	1.72-1.53 and 1.42-1.23 m	1.72–1.49 (m, 2H) 1.36 –1.27 (m, 2H)
3	4.02-3.93 m	3.98-3.93 (m, 2H)
4	2.25-2.15 and 1.91-1.77 m	2.25 – 2.12 (m, 2H) and 1.82 (dddd, J = 24.8, 16.0, 5.3, 4.1 Hz, 2H)
4a	4.02-3.93 and 3.87-3.80 m	3.98-3.93 (m, 2H)
5a		
6		

7	6.66-6.63 m and 6.56 d (*J* = 8.2 Hz)	6.62 (d, *J* = 2.7 Hz, 1H) and 6.55 (d, *J* = 8.2 Hz, 1H)
8	6.34 d (*J* = 8.2 Hz) and 6.29 (*J* = 8.2 Hz)	6.33 (d, *J* = 8.1 Hz, 1H) and 6.29 (d, *J* = 8.2 Hz, 1H)
8a		
8b		
9	3.87-3.80, 3.78-3.72 and 3,54-3.45 m	3.84 (d, *J* = 6.3 Hz, 2H) and 3.53 (d, *J* = 8.0 Hz, 1H), 3.49 (d, *J* = 7.9 Hz, 1H)
11	2.96-2.87 and 2.71-2.64 m	2.92 (dd, *J* = 14.9, 10.8 Hz, 2H), and 2.69 (dd, *J* = 14.5, 4.4 Hz, 2H)
12	1.42-1.23 m	1.72–1.49 (m, 2H), 1.36 – 1.27 (m, 2H)
13	3.36-3.24 m and 3.24	
1'	3.11 m	3.34 (t, *J* = 14.7 Hz, 2H) and 3.26 – 3.14 (m, 2H)
2'		
3'	7.03 and 7.01 s	7.03 (s, 1H) and 7.01 (s, 1H)
3'a		
5'	6.01- 5.99 m	6.02 – 5.95 (m, 4H)
6'a		
7'	6.76 and 6.74 s	6.75 (s, 1H) and 6.74 (s, 1H)
8'		
9'		
10'	6.83 dd (*J* =7.4 Hz, *J* =1.0 Hz) and 6.66-6.63 m	6.83 (dd, *J* = 7.2, 1.2 Hz, 1H) and 6.64 (d, *J* = 1.6 Hz, 1H)
11'	7.03-6.96 and 6.89 t (*J* =7.4 Hz)	6.92 (d, *J* = 3.2 Hz, 1H), 6.88 (dd, *J* = 7.9, 7.1 Hz, 1H)
12'	7.48 dd (*J* =7.7 Hz, *J* =1.0 Hz) and 7.46 dd (*J* =7.7 Hz, *J* =1.0 Hz)	7.46 (td, *J* = 7.7, 1.2 Hz, 2H)
12'a		

13'	6.43 d (*J* =2.9 Hz) and 6.39 d (*J* =2.9 Hz)	6.42 (d, *J* = 3.1 Hz, 1H) and 6.38 (d, *J* = 3.2 Hz, 1H)
14'	7.03-6.96 and 6.94-6.92 m	7.03–6.96 (m, 1H) and 6.97 (d, *J* = 7.9 Hz, 1H)
15'a		
6-OCH_3	3.80 and 3.77 s	3.78 (s, 3H) and 3.75 (s, 3H)
15'-N CH_3	3.27 and 3.16 s	3.25 (s, 3H) and 3.14 (s, 3H)
O-H		4.59 (bs, 2 H)

Comparison of ^{13}C-NMR Data of (–)-narcipavline [(–)-**1**] of this report with isolation of (**1)** by Cahlíková:[4]

	Cahlíková's isolation report (^{13}C-NMR, 500 MHz, CD_3OD)[4]	This report (^{13}C-NMR, 500 MHz, CD_3OD)
1	25.3 and 25.2	25.3 and 25.2
2	27.9 and 27.8	27.9 and 27.8
3	65.9 and 65.9	65.88 and 65.86
4	32.8 and 32.7	32.74 and 32.68
4a	90.4 and 90.4	90.4 and 90.3
5a	147.8 and 147.8	147.84 and 147.77
6	145.3 and 145.1	145.4 and 145.3
7	112.7 and 112.6	112.8 and 112.6
8	122.6 and 122.3	122.7 and 122.5
8a	130.3	129.7
8b	137.4 and 137.2	137.3 and 137.2
9	59.3 and 58.7	59.2 and 58.8
11	52.6 and 52.5	52.6 and 52.5
12	33.1 and 32.3	33.1 and 32.9
13	48.0 and 47.9	47.9 and 47.8
1'	55.4 and 54.2	55.5 and 54.3
2'	133.1 and 132.9	132.5
3'	110.1 and 109.9	110.1 and 109.9

3'a	148.8 and 148.8	148.9 and 148.8
5'	102.6 and 102.5	102.63 and 102.59
6'a	147.5 and 147.3	147.7 and 147.4
7'	111.9 and 111.8	111.9 and 111.8
8'	135.0 and 134.7	135.2 and 134.8
9'	126.0 and 125.8	125.9 and 125.7
10'	124.9	124.9
11'	119.7 and 119.6	119.7 and 119.6
12'	121.0 and 120.9	121.1 and 121.0
12'a	131.2 and 131.1	131.2 and 131.1
13'	101.8 and 101.8	101.87 and 101.85
14'	131.8 and 131.7	131.84, 131.79
15'a	135.9 and 135.8	135.9 and 135.8
6-OCH_3	56.7 and 56.7	56.71 and 56.67
15'-N CH_3	36.0 and 35.8	36.1 and 35.8

Comparison of ^{1}H-NMR data of (-)-narcikachnine [(–)-**2**] with isolation of (**2)** by Cahlíková:[4]

	Cahlíková's isolation report (^{1}H-NMR, 500 MHz, $CDCl_3$)[4]	This report in (^{1}H-NMR, 500 MHz, CD_3OD)	This report in (^{1}H-NMR, 400 MHz, $CDCl_3$)
1	1.88–1.47 m	1.85–1.60 (m, 2H), 1.50 – 1.40 (m, 2H)	1.87–1.58 m
2	1.88–1.47 m	1.85 –1.60 (m, 4H)	1.87–1.58 m
3	4.04 bs	4.24 (bs, 1H), 4.13–3.96 (m, 1H)	4.12–3.99
4	2.46 t (J = 8.2 Hz) and 1.88–1.47 m	2.70 (m, 2H), 2.24 (d, J = 10.5 Hz, 1H), and 1.98 (dt, J = 15.8, 4.5 Hz, 1H),	2.44 (t, J = 15.3 Hz) and 1.87–1.58 m
4a	4.28–4.25 and 4.14–4.11 m	4.13–3.96 (m, 2H)	4.26–4.25 m and 4.12–3.99 m
5a			
6			

7	6.62–6.57 m	6.78–6.67 (m, 2H)	6.64 – 6.54 m
8	6.51 d (*J* = 8.3 Hz) and 6.40 (*J* = 8.3 Hz)	6.55 (d, *J* = 8.6 Hz, 1H) and 6.41 (s, 1 H)	6.52 (d, *J* = 8.2 Hz) and 6.39 (d, *J* = 8.3 Hz)
8a			
8b			
9	3.89 (*J* = 15.0 Hz) d, 3.88 (*J* = 15.0 Hz) and 3.65 d (*J* = 15.0 Hz) and 3.52–3.43 m	4.13–3.96 (m, 2H), 3.79 (d, *J* = 15.4 Hz, 2H)	4.12–3.99 m, 3.80–3.61 m, 3.55–3.36 m
11	3.05–2.85 and 2.83–2.72 m	2.98–2.89 (m, 4H)	2.95–2.86 m
12	1.88–1.47 and 1.44–1.37 m	1.85–1.60 (m, 2H), 1.37–1.32 (m, 2H)	1.87–1.58 m, 1.36–1.28 m
13			
1'	3.52–3.42 m and 3.39–3.32 m	3.61 (d, *J* = 35.8 Hz, 2H), and 3.53-3.41 (m, 2H)	3.55 – 3.36 m
2'			
3'	7.06 and 7.04–6.99 m	7.11–7.02 (m, 2H)	7.06 d (*J* = 2.0 Hz) and 7.01 s
3'a			
5'	5.98–5.96 m	6.00, (dd, *J* =10.1, 3.3 Hz, 4H)	5.97 – 5.96 m
6'a			
7'	6.75 and 6.72 s	6.78–6.67 (m, 2 H)	6.74 s and 6.71 s
8'			
9'			
10'	6.82 d (*J* =7.1 Hz) and 6.68-6.62 m	6.82 d (*J* =7.5 Hz, 1H) and 6.78–6.67 m (1 H)	6.84–6.76 m and 6.70–6.60 m
11'	6.66 t (*J* =7.1 Hz) and 6.62–6.57 m	6.78–6.67 (m, 2 H)	6.70–6.60 m
12'	7.04–6.99 m	7.11–7.02 (m, 2H)	6.99 s
12'a			
13'	3.03–2.85 and 2.83–2.72 m	2.98–2.89 (m, 2H), and 2.87–2.76 (m, 2H)	2.95–2.86 m, 2.83–2.74 m

14'	3.31–3.21 m and 3.17 dd (*J* =9.1 Hz, *J* =9.1 Hz) and 3.08 dd (*J* =9.1 Hz, *J* =9.1 Hz)	3.29–3.18 (m, 2H), 3.08 (d, *J* = 14.1 Hz, 2H)	3.26–3.21 m and 3.04–3.02 m
15'a			
6-OCH_3	3.85 s	3.84 (s, 3H) and 3.84 (s, 3H)	3.85 s, and 3.84 s
15'-NCH_3	2.23 and 2.18 s	2.24 (s, 3H) and 2.14 (s, 3H)	2.22 s and 2.15 s
OH		4.59 (bs, 2H)	

Comparison of ^{13}C-NMR data of (-)-narcikachnine [(−)-**2**] with isolation of (**2)** by Cahlíková:[4]

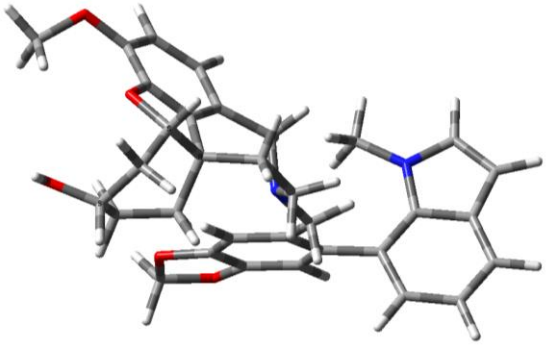
	Cahlı´kova´'s isolation report (^{13}C-NMR, 125 MHz, $CDCl_3$)[4]	This report (^{13}C-NMR, 126 MHz, CD_3OD)	This report (^{13}C-NMR, 126 MHz, $CDCl_3$)
1	23.8 and 23.7	24.0 and 23.9	23.8
2	27.7	26.5	27.68, 27.65
3	65.5 and 65.5	64.5	65.5 and 65.4
4	31.5 and 31.4	30.82 and 30.75	31.5 and 31.4
4a	90.0 and 89.9	89.1 and 88.9	90.0 and 89.8
5a	146.0	146.8	145.9
6	143.9	144.1	144.0
7	110.6 and 110.5	111.5 and 111.3	110.6
8	121.7 and 121.7	121.4	121.8
8a	130.1	129.9	130.2
8b	136.6	135.9 and 135.7	136.6
9	58.6 and 58.3	58.3	58.5
11	52.3 and 51.2	51.7 and 49.8	52.3
12	32.1 and 31.2	31.38 and 31.35	31.9 and 31.6
13	46.7 and 46.7	46.6 and 46.5	46.7 and 46.6
1'	54.9 and 53.7	56.4	52.4

2'	131.9	131.2	
3'	108.7 and 108.5	108.5	108.9 and 108.5
3'a	146.9 and 146.9	147.3	146.9
5'	100.9 and 100.9	101.24 and 101.19	101.1 and 101.0
6'a	145.9 and 145.7	146.4 and 146.6	145.9
7'	110.4 and 110.3	110.1 and 109.7	110.4 and 110.3
8'	133.6 and 133.4	134.2	133.6 and 133.5
9'	122.8 and 122.8	123.3 and 123.1	123.0
10'	130.4 and 130.2	130.2	130.5
11'	118.0 and 117.9	118.4	118.0
12'	123.2	123.3	123.5 and 123.3
12'a	131.0	131.2	131.1
13'	28.6 and 28.6	28.2 and 28.0	28.7 and 28.5
14'	57.1 and 56.9	56.6	57.1 and 56.9
15'a	150.5 and 150.4	150.5 and 149.9	150.6 and 150.4
6-OCH_3	55.9 and 55.9	55.3	56.0 and 55.9
15'-NCH_3	38.7 and 38.7	37.9	38.8 and 38.7

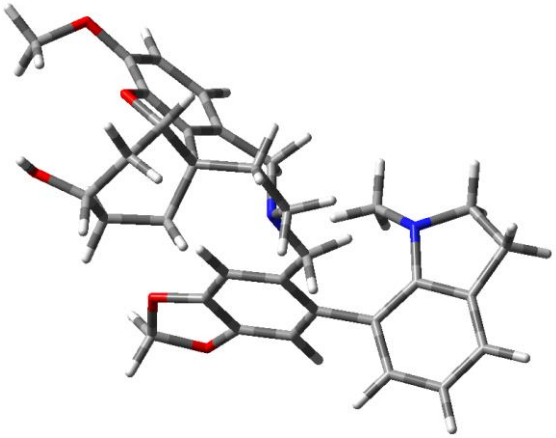
Theoretical Calculations: Methods

Geometry optimization

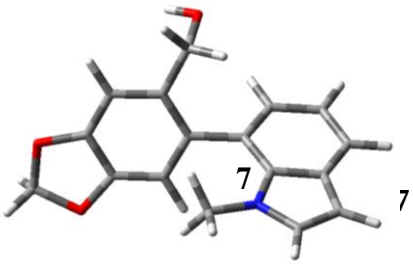
The geometry optimizations for molecules narcipavline **1**, narcikachnine **2**, and galanthindole **7** were performed using Density Functional Theory (DFT) as implemented in Gaussian 16. The B3LYP functional was employed in combination with the 6-31G(d) basis set. All molecules were treated with a neutral charge (0) and a singlet spin state. The optimizations were carried out in the gas phase to ensure accurate energy minimization.



Energy minimized structure of **1a**



Energy minimized structure of **2a**

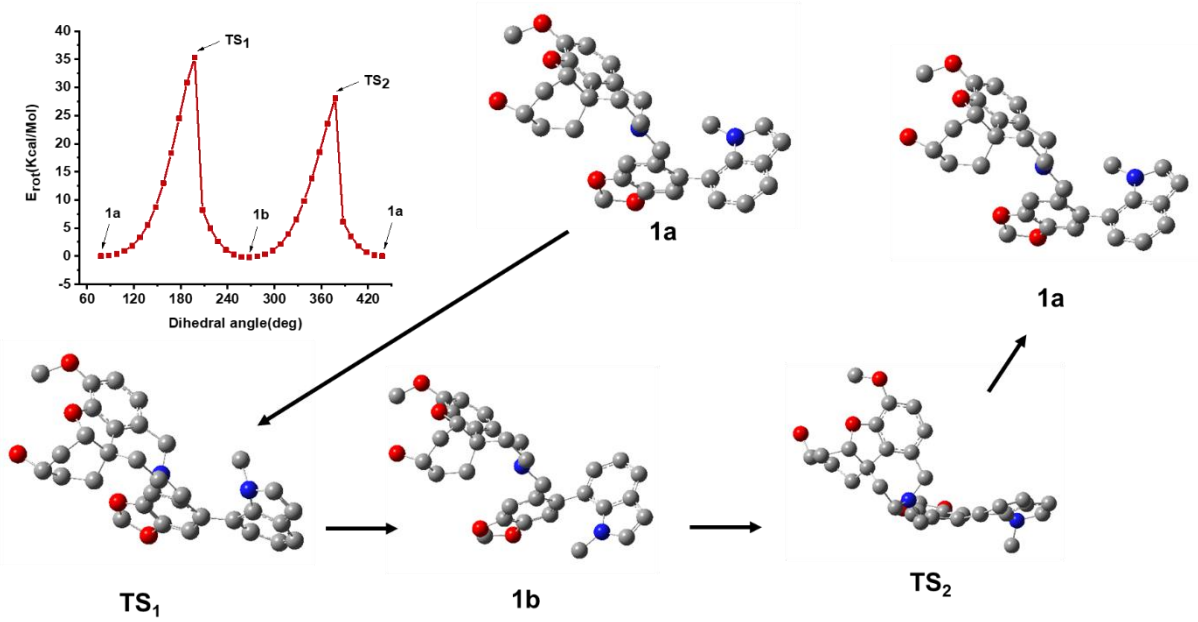


Computational assessment of rotational energy barriers

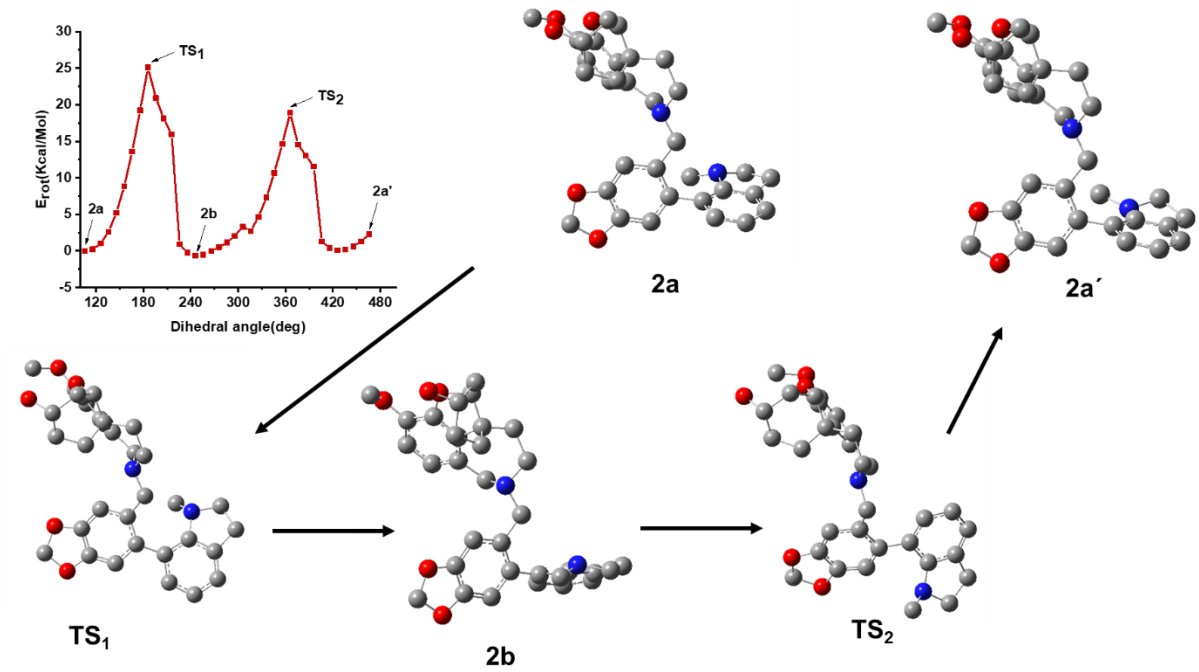
To computationally assess the rotational barriers of atropisomers, we conducted relaxed torsion scans employing the B3LYP/6-31G(d) method with the opt=modredundant keyword. This approach effectively samples the potential energy surface (PES) for torsional motion. The rotation around the C-C bond of interest was simulated in 36 discrete steps, each involving a 10-degree rotation. At each step, the geometry was fully optimized with tight convergence criteria to ensure the accuracy of the results.

A torsion profile was generated by plotting the energy values obtained from the 36 geometry optimizations against the corresponding dihedral angles. This profile allowed us to identify and

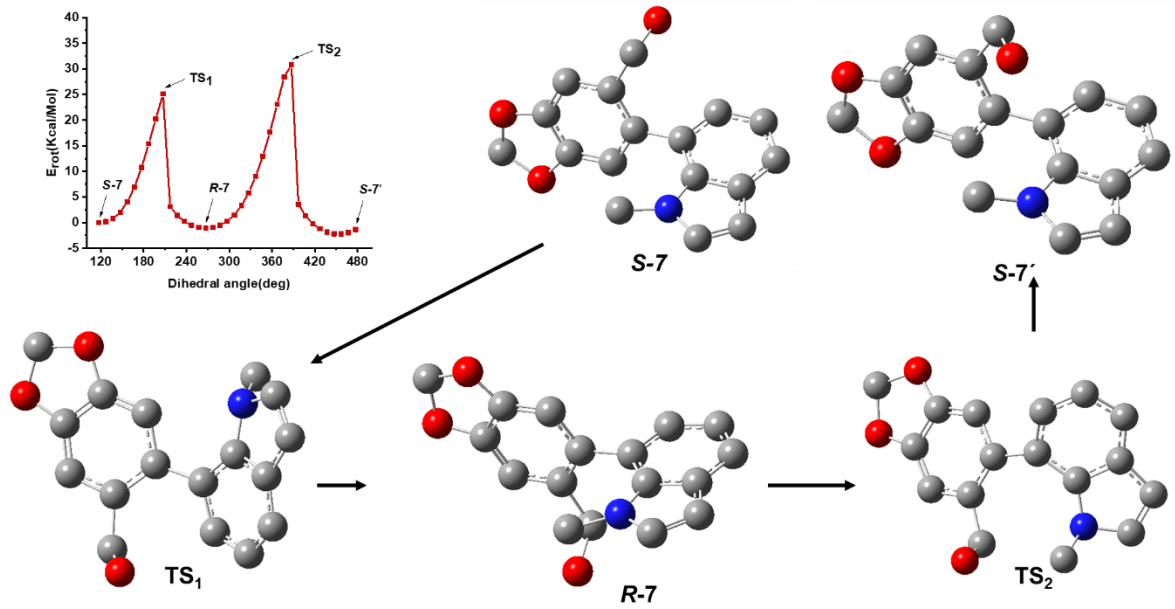
characterize the transition states (TS) that emerged during the rotation around the bonds of interest. Each identified TS structure from the relaxed torsion scan was subsequently followed by transition state optimization using the same B3LYP/6-31G(d) method, confirming that these structures were first-order saddle points on the potential energy surface through vibrational frequency calculations.



rotational energy barrier plot for narcipavline **1**



rotational energy barrier plot for narcikachnine **2**



rotational energy barrier plot for galanthindole **7**

Results and Discussion

The rotational energy barriers for the three molecules, narcipavline **1**, narcikachnine **2**, and galanthindole **7**, were computed to gain insights into their conformational dynamics, particularly concerning the potential for separating individual isomers. The rotational pathway was modeled as a 360-degree rotation around the C-C bond, divided into 36 discrete steps, with energy profiles indicating distinct transition states (TS_1 and TS_2) along the pathway. The calculated rotational barriers are as follows: **1**: TS_1 = 35.35 kcal/mol, TS_2 = 28.09 kcal/mol; **2**: TS_1 = 25.08 kcal/mol, TS_2 = 18.90 kcal/mol; **7**: TS_1 = 25.09 kcal/mol, TS_2 = 30.78 kcal/mol.

Molecules	**ΔE (kcal/mol)**	
	TS_1	**TS_2**
1a	**35.35**	**28.09**
2a	**25.08**	**18.90**
7	**25.09**	**30.78**

For narcipavline **1**, the energy profile reveals that conformations **1a** and **1b** are different, indicating that these conformations are atropisomers of each other. After a full 360-degree rotation, conformations are the same, meaning **1** does not form distinct isomers at this point. The high energy barriers of 35.35 kcal/mol at TS_1 and 28.09 kcal/mol at TS_2 indicate significant intramolecular forces and steric hindrance during rotation. This substantial energy requirement

suggests that **1** is structurally rigid, making it less likely to undergo spontaneous conformational changes. This rigidity could facilitate the distinct separation of conformations **1a** and **1b**.

In contrast, narcikachnine **2** exhibits the lower energy barrier at TS_1 (25.08 kcal/mol) and TS_2 (18.90 kcal/mol), indicating greater rotational flexibility. The energy profile shows that conformations **2a**, **2b**, and **2a'** are all different. This suggests that the molecule undergoes significant structural changes throughout the rotation. The presence of distinct conformations implies that **2** can **readily form different isomers**, complicating the separation of **2a**, **2b**, and **2a'** due to the potential for multiple states in a mixture. The moderate energy peaks at TS_1 and TS_2 suggest weaker intramolecular interactions, allowing **2** to transition between conformations with less resistance, which could lead to challenges in effectively isolating the individual conformers.

Galanthindole **7** presents an intermediate energy barrier, with TS_1 at 25.09 kcal/mol and TS_2 at 30.78 kcal/mol, reflecting a balance between flexibility and rigidity. The energy profile indicates that conformations (*S*)-**7**, (*R*)-**7**, and (*S*)-**7'** are all different, suggesting that **7** also forms distinct conformers. The energy peaks at TS_1 and TS_2 indicate that **7** experiences moderate steric hindrance during rotation. This intermediate behaviour may allow for the possibility of selectively separating the distinct conformers (*S*)-**7**, (*R*)-**7**, and (*S*)-**7'**.

The optimized coordinates of narcipavline **1** are given below:

Symbol	**X**	**Y**	**Z**
C	-2.89781	0.796643	3.056475
C	-1.66045	0.373727	2.567071
C	-1.55429	-0.37199	1.381697
C	-2.74091	-0.66236	0.706381
C	-3.97679	-0.32541	1.255258
C	-4.09163	0.445091	2.416405
C	-2.98611	-1.44975	-0.57387
C	-4.48668	-1.84004	-0.35798
O	-5.03437	-0.86401	0.573622
C	-2.85504	-0.58763	-1.86537
C	-4.05943	0.331565	-2.0975
C	-5.34764	-0.46497	-2.35409

C	-5.33458	-1.8298	-1.62079
C	-2.05777	-2.67809	-0.62029
O	-6.43183	0.37051	-1.94644
H	-6.36272	-2.12508	-1.37602
C	-0.20414	-0.91725	0.951997
C	-0.59442	-2.37299	-1.00183
N	-0.04846	-1.1052	-0.4959
C	1.35158	-0.97234	-0.91654
C	1.902445	0.445947	-0.8318
C	1.012857	1.538786	-0.92762
C	1.543967	2.809872	-0.90048
C	2.912596	3.032169	-0.78812
C	3.805744	1.986406	-0.69817
C	3.289906	0.668091	-0.71439
C	4.270628	-0.46602	-0.68135
C	4.923231	-0.92174	0.485991
C	5.888996	-1.97481	0.441713
C	6.203161	-2.58306	-0.78438
C	5.562587	-2.14498	-1.93307
C	4.616314	-1.10509	-1.87536
N	4.80674	-0.52924	1.814195
C	5.670884	-1.29936	2.572936
C	6.346385	-2.18698	1.782327
O	0.882734	4.015996	-0.94846
C	1.907786	5.009122	-1.05457
O	3.163921	4.384954	-0.7621
H	-5.43496	-0.67048	-3.43396
O	-5.29022	0.795008	2.981653
C	-6.21471	1.465007	2.116703
C	3.942129	0.494613	2.376415
H	-7.25818	-0.08598	-2.16918
H	-4.9408	-2.60544	-2.29184
H	-4.5488	-2.82098	0.136493
H	-5.81214	2.43748	1.802558
H	-7.11786	1.623516	2.71056
H	-6.45161	0.869457	1.230085
H	-2.96504	1.38623	3.965976
H	0.564562	-0.21079	1.279905
H	0.003217	-1.86214	1.494408
H	-0.51238	-2.32844	-2.09418
H	0.024323	-3.23357	-0.67778
H	-2.43363	-3.41151	-1.3484
H	-2.09541	-3.17242	0.358185
H	-0.05443	1.369276	-1.0037
H	4.87409	2.160616	-0.62683
H	1.927392	5.40875	-2.07877

H	1.720094	5.805032	-0.32843
H	4.141198	-0.76714	-2.79272
H	5.793837	-2.59944	-2.89269
H	6.937495	-3.38353	-0.82553
H	5.725149	-1.14009	3.641703
H	7.079045	-2.9102	2.11299
H	4.032575	0.457018	3.464624
H	2.897252	0.31873	2.106247
H	4.22141	1.495148	2.032622
H	-0.75853	0.63082	3.117999
H	2.011204	-1.65768	-0.35606
H	1.404238	-1.30678	-1.96127
H	-1.93054	-0.0099	-1.81099
H	-4.22526	0.963044	-1.21821
H	-3.86891	1.008316	-2.93778
H	-2.74865	-1.26468	-2.72728

The optimized coordinates of narcikachnine **2** are given below:

Symbol	**X**	**Y**	**Z**
C	-3.13232	0.496227	3.077696
C	-1.84839	0.150986	2.651179
C	-1.62889	-0.47921	1.415298
C	-2.75093	-0.73412	0.624631
C	-4.035	-0.48015	1.102828
C	-4.26213	0.175941	2.316493
C	-2.87294	-1.40514	-0.73729
C	-4.37209	-1.85132	-0.67533
O	-5.02012	-0.97915	0.293994
C	-2.67258	-0.42436	-1.93179
C	-3.88538	0.481212	-2.17427
C	-5.12392	-0.3212	-2.60115
C	-5.12182	-1.74687	-1.99455
C	-1.90454	-2.60022	-0.8226
O	-6.26276	0.445064	-2.20645
H	-6.1554	-2.0897	-1.85868
C	-0.23457	-0.95122	1.044204
C	-0.42749	-2.22297	-1.06016
N	0.033455	-0.99397	-0.3994
C	1.454363	-0.77481	-0.69415
C	1.922553	0.666448	-0.52256
C	0.974388	1.708546	-0.45093
C	1.440613	3.004239	-0.37251
C	2.798808	3.297326	-0.37205
C	3.748954	2.300818	-0.44508

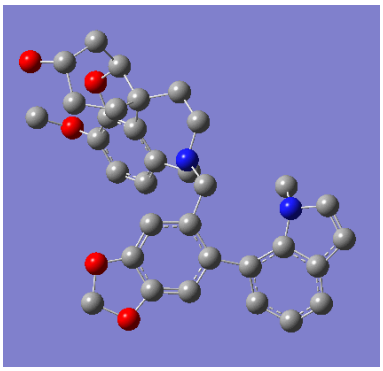
C	3.304012	0.959758	-0.51258
C	4.339713	-0.11174	-0.67773
C	4.698581	-1.06052	0.30154
C	5.640364	-2.06813	0.003388
C	6.270994	-2.12849	-1.22802
C	5.966335	-1.16308	-2.19521
C	5.013182	-0.18782	-1.91378
N	4.202656	-1.23021	1.611062
C	5.107452	-2.16636	2.306145
C	5.742241	-3.00593	1.184862
O	0.715658	4.169584	-0.26217
C	1.673531	5.226222	-0.38129
O	2.982472	4.657225	-0.25865
H	-5.12267	-0.42874	-3.69865
O	-5.51108	0.441869	2.815126
C	-6.38711	1.16743	1.9448
C	3.798338	-0.09917	2.433399
H	-7.05448	-0.01148	-2.53144
H	-4.65323	-2.44706	-2.69961
H	-4.43969	-2.87482	-0.27702
H	-5.99181	2.174053	1.752647
H	-7.33724	1.248991	2.47788
H	-6.53776	0.651417	0.991909
H	-3.28733	0.997403	4.028557
H	0.488642	-0.26823	1.499394
H	-0.04314	-1.9405	1.50707
H	-0.266	-2.07426	-2.13416
H	0.193266	-3.09392	-0.76879
H	-2.20094	-3.27221	-1.64115
H	-1.99947	-3.184	0.101247
H	-0.08568	1.486178	-0.45967
H	4.808998	2.530289	-0.44111
H	1.57257	5.703658	-1.36688
H	1.516429	5.952202	0.421511
H	4.758942	0.547717	-2.67277
H	6.457944	-1.17991	-3.16362
H	6.998116	-2.91039	-1.43515
H	5.88668	-1.60086	2.847957
H	6.76559	-3.31443	1.42131
H	3.381928	-0.48408	3.370387
H	4.646138	0.563713	2.681441
H	3.031652	0.4932	1.936239
H	-0.99948	0.377898	3.29209
H	2.091643	-1.44583	-0.09404
H	1.619958	-1.06385	-1.74045
H	-1.77376	0.168989	-1.75451

H	-4.13782	1.025187	-1.25785
H	-3.65383	1.236679	-2.93323
H	-2.48014	-1.01663	-2.84003
H	5.157697	-3.91881	1.002384
H	4.551545	-2.75933	3.039837

The optimized coordinates of galanthindole **7** are given below:

Symbol	**X**	**Y**	**Z**
C	-0.40543	2.387644	1.409649
C	-1.06685	1.221206	0.706561
C	-2.46299	1.066357	0.873802
C	-3.09609	0.054387	0.185476
C	-2.38973	-0.80329	-0.65186
C	-1.02764	-0.68604	-0.82804
C	-0.34764	0.34406	-0.13317
C	1.124355	0.481779	-0.36184
C	2.072009	-0.50178	0.00792
C	3.448955	-0.38524	-0.35545
C	3.889563	0.737597	-1.07379
C	2.97287	1.724168	-1.40247
C	1.616908	1.593545	-1.05296
N	1.942732	-1.67332	0.74703
C	3.187581	-2.27527	0.830024
C	4.126286	-1.53302	0.170563
O	-4.42369	-0.30503	0.205806
C	-4.56112	-1.3085	-0.80738
O	-3.24802	-1.73098	-1.19413
C	0.770259	-2.17565	1.443477
H	-0.48802	-1.35242	-1.49235
H	-5.11248	-2.16124	-0.40182
H	-5.07993	-0.88227	-1.67771
H	0.917849	2.37758	-1.32327
H	3.294935	2.607389	-1.9472
H	4.935704	0.831107	-1.35426
H	3.292952	-3.20343	1.375903
H	5.178658	-1.76465	0.080455
H	1.094913	-2.94496	2.148454
H	0.037604	-2.61263	0.757249
H	0.280436	-1.37472	2.003326
H	0.642372	2.173065	1.626828
H	-0.92016	2.577914	2.36455
O	-0.38638	3.577879	0.612583
H	-1.29687	3.734866	0.315488
H	-3.02027	1.720946	1.538067

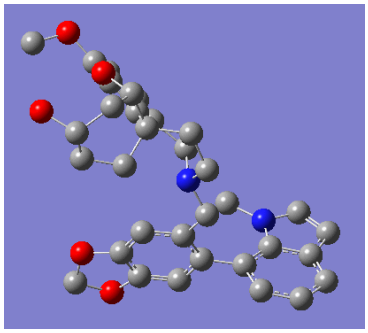
Vibrational frequencies of narcipavline 1-TS1:



1	-19.26	37	383.53	73	795.19	109	1122.08	145	1381.98	181	1669.53
2	18.83	38	391.50	74	811.82	110	1133.55	146	1386.72	182	1684.23
3	21.97	39	397.14	75	816.10	111	1140.10	147	1394.45	183	2911.44
4	36.92	40	409.69	76	822.00	112	1152.41	148	1397.17	184	2917.23
5	53.05	41	421.77	77	824.81	113	1155.78	149	1403.13	185	2972.23
6	54.62	42	434.22	78	858.29	114	1160.26	150	1405.75	186	3009.35
7	58.24	43	445.46	79	862.02	115	1160.62	151	1412.67	187	3011.46
8	64.36	44	455.96	80	877.29	116	1173.39	152	1419.68	188	3022.13
9	81.57	45	480.87	81	880.50	117	1176.82	153	1425.05	189	3027.41
10	91.21	46	502.22	82	886.75	118	1182.35	154	1436.64	190	3032.14
11	106.71	47	511.21	83	889.50	119	1185.56	155	1450.54	191	3034.23
12	112.23	48	517.38	84	910.40	120	1188.08	156	1451.64	192	3038.30
13	118.42	49	533.07	85	912.43	121	1200.83	157	1453.92	193	3043.78
14	128.74	50	537.87	86	926.86	122	1203.68	158	1473.22	194	3052.46
15	140.85	51	558.89	87	932.05	123	1214.33	159	1479.19	195	3068.60
16	159.18	52	571.72	88	937.79	124	1228.52	160	1497.45	196	3076.24
17	165.03	53	580.58	89	956.71	125	1238.62	161	1498.28	197	3079.66
18	167.83	54	591.41	90	962.78	126	1242.13	162	1511.21	198	3094.44
19	185.37	55	597.05	91	968.46	127	1247.22	163	1516.40	199	3110.85
20	194.28	56	605.23	92	979.26	128	1251.84	164	1518.20	200	3113.79
21	211.90	57	615.17	93	980.74	129	1260.84	165	1520.37	201	3115.62
22	215.00	58	624.58	94	987.25	130	1266.05	166	1521.86	202	3116.76
23	224.79	59	640.40	95	1003.12	131	1268.42	167	1526.76	203	3138.28
24	248.58	60	647.96	96	1005.95	132	1282.78	168	1529.70	204	3155.64
25	252.97	61	662.76	97	1008.40	133	1287.36	169	1533.46	205	3177.90
26	261.41	62	677.91	98	1023.94	134	1291.48	170	1542.35	206	3187.64
27	270.31	63	688.05	99	1044.92	135	1294.82	171	1542.65	207	3201.78
28	276.50	64	721.01	100	1050.95	136	1305.96	172	1545.65	208	3204.66
29	296.78	65	730.72	101	1061.24	137	1315.42	173	1552.27	209	3209.27
30	300.96	66	736.07	102	1069.23	138	1316.95	174	1574.40	210	3214.96
31	307.62	67	739.04	103	1076.78	139	1343.21	175	1576.24	211	3225.45
32	321.65	68	753.38	104	1091.36	140	1346.75	176	1586.61	212	3235.78
33	333.24	69	765.98	105	1096.04	141	1354.21	177	1630.19	213	3242.82

34	341.69	70	772.58	106	1101.58	142	1354.75	178	1637.67	214	3264.14
35	357.00	71	775.59	107	1109.18	143	1362.47	179	1638.86	215	3270.96
36	359.98	72	778.45	108	1113.98	144	1381.12	180	1667.79	216	3735.97

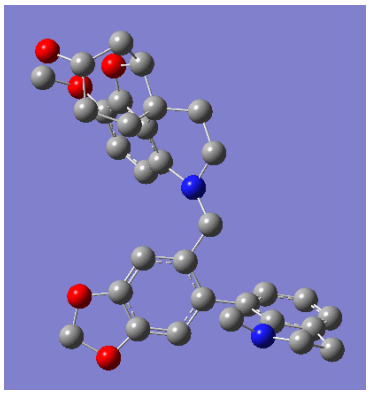
Vibrational frequencies of 1-TS2:



1	-332.27	37	366.59	73	785.46	109	1128.25	145	1387.52	181	1667.82
2	10.23	38	389.92	74	813.71	110	1137.16	146	1393.74	182	1669.81
3	17.06	39	392.95	75	816.74	111	1152.82	147	1397.07	183	2915.22
4	23.03	40	403.99	76	822.36	112	1155.68	148	1399.89	184	2926.96
5	24.45	41	429.03	77	826.14	113	1156.19	149	1408.69	185	2974.28
6	39.98	42	435.96	78	845.13	114	1157.70	150	1416.63	186	2993.45
7	54.88	43	456.46	79	856.17	115	1165.88	151	1418.95	187	3012.03
8	56.91	44	460.08	80	868.51	116	1180.59	152	1422.13	188	3016.47
9	62.66	45	474.48	81	880.77	117	1184.22	153	1436.68	189	3024.82
10	70.94	46	509.53	82	882.12	118	1187.85	154	1442.92	190	3029.65
11	85.13	47	511.78	83	897.78	119	1192.12	155	1453.78	191	3034.51
12	89.96	48	518.42	84	903.16	120	1206.67	156	1459.91	192	3041.79
13	95.93	49	538.53	85	912.73	121	1207.29	157	1468.51	193	3046.04
14	112.36	50	541.91	86	926.30	122	1215.04	158	1473.31	194	3060.79
15	118.73	51	560.33	87	930.84	123	1232.97	159	1497.77	195	3066.93
16	128.21	52	570.18	88	936.86	124	1235.69	160	1497.90	196	3067.55
17	151.03	53	575.21	89	950.53	125	1241.28	161	1508.55	197	3074.30
18	157.42	54	582.17	90	954.78	126	1242.67	162	1509.24	198	3080.75
19	167.19	55	588.25	91	963.78	127	1248.62	163	1510.50	199	3092.79
20	179.04	56	595.30	92	973.81	128	1256.78	164	1514.64	200	3111.22
21	194.31	57	608.40	93	976.91	129	1263.26	165	1520.97	201	3112.31
22	213.66	58	625.10	94	990.26	130	1273.70	166	1521.48	202	3116.83
23	221.39	59	640.84	95	1007.12	131	1283.59	167	1528.04	203	3131.67
24	223.80	60	650.23	96	1011.95	132	1289.83	168	1529.49	204	3136.69
25	227.78	61	674.94	97	1032.78	133	1293.30	169	1532.21	205	3151.30
26	234.88	62	676.89	98	1033.24	134	1306.06	170	1538.67	206	3153.57
27	255.25	63	700.10	99	1049.44	135	1315.39	171	1539.56	207	3177.43
28	262.65	64	723.44	100	1059.16	136	1325.19	172	1541.40	208	3178.95
29	272.12	65	727.37	101	1061.66	137	1343.82	173	1543.38	209	3189.11
30	281.59	66	728.15	102	1072.39	138	1343.97	174	1552.28	210	3203.85

31	290.52	67	730.22	103	1073.25	139	1348.85	175	1574.82	211	3209.92
32	315.35	68	737.71	104	1087.92	140	1356.81	176	1577.56	212	3221.12
33	316.19	69	740.91	105	1089.27	141	1358.66	177	1632.08	213	3241.64
34	321.28	70	764.19	106	1100.38	142	1367.90	178	1637.06	214	3252.88
35	344.76	71	775.10	107	1109.62	143	1379.58	179	1649.99	215	3272.26
36	348.16	72	777.93	108	1118.19	144	1382.72	180	1662.50	216	3776.47

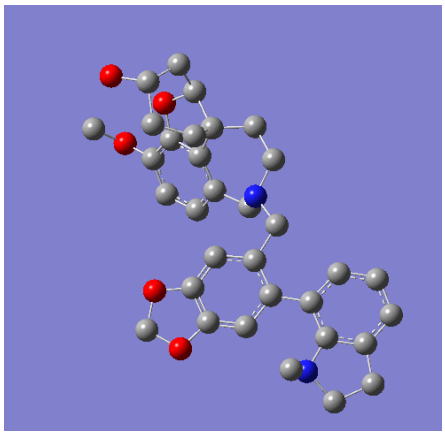
Vibrational frequencies of 2-TS1:



1	-329.47	38	365.30	75	816.24	112	1152.10	149	1394.00	186	1670.15
2	9.26	39	386.83	76	823.63	113	1153.59	150	1397.16	187	2914.29
3	16.95	40	393.17	77	836.86	114	1156.61	151	1400.08	188	2922.59
4	21.13	41	403.26	78	860.29	115	1166.43	152	1411.83	189	2956.02
5	25.43	42	428.57	79	869.95	116	1181.60	153	1417.40	190	2965.15
6	43.60	43	435.02	80	877.30	117	1184.35	154	1419.16	191	2992.08
7	52.85	44	452.38	81	881.97	118	1187.35	155	1422.14	192	2995.67
8	57.85	45	459.36	82	888.25	119	1192.08	156	1437.72	193	3011.98
9	62.75	46	469.46	83	908.77	120	1195.60	157	1443.08	194	3015.50
10	69.43	47	488.23	84	912.29	121	1205.20	158	1453.91	195	3028.17
11	77.23	48	511.89	85	916.12	122	1206.58	159	1461.23	196	3029.01
12	89.92	49	521.44	86	929.07	123	1212.58	160	1466.48	197	3030.76
13	102.39	50	538.00	87	934.69	124	1228.15	161	1474.06	198	3032.58
14	107.81	51	540.65	88	947.72	125	1231.79	162	1495.14	199	3033.87
15	117.48	52	561.76	89	950.67	126	1235.11	163	1497.80	200	3041.15
16	139.91	53	566.40	90	963.66	127	1236.64	164	1508.56	201	3056.84
17	146.76	54	569.95	91	974.34	128	1241.42	165	1511.15	202	3067.06
18	158.28	55	579.98	92	977.27	129	1243.69	166	1513.44	203	3073.81
19	167.11	56	580.35	93	978.76	130	1257.03	167	1516.97	204	3079.06
20	181.06	57	591.07	94	990.52	131	1263.06	168	1519.10	205	3089.30
21	187.28	58	608.58	95	1007.54	132	1268.19	169	1520.97	206	3093.59
22	204.51	59	626.50	96	1012.42	133	1278.64	170	1523.21	207	3097.31
23	207.42	60	639.88	97	1019.29	134	1287.12	171	1525.71	208	3101.39
24	221.71	61	649.08	98	1029.69	135	1289.74	172	1527.41	209	3110.62
25	230.25	62	665.16	99	1044.63	136	1290.72	173	1531.65	210	3111.37
26	239.83	63	683.14	100	1052.58	137	1305.55	174	1532.71	211	3111.96

27	246.77	64	692.86	101	1061.65	138	1307.88	175	1535.12	212	3136.87
28	264.42	65	727.23	102	1071.28	139	1315.18	176	1539.66	213	3152.84
29	265.01	66	731.52	103	1073.62	140	1324.72	177	1543.17	214	3177.74
30	278.82	67	735.15	104	1085.02	141	1330.28	178	1552.35	215	3178.83
31	289.46	68	740.77	105	1088.85	142	1343.56	179	1552.40	216	3179.91
32	295.09	69	755.22	106	1089.62	143	1348.28	180	1575.75	217	3184.42
33	317.15	70	773.95	107	1100.65	144	1356.66	181	1635.55	218	3206.32
34	323.18	71	775.25	108	1109.53	145	1365.12	182	1637.50	219	3209.58
35	341.39	72	777.51	109	1122.78	146	1368.29	183	1659.92	220	3225.82
36	343.90	73	792.49	110	1134.92	147	1382.98	184	1663.92	221	3238.33
37	352.02	74	795.24	111	1141.32	148	1391.53	185	1668.95	222	3776.13

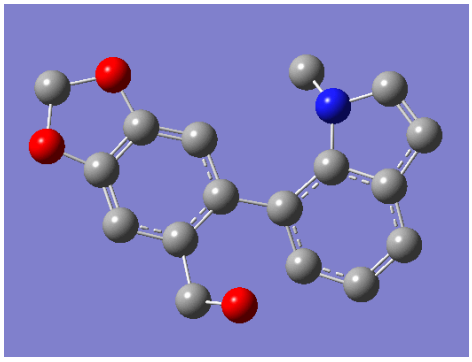
Vibrational frequencies of 2-TS2:



1	-23.71	38	387.65	75	816.91	112	1152.81	149	1382.86	186	1679.21
2	17.73	39	397.52	76	822.80	113	1156.28	150	1394.25	187	2916.11
3	21.67	40	398.44	77	834.78	114	1159.11	151	1396.99	188	2919.58
4	33.82	41	404.71	78	857.99	115	1162.70	152	1399.89	189	2972.10
5	52.41	42	415.46	79	865.71	116	1167.79	153	1404.07	190	2972.40
6	53.96	43	436.18	80	880.08	117	1175.50	154	1419.25	191	2994.28
7	63.29	44	450.10	81	890.59	118	1182.76	155	1420.96	192	3009.50
8	76.42	45	455.93	82	904.96	119	1185.52	156	1430.72	193	3010.27
9	78.66	46	467.37	83	911.90	120	1187.76	157	1448.93	194	3026.17
10	93.02	47	500.91	84	914.62	121	1202.83	158	1451.00	195	3029.09
11	108.57	48	515.84	85	928.39	122	1209.56	159	1453.27	196	3034.64
12	114.14	49	530.87	86	935.85	123	1212.50	160	1468.11	197	3034.99
13	117.89	50	537.39	87	951.26	124	1217.24	161	1474.26	198	3044.14
14	129.39	51	545.85	88	955.35	125	1231.66	162	1482.46	199	3047.26
15	139.09	52	549.63	89	957.21	126	1234.81	163	1497.71	200	3057.12
16	146.47	53	566.20	90	968.53	127	1239.05	164	1498.58	201	3060.89
17	163.28	54	573.64	91	971.78	128	1246.00	165	1512.50	202	3069.21
18	168.13	55	575.61	92	980.64	129	1250.32	166	1512.92	203	3079.30
19	182.92	56	584.62	93	982.32	130	1253.03	167	1516.62	204	3081.30

20	193.89	57	606.17	94	989.54	131	1263.03	168	1520.36	205	3094.04
21	207.91	58	612.22	95	992.06	132	1266.47	169	1520.71	206	3098.20
22	215.40	59	627.85	96	1005.04	133	1281.92	170	1524.17	207	3102.65
23	224.21	60	649.88	97	1015.75	134	1284.00	171	1527.44	208	3106.86
24	227.86	61	660.65	98	1024.94	135	1287.43	172	1530.87	209	3110.78
25	228.81	62	676.32	99	1042.21	136	1293.14	173	1532.17	210	3117.21
26	258.39	63	686.69	100	1048.19	137	1306.88	174	1534.00	211	3125.69
27	267.30	64	696.36	101	1056.22	138	1312.30	175	1536.67	212	3140.29
28	274.98	65	709.69	102	1062.01	139	1316.67	176	1542.68	213	3146.50
29	292.94	66	730.17	103	1072.44	140	1327.49	177	1544.41	214	3155.99
30	299.38	67	738.53	104	1076.73	141	1330.32	178	1550.48	215	3179.55
31	307.30	68	739.89	105	1096.68	142	1338.08	179	1552.87	216	3181.69
32	310.25	69	761.03	106	1099.72	143	1346.97	180	1577.17	217	3199.20
33	321.04	70	773.30	107	1101.29	144	1354.40	181	1624.03	218	3210.10
34	347.53	71	779.00	108	1113.05	145	1357.80	182	1637.32	219	3246.21
35	356.51	72	780.23	109	1114.37	146	1362.64	183	1646.89	220	3254.32
36	357.70	73	787.04	110	1123.15	147	1364.52	184	1664.64	221	3353.48
37	379.14	74	798.20	111	1135.37	148	1379.10	185	1669.68	222	3735.93

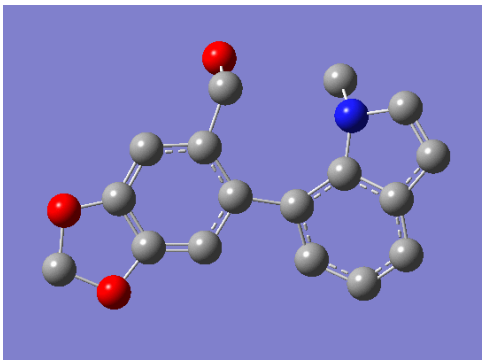
Vibrational frequencies of 7-TS1:



1	-68.30	18	377.60	35	763.60	52	1098.67	69	1363.83	86	1665.62
2	49.01	19	382.88	36	770.63	53	1116.23	70	1391.67	87	1678.73
3	66.41	20	432.71	37	805.72	54	1122.31	71	1400.34	88	3009.31
4	73.24	21	469.77	38	818.17	55	1145.26	72	1422.49	89	3030.15
5	98.21	22	494.43	39	825.46	56	1152.19	73	1443.75	90	3053.03
6	104.55	23	539.07	40	860.06	57	1157.39	74	1449.74	91	3080.35
7	136.43	24	551.15	41	869.40	58	1182.91	75	1467.20	92	3110.23
8	181.88	25	586.15	42	877.00	59	1203.99	76	1487.80	93	3114.87
9	195.02	26	597.75	43	909.98	60	1213.32	77	1525.58	94	3172.82
10	220.68	27	621.74	44	919.34	61	1218.16	78	1535.21	95	3187.68
11	244.23	28	630.82	45	962.37	62	1227.76	79	1544.71	96	3205.53
12	254.15	29	676.47	46	968.16	63	1249.37	80	1552.40	97	3211.99
13	266.56	30	691.24	47	998.93	64	1279.79	81	1564.35	98	3246.38
14	277.73	31	724.62	48	1017.49	65	1285.56	82	1577.27	99	3267.98

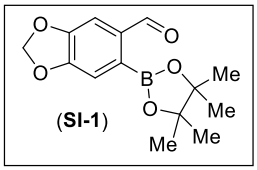
15	285.80	32	735.63	49	1041.71	66	1302.81	83	1580.96	100	3289.31
16	336.28	33	738.48	50	1071.56	67	1312.87	84	1631.29	101	3400.51
17	361.41	34	742.68	51	1091.54	68	1353.63	85	1646.52	102	3742.94

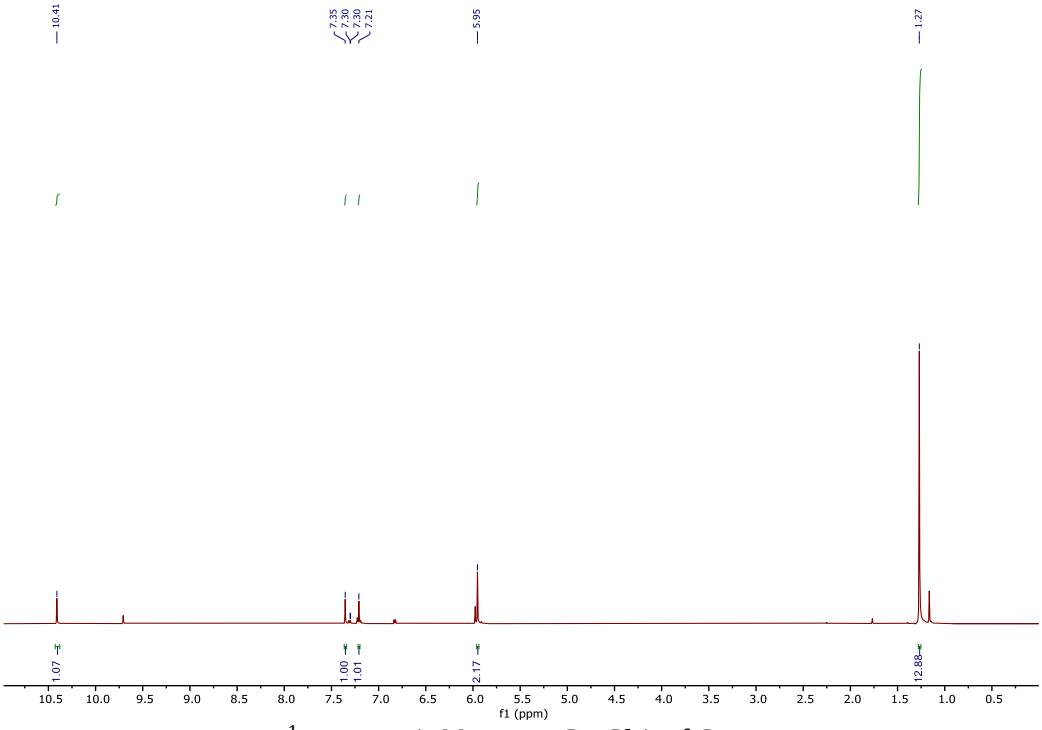
Vibrational frequencies of 7-TS2:



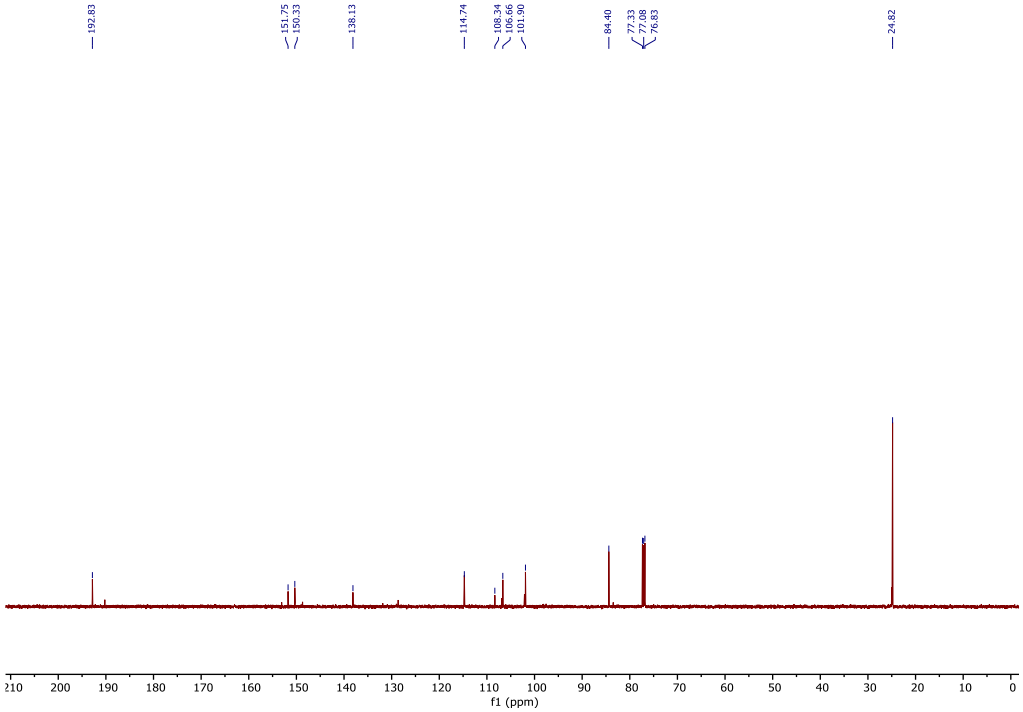
1	-38.07	18	387.56	35	773.64	55	1142.06	69	1365.37	86	1666.83
2	57.49	19	407.09	36	789.77	56	1151.32	70	1384.36	87	1682.30
3	72.09	20	452.01	37	812.09	57	1171.81	71	1397.98	88	3015.63
4	100.58	21	485.27	38	824.10	58	1176.75	72	1426.03	89	3034.69
5	122.49	22	505.61	39	862.16	59	1188.60	73	1437.33	90	3041.31
6	143.37	23	516.17	40	871.93	60	1199.03	74	1446.58	91	3116.18
7	156.75	24	569.66	41	882.67	61	1209.77	75	1452.95	92	3121.39
8	172.63	25	586.47	42	888.91	62	1218.50	76	1487.59	93	3187.18
9	184.79	26	600.69	43	908.01	63	1253.55	77	1519.05	94	3198.86
10	209.41	27	617.61	44	936.97	64	1265.06	78	1526.87	95	3204.48
11	241.51	28	644.97	45	964.76	65	1289.61	79	1549.91	96	3220.30
12	268.87	29	667.44	46	973.34	66	1298.54	80	1555.03	97	3224.84
13	283.48	30	687.45	47	997.38	67	1311.18	81	1576.78	98	3231.91
14	290.11	31	730.19	48	1010.14	68	1359.80	82	1582.92	99	3244.84
15	329.67	32	735.38	49	1025.55	55	1142.06	83	1583.27	100	3265.88
16	350.33	33	749.30	50	1050.52	56	1151.32	84	1630.59	101	3281.55
17	356.82	34	760.04	51	1077.25	57	1171.81	85	1639.53	102	3728.77

Spectral Data

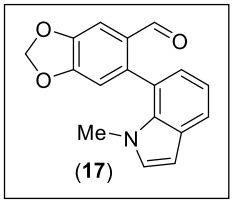


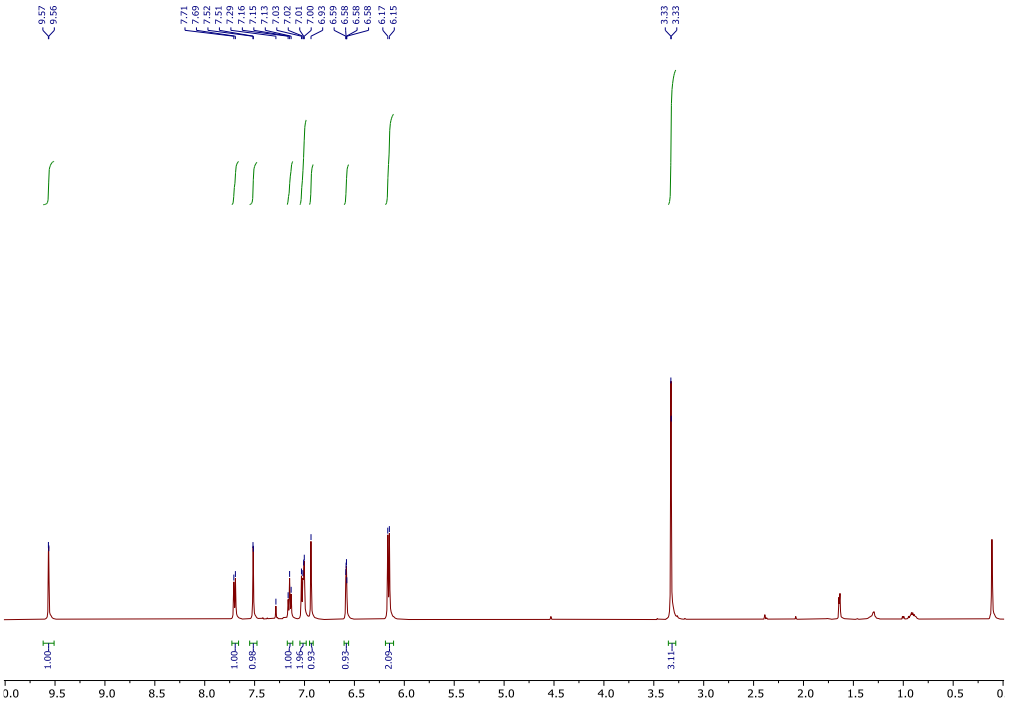


^{1}H NMR (500 MHz, $CDCl_3$) of **SI-1**

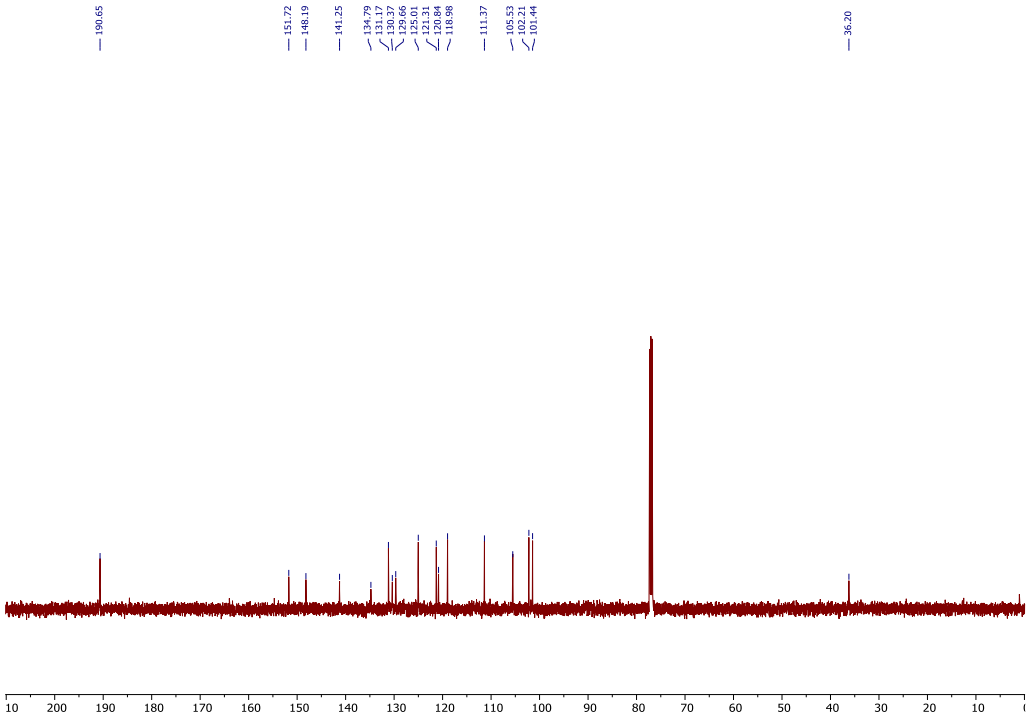


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of **SI-1**

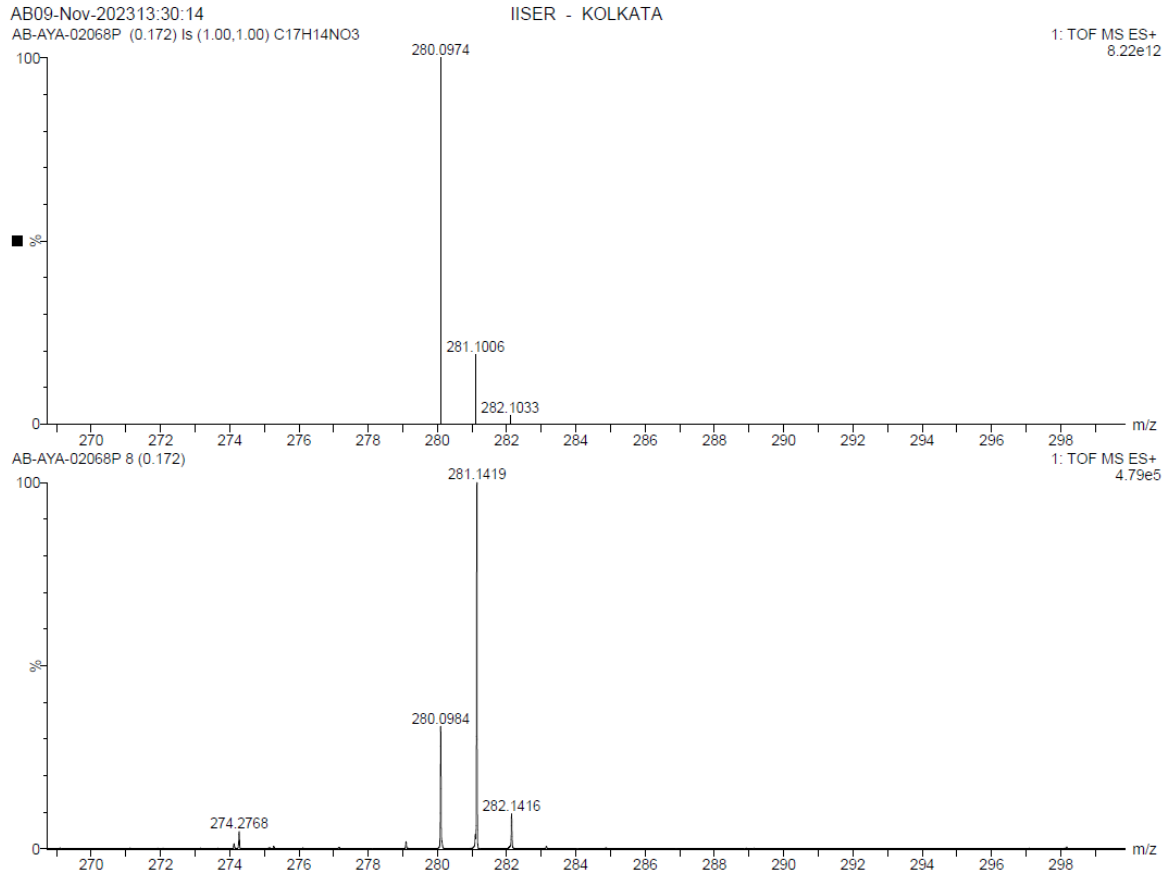




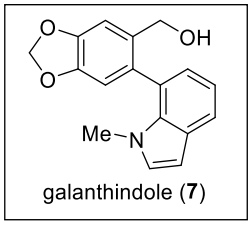
^{1}H NMR (500 MHz, $CDCl_3$) of **17**



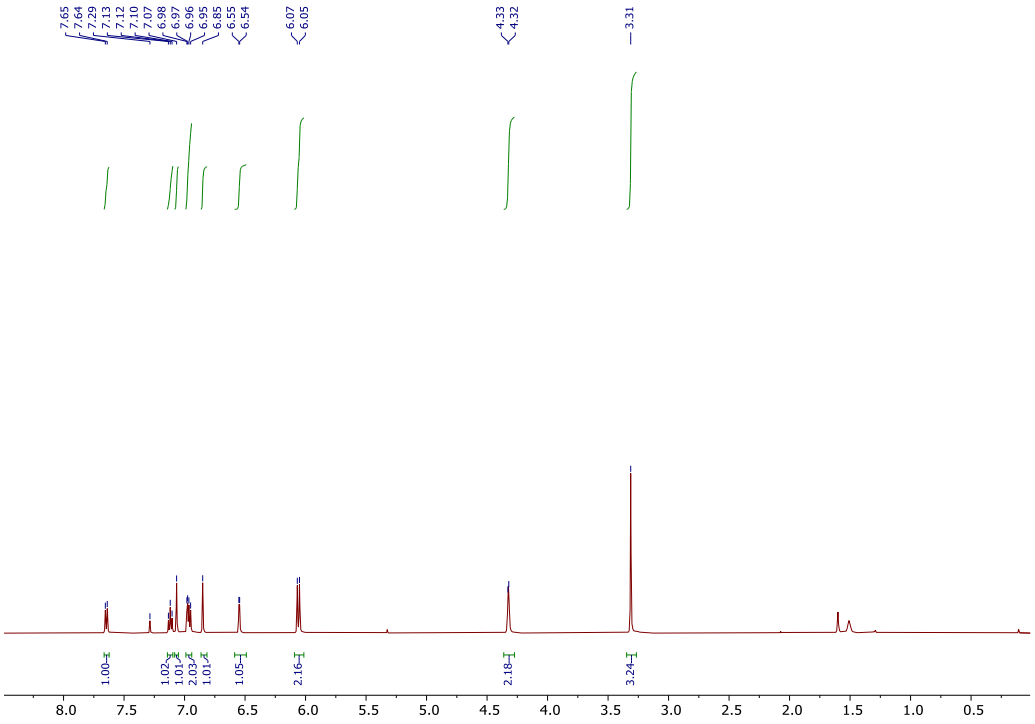
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of **17**



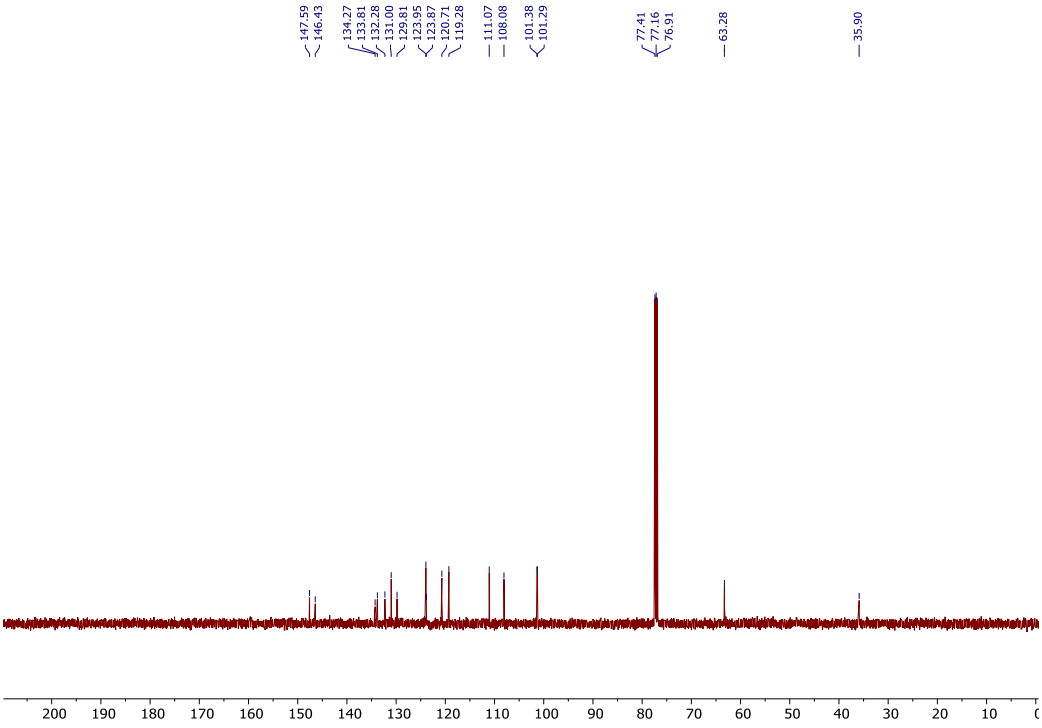
HRMS data of **17**



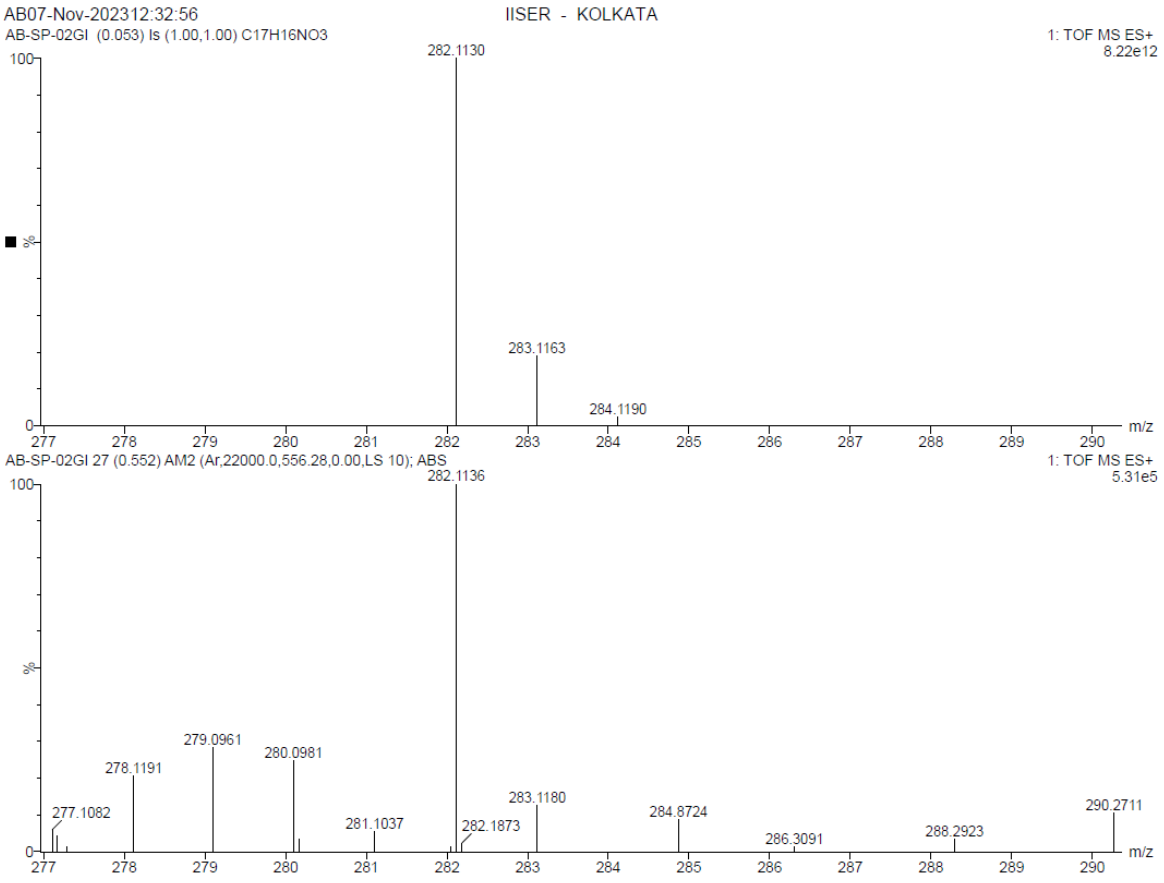
galanthindole (**7**)



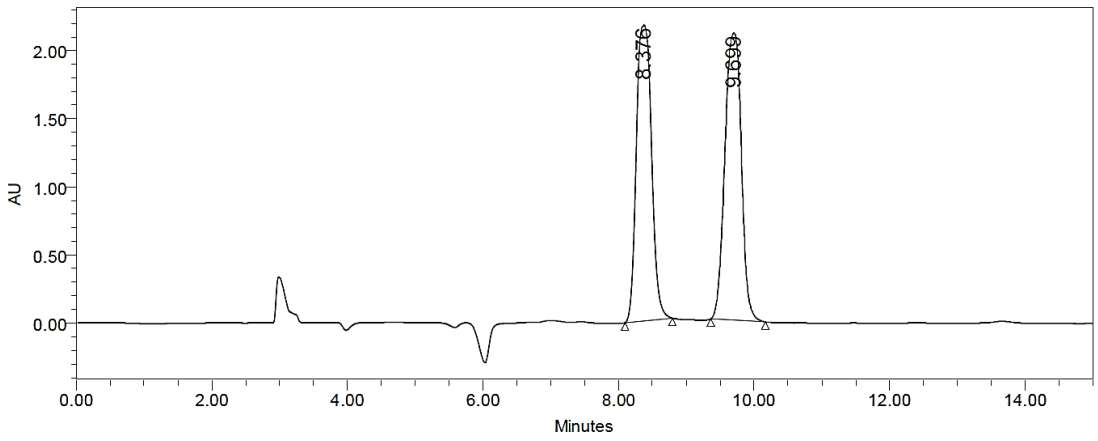
^{1}H NMR (500 MHz, $CDCl_3$) of **7**



^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of **7**

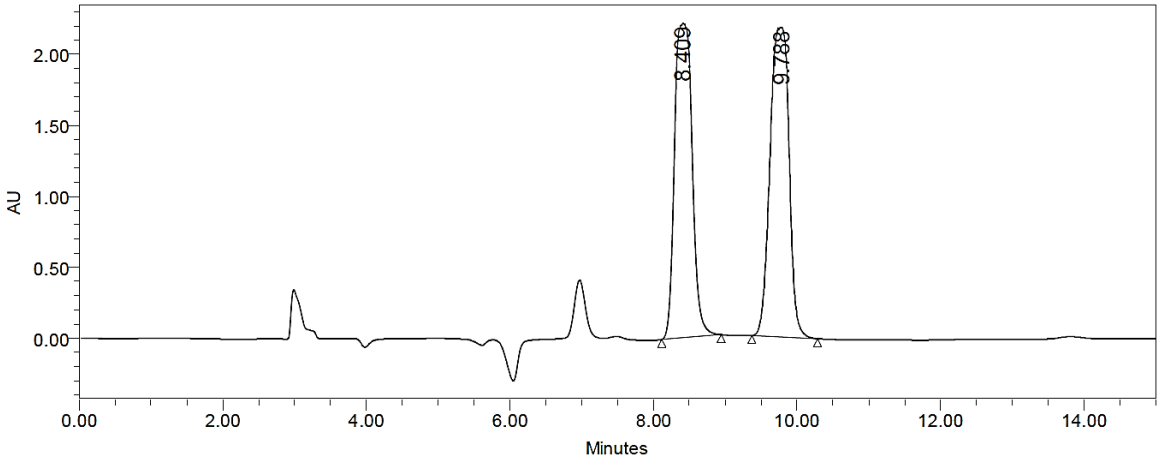


HRMS data of **7**



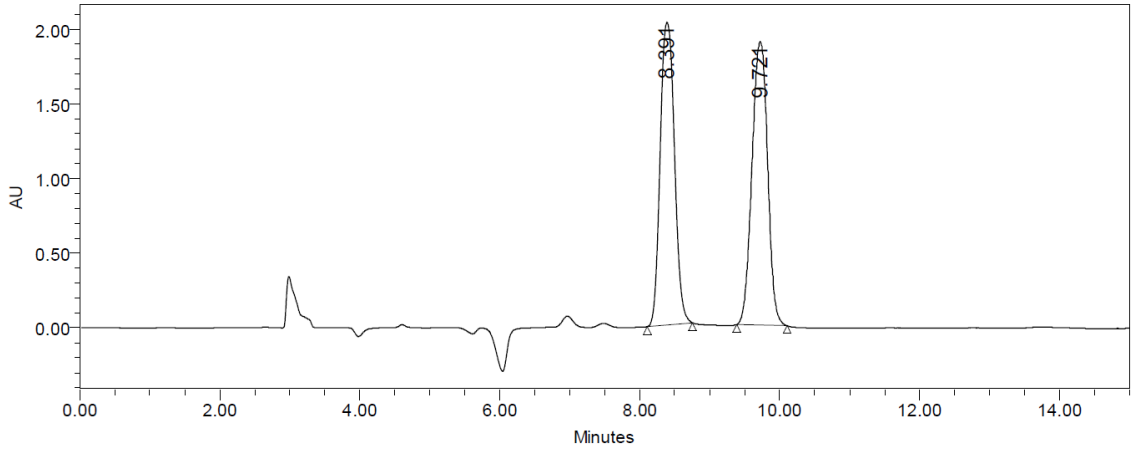
	RT	Area	% Area	Height
1	8.376	33742892	48.67	2174522
2	9.699	35588589	51.33	2109148

HPLC data of (±)-**7**



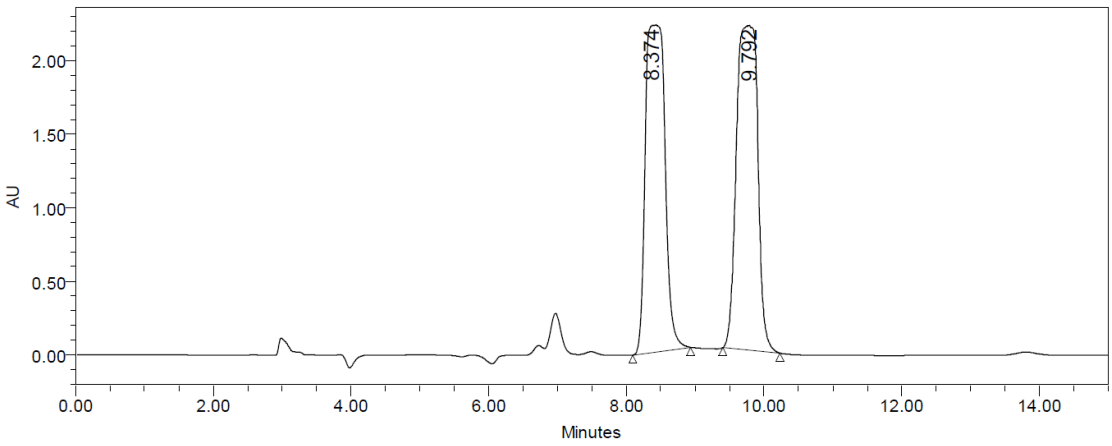
	RT	Area	% Area	Height
1	8.409	37786579	48.46	2218917
2	9.788	40194672	51.54	2183919

HPLC data of (±)-**7** for (*S*)-CBS at room temperature



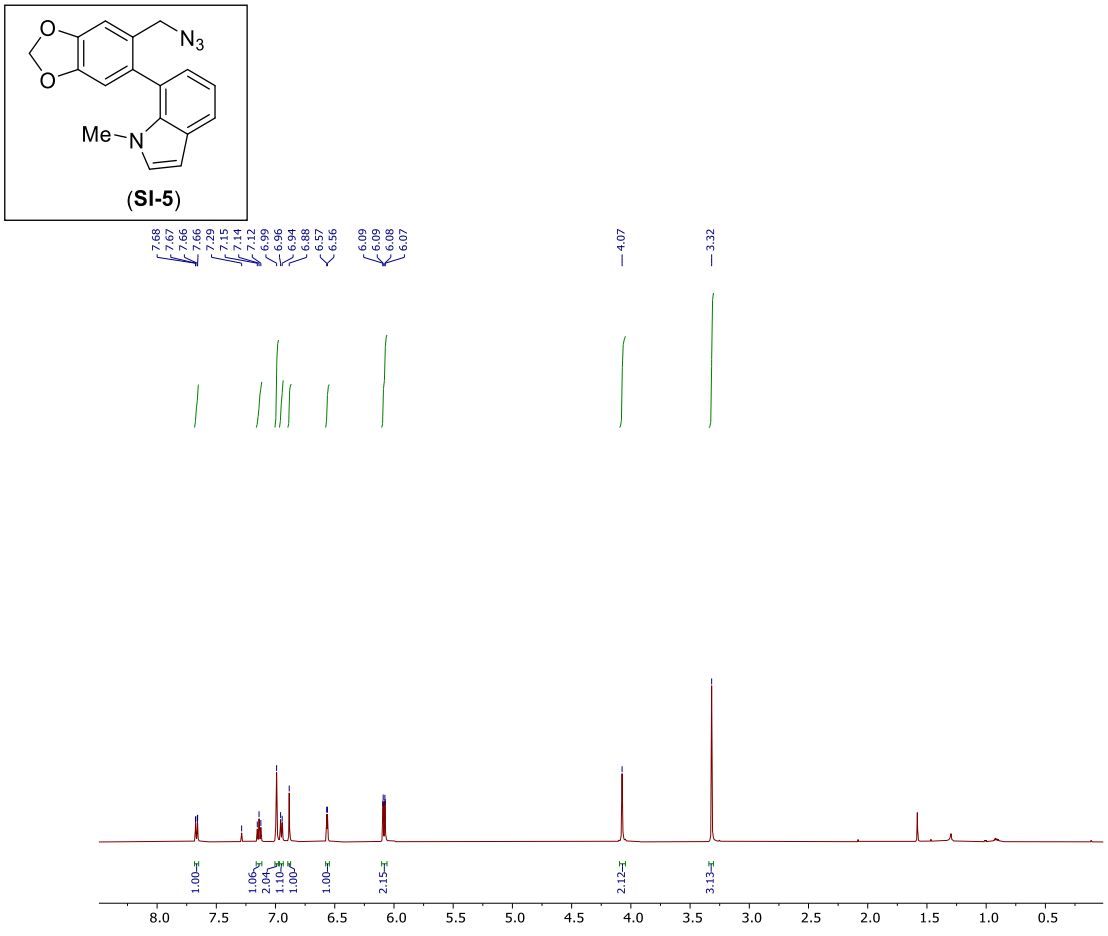
	RT	Area	% Area	Height
1	8.391	28658275	49.31	2026996
2	9.721	29460934	50.69	1898492

HPLC data of (±)-**7** for (*S*)-CBS at 0 ºC

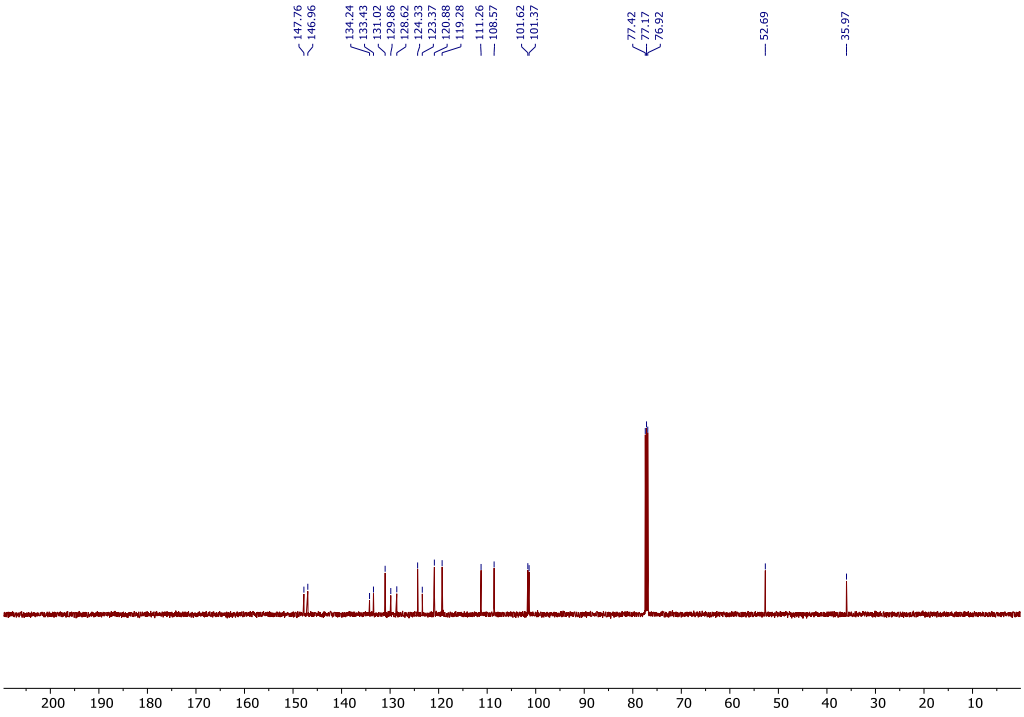


	RT	Area	% Area	Height
1	8.374	44078723	48.21	2225252
2	9.792	47357150	51.79	2207294

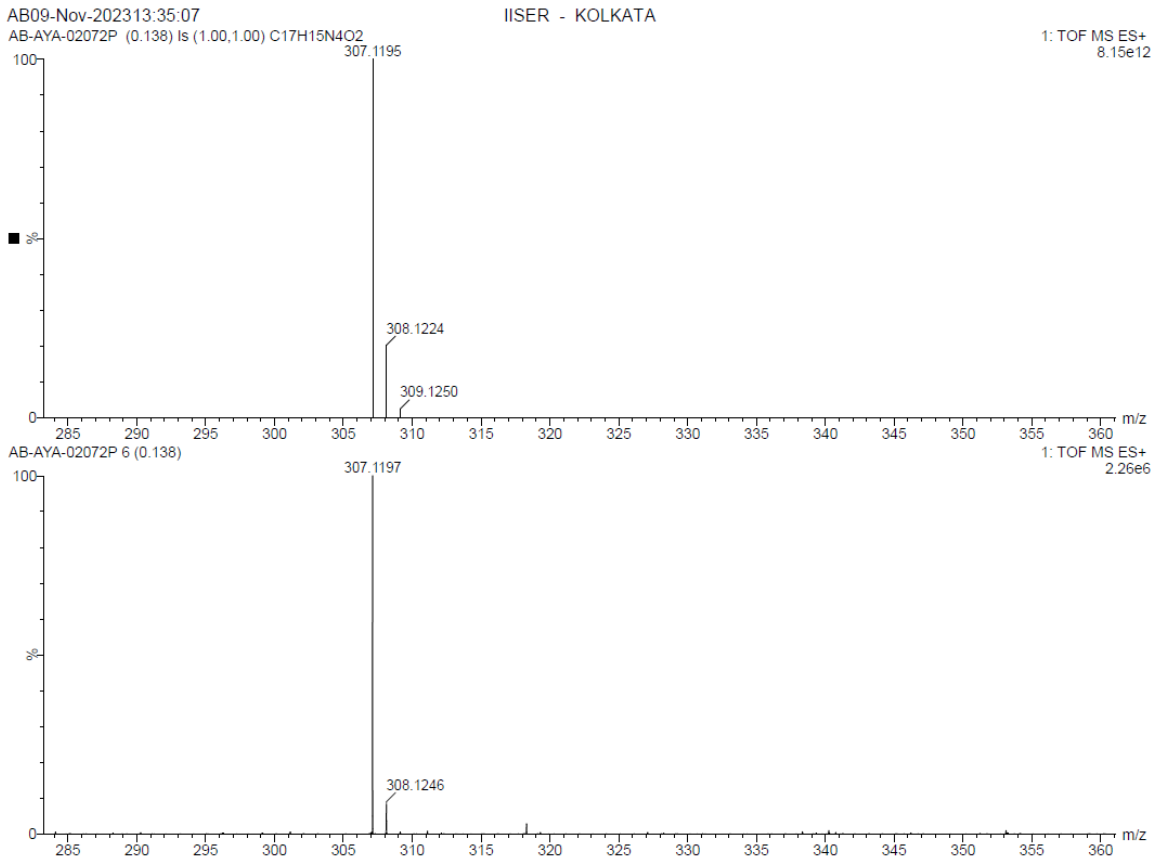
HPLC data of (±)-**7** for (*S*)-CBS at –78 ºC



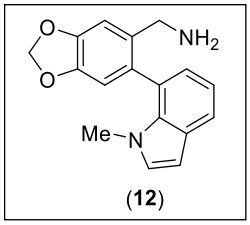
^{1}H NMR (400 MHz, $CDCl_3$) of compound **SI-5**

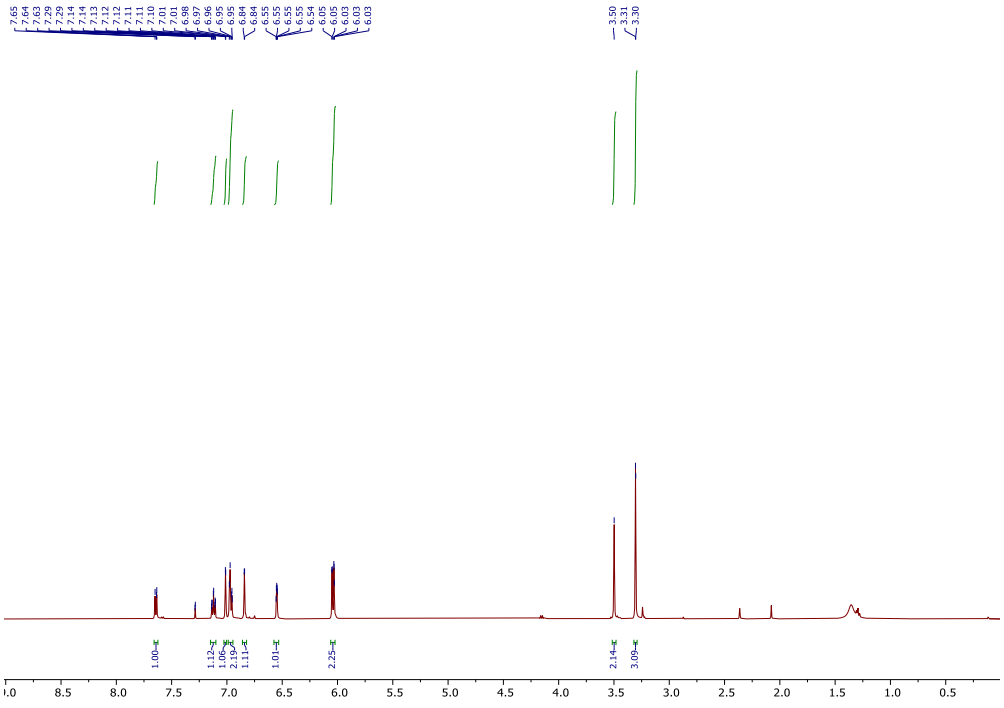


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of **SI-5**

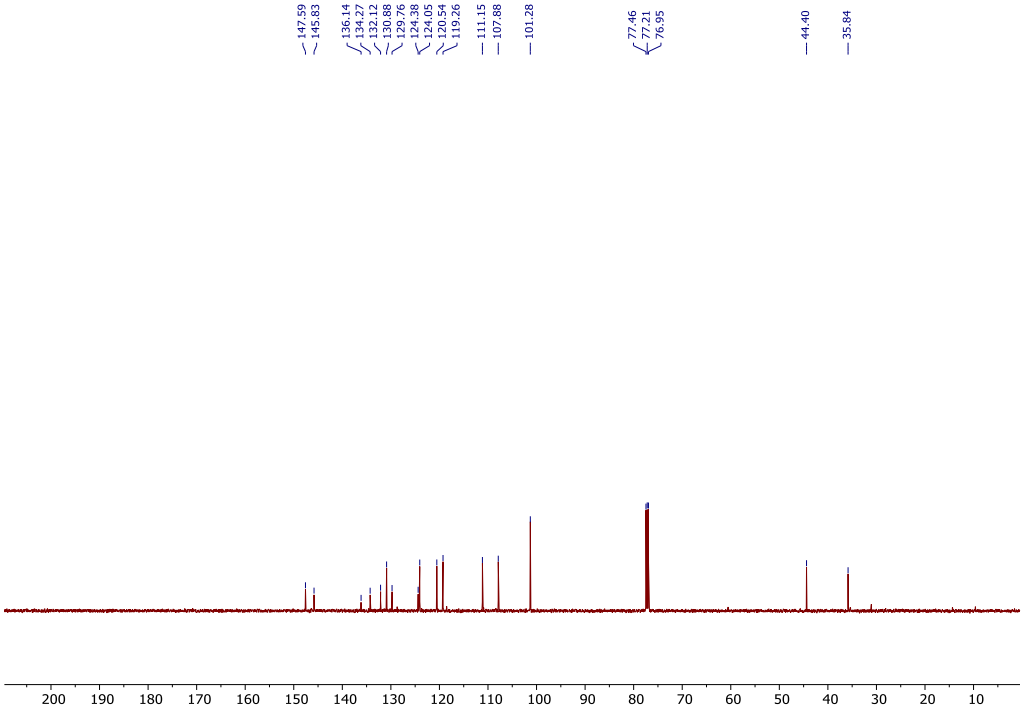


HRMS data of **SI-5**

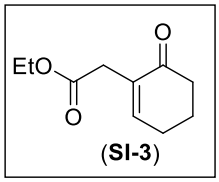


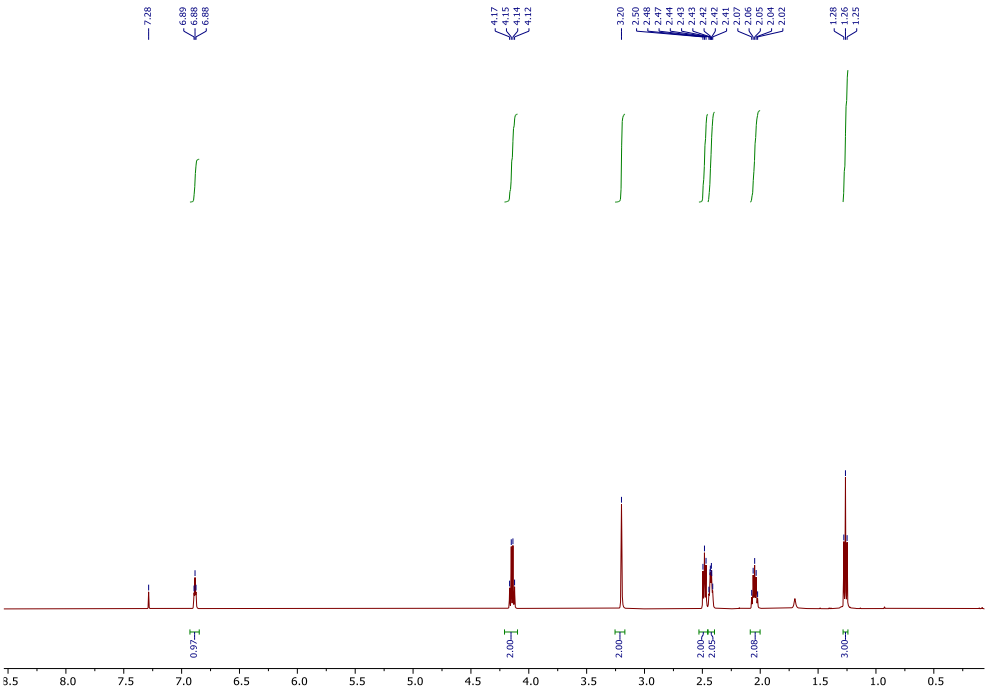


^{1}H NMR (400 MHz, $CDCl_3$) of compound (±)-**12**

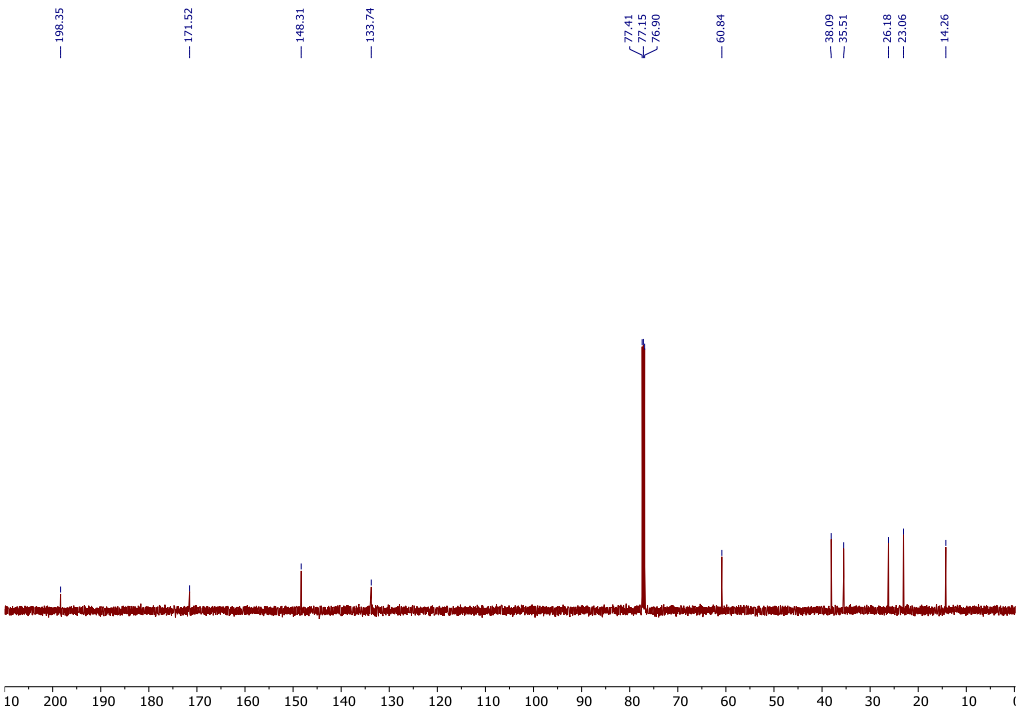


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of compound (±)-**12**

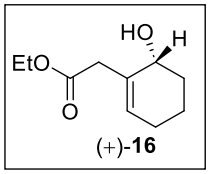


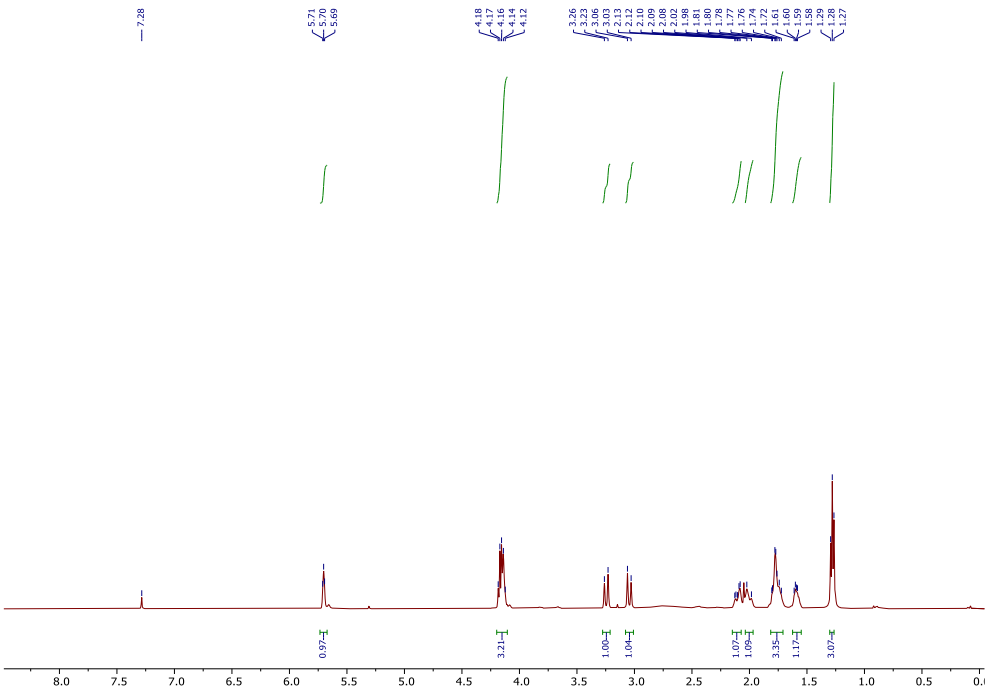


^{1}H NMR (500 MHz, $CDCl_3$) of compound **SI-3**

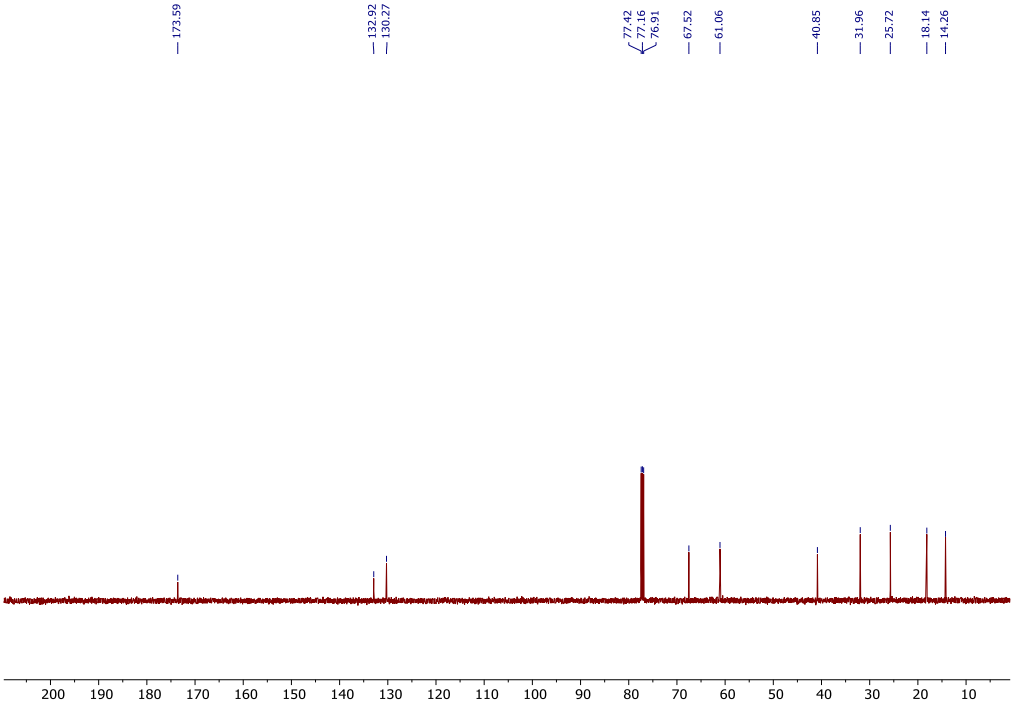


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of compound **SI-3**

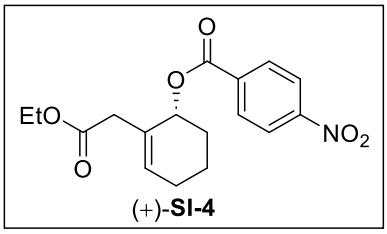




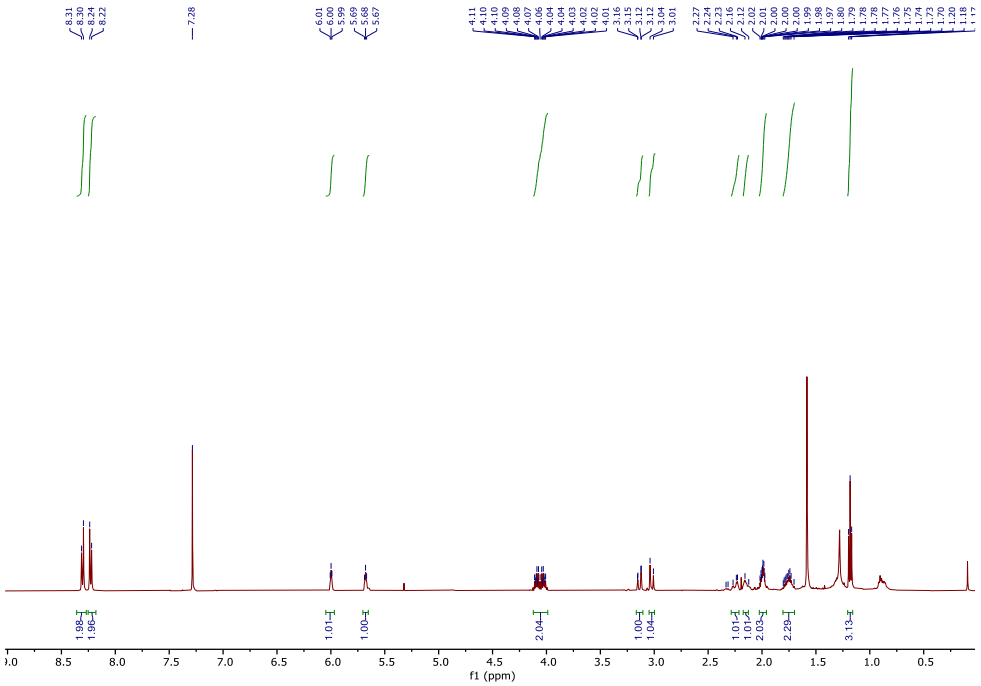
^{1}H NMR (400 MHz, $CDCl_3$) of compound (+)-**16**



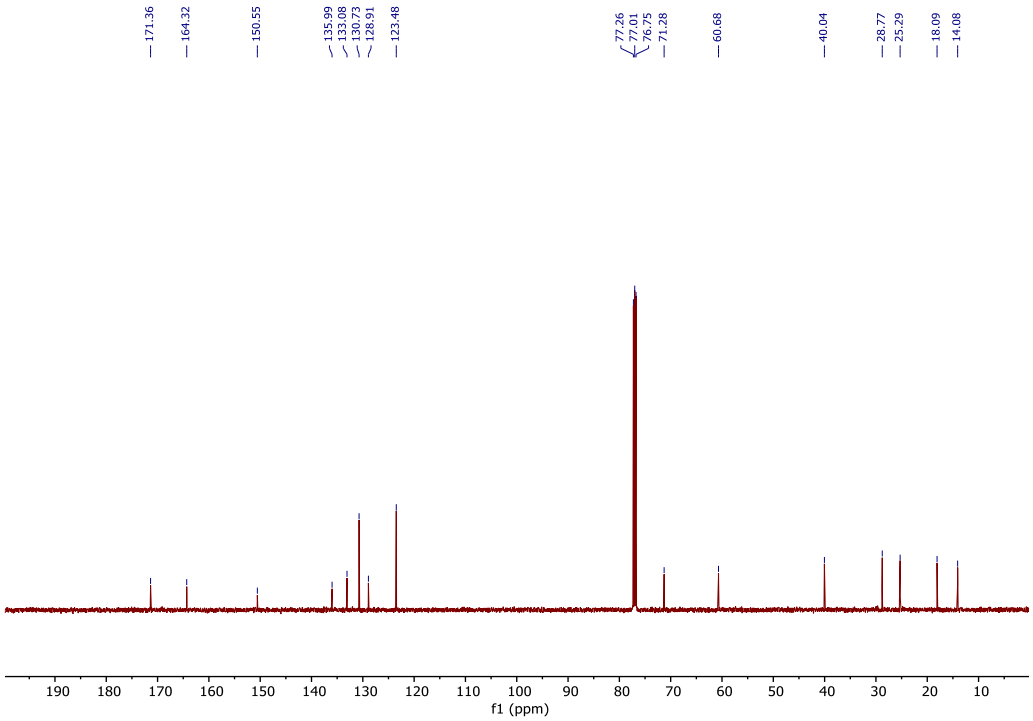
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of compound (+)-**16**



(+)-**SI-4**



^{1}H NMR (500 MHz, $CDCl_3$) of compound (+)-**SI-4**



^{13}C NMR (126 MHz, $CDCl_3$) of compound (+)-**SI-4**

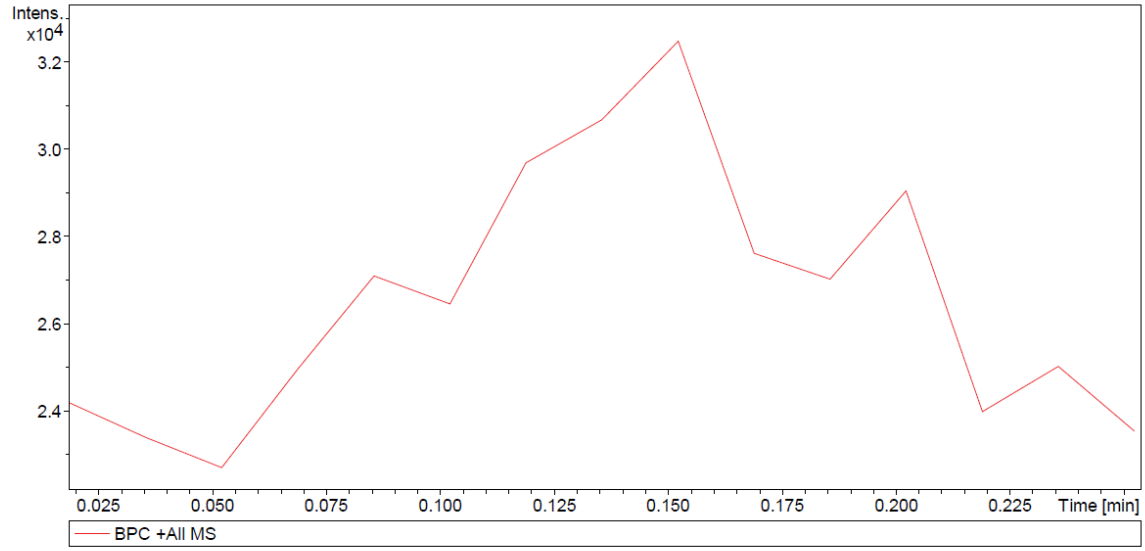
Display Report

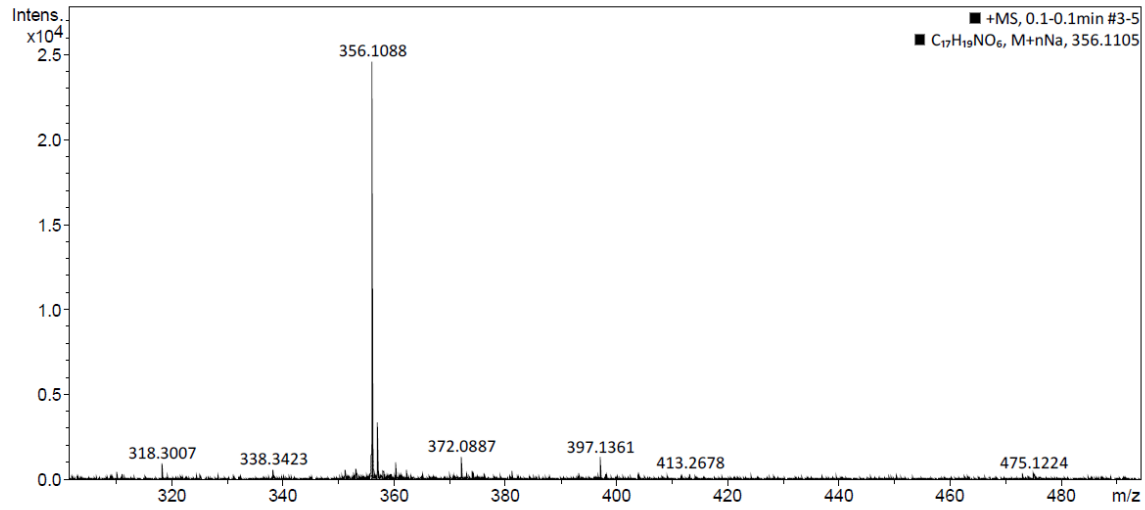
Analysis Info

Analysis Name	D:\Data\User data\2023\NOV\AB-AYA-02110.d	Acquisition Date	11/10/2023 10:57:17 AM
Method	Tune_pos_Standard_July2022.m	Operator	IISER Kolkata
Sample Name	AB-AYA-02110	Instrument	maXis impact 8282001.00127
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	1000 m/z	Set Charging Voltage	2000 V	Set Divert Valve	Source
		Set Corona	0 nA	Set APCI Heater	0 °C

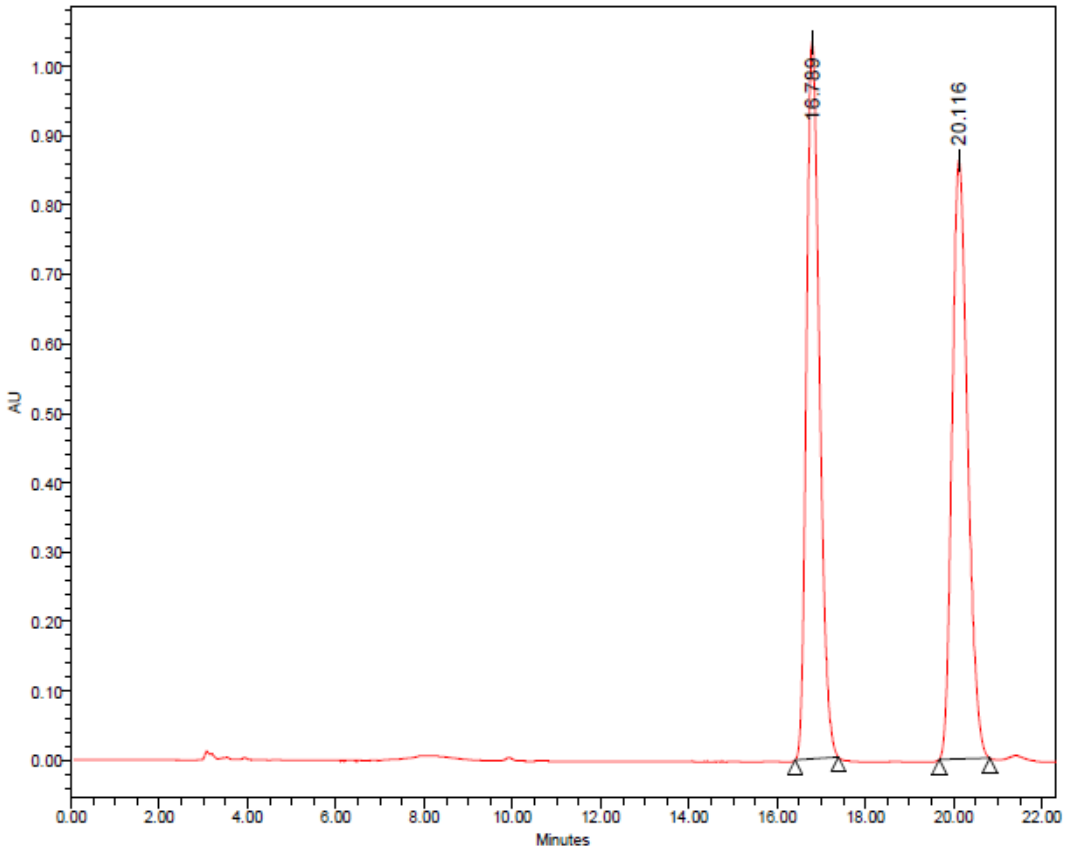




AB-AYA-02110.d

Bruker Compass DataAnalysis 4.1 printed: 11/10/2023 10:59:17 AM by: IISER Kolkata Page 1 of 1

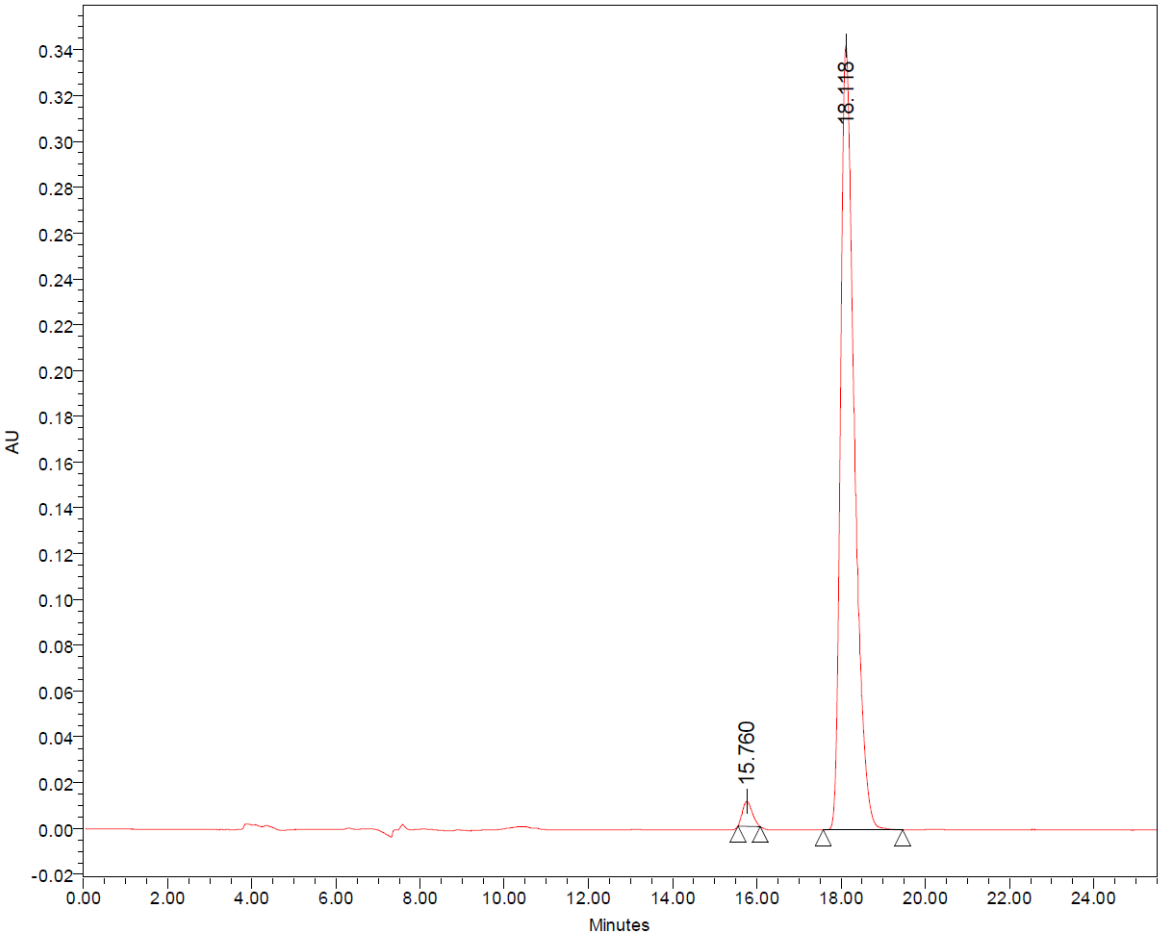
HRMS data of (+)-**SI-4**



Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB_AYA_02110_RAC_IC3_15_1	1	1	20.116	21083777	50.00	862683
2	AB_AYA_02110_RAC_IC3_15_1	1	1	16.789	21087326	50.00	1032817
Mean				18.452			
Std. Dev.				2.353			

HPLC data of (±)-**SI-4**



Sample Name: AB-SP-02CBSN-IC-3-15-01-CHI; Date Acquired: 16-09-2024 21:09:09 IST; Vial: 1:A,1; Injection: 1

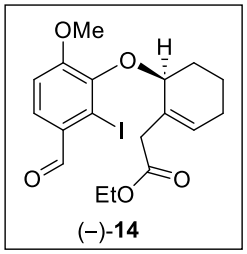
Peak Summary with Statistics
Name:

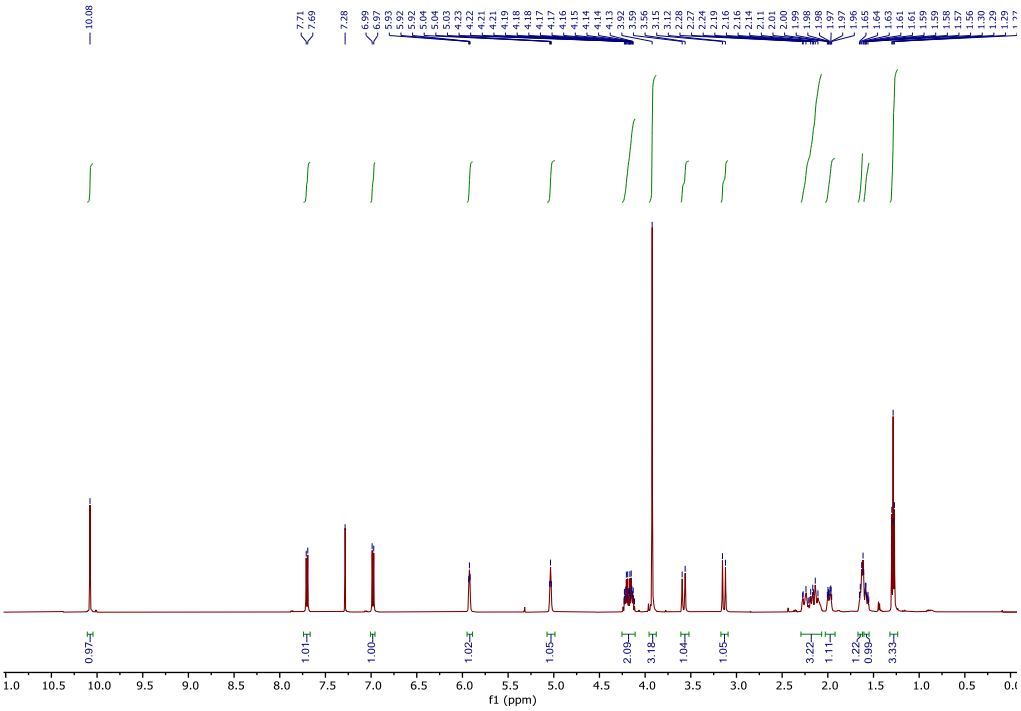
	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02CBSN-IC-3-15-01-CHI	1:A,1	1	18.118	7813233	97.87	342538
2	AB-SP-02CBSN-IC-3-15-01-CHI	1:A,1	1	15.760	170364	2.13	10787
Mean				16.939			
Std. Dev.				1.667			

Reported by User: System
Report Method: Peak Summary Report
Report Method ID: 2585
Page: 1 of 2

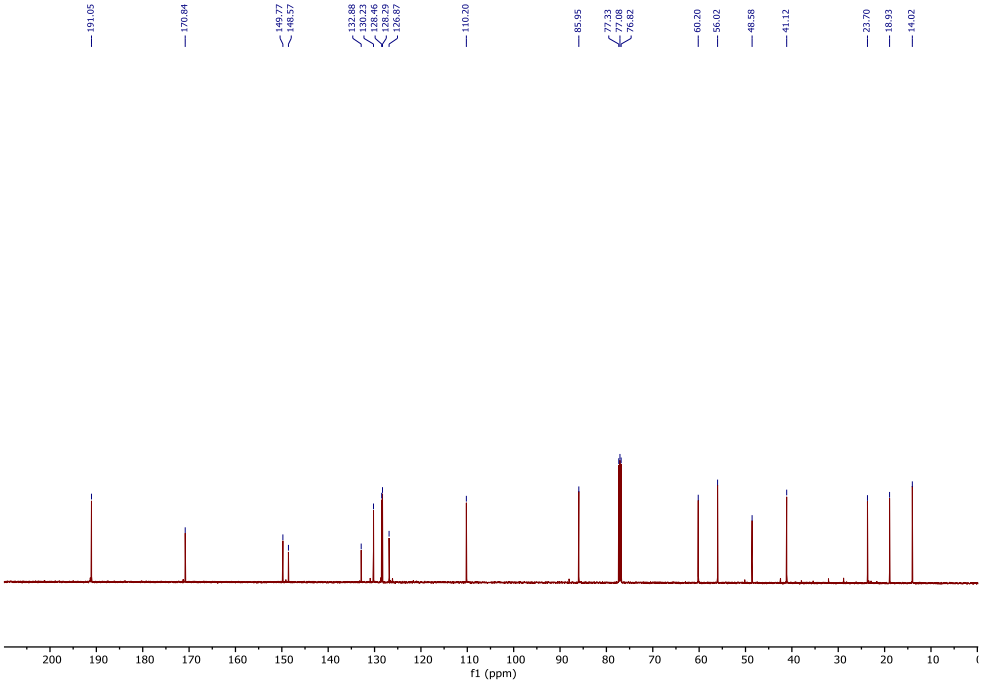
Project Name: AB Research Group
Date Printed:
16-09-2024
21:38:10 Asia/Kolkata

HPLC data of (+)-**SI-4**

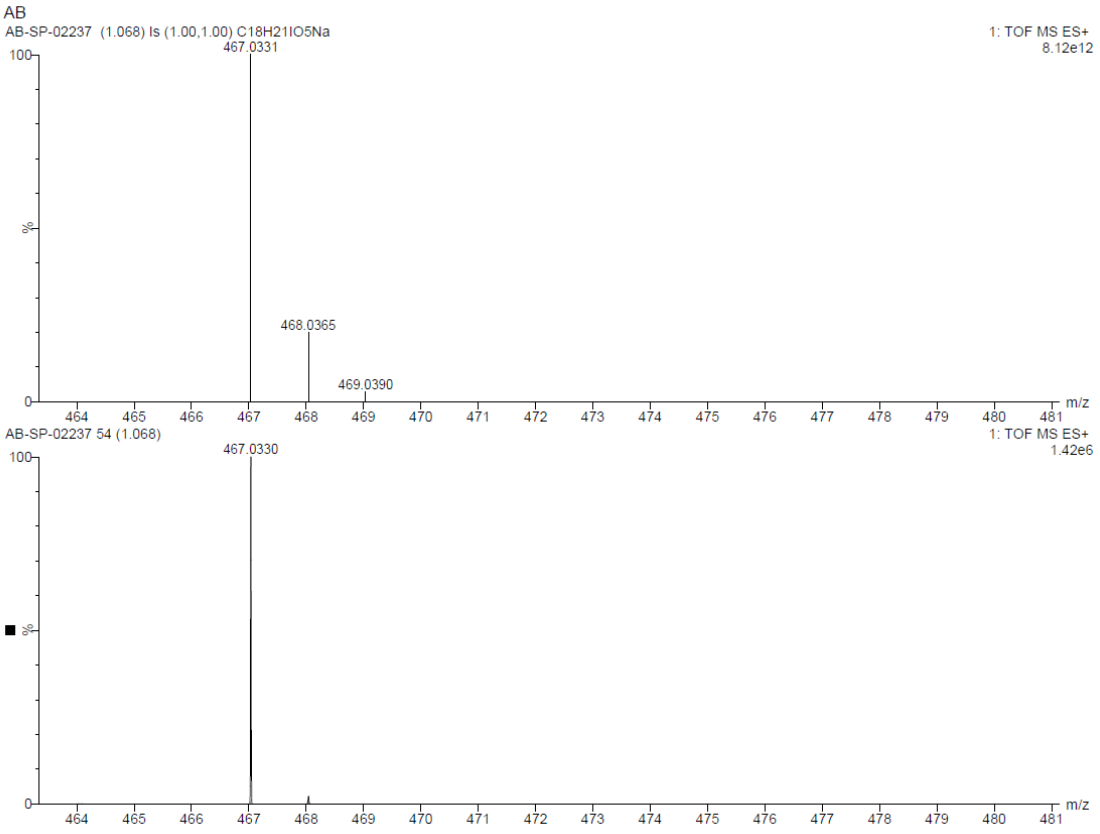




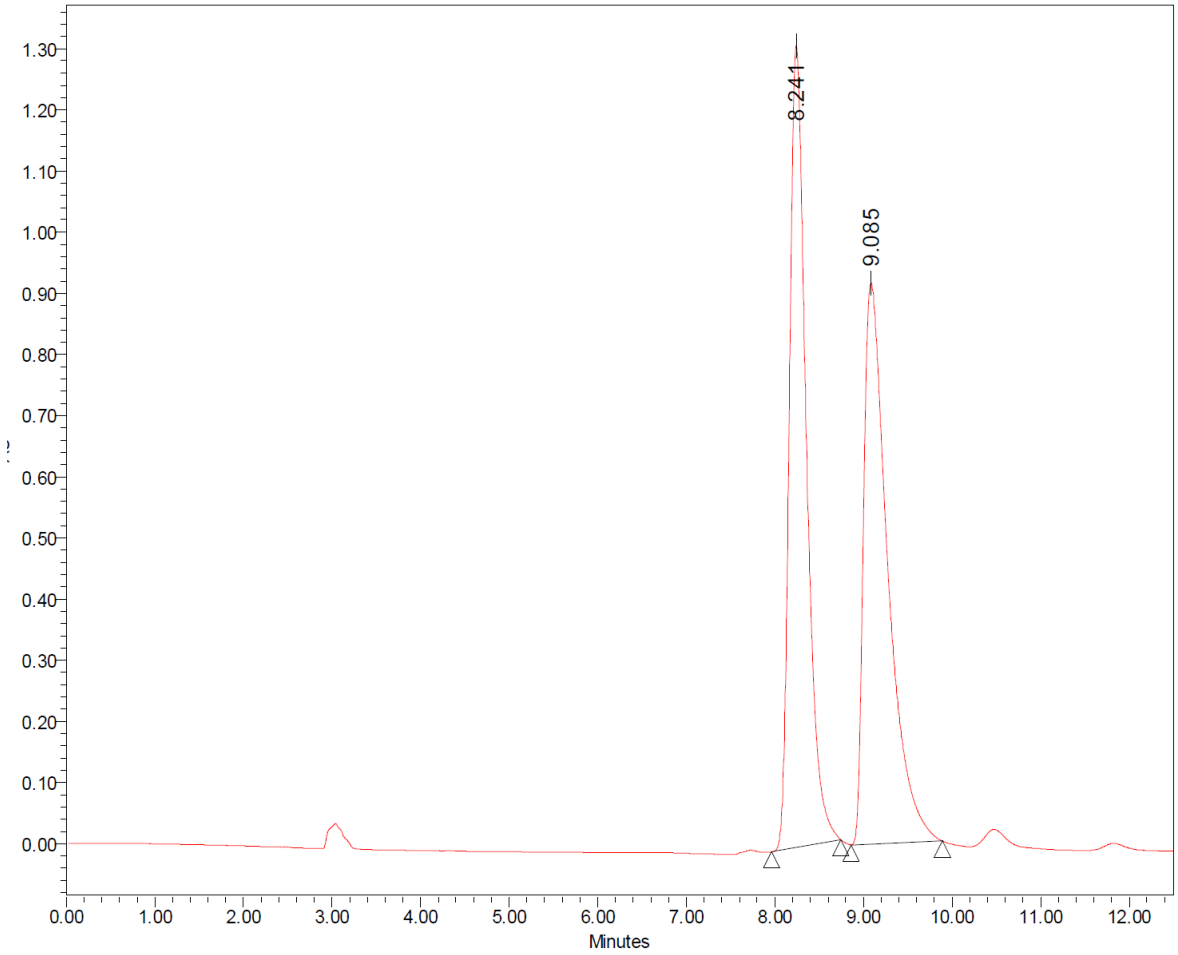
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**14**



^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**14**



HRMS data of (−)-**14**



Sample Name: AB-SP_02227R_OD-H_10_01_RAC; Date Acquired: 26-12-2023 14:14:44 IST; Vial: 1
Injection: 1

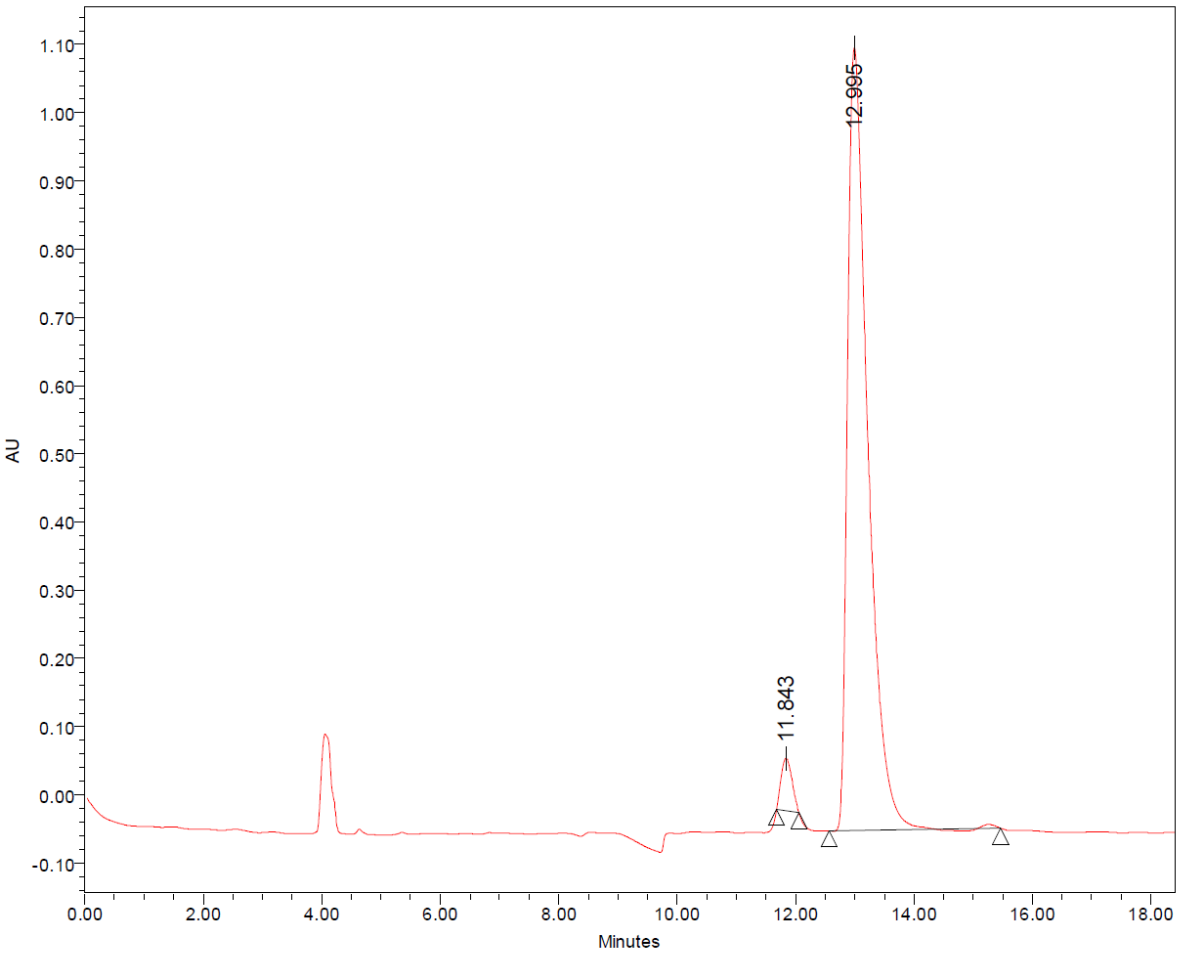
Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP_02227R_OD-H_10_01_RAC	1	1	8.241	17523849	50.11	1311456
2	AB-SP_02227R_OD-H_10_01_RAC	1	1	9.085	17446580	49.89	917490
Mean				8.663			
Std. Dev.				0.597			

Reported by User: System
Report Method: Peak Summary Report
Report Method ID 7327
Page: 1 of 2

Project Name: AB Research Group
Date Printed:
26-12-2023
14:47:02 Asia/Calcutta

HPLC data of (±)-**14**



Sample Name: AB-SP-02382-OD-H-10-01-CHI; Date Acquired: 10-09-2024 14:17:37 IST; Vial: 1:A,1; Injection: 1

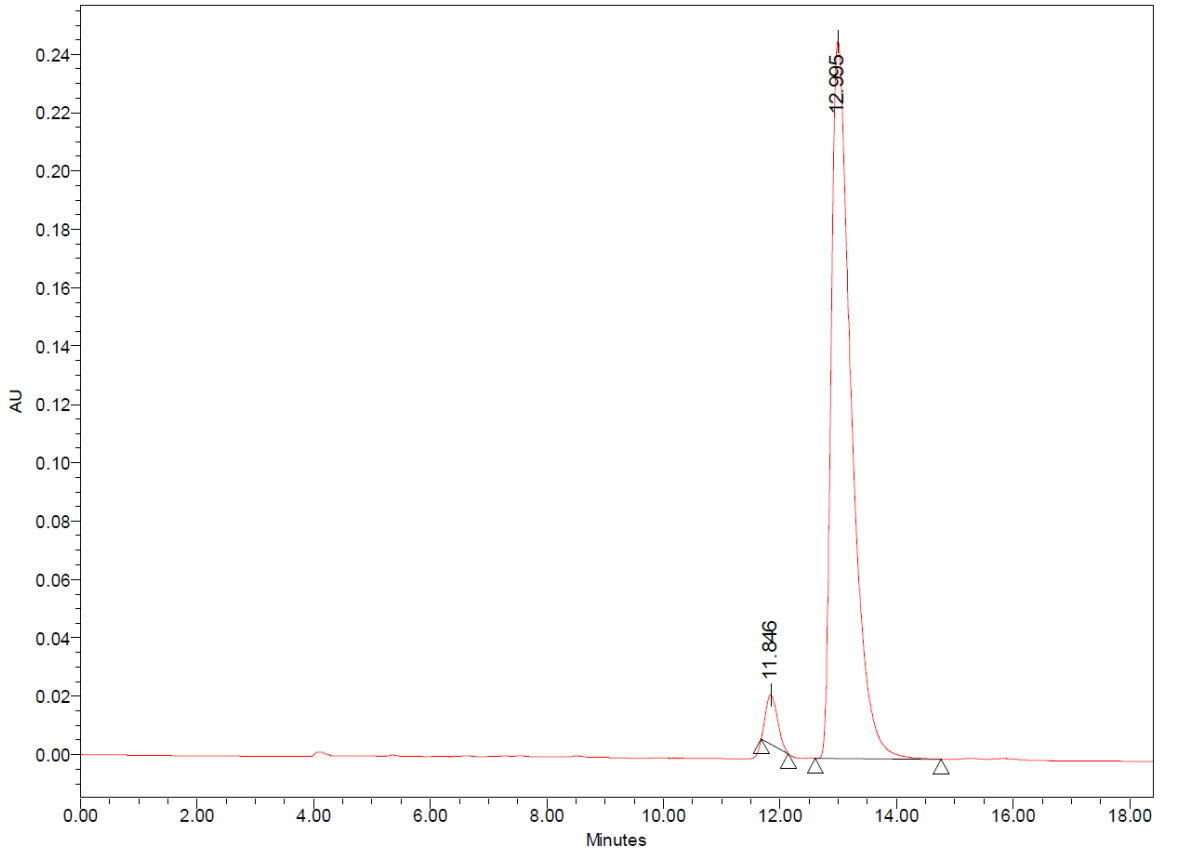
Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02382-OD-H-10-01-CHI	1:A,1	1	12.995	27622810	96.57	1147588
2	AB-SP-02382-OD-H-10-01-CHI	1:A,1	1	11.843	981782	3.43	76780
Mean				12.419			
Std. Dev.				0.815			

Reported by User: System
Report Method: Peak Summary Report
Report Method ID: 2585
Page: 1 of 2

Project Name: AB Research Group
Date Printed:
06-10-2024
11:07:22 Asia/Kolkata

HPLC data of (–)-**14** of optimized condition (entry 5).

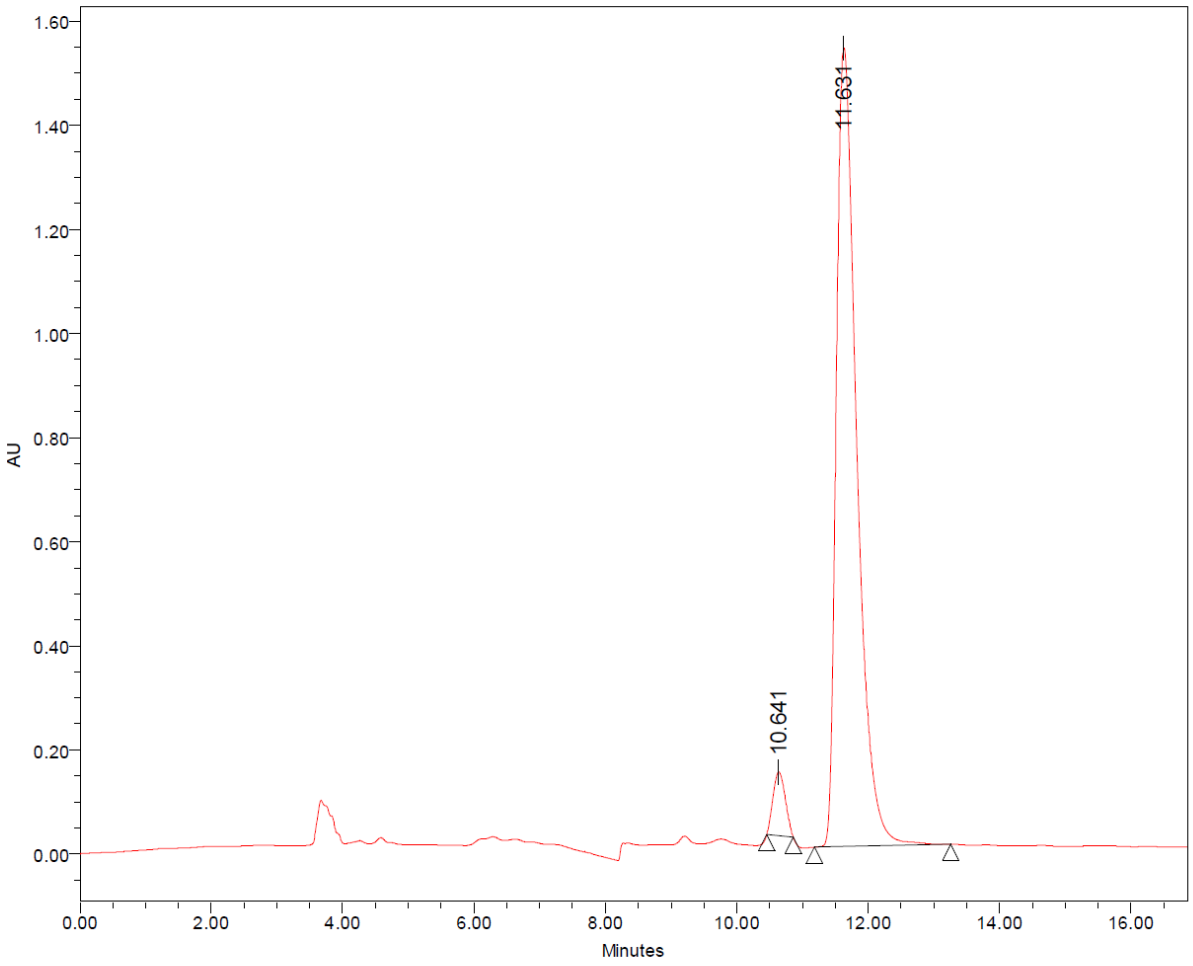


Sample Name: AB-SP-02382-OD-H-10-01-CHI; Date Acquired: 10-09-2024 14:17:37 IST; Vial: 1:A,1; Injection: 1

Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02382-OD-H-10-01-CHI	1:A,1	1	12.995	5889246	96.17	245717
2	AB-SP-02382-OD-H-10-01-CHI	1:A,1	1	11.846	234631	3.83	16867
Mean				12.420			
Std. Dev.				0.813			

HPLC data of (−)-**14** of reaction condition of entry 8

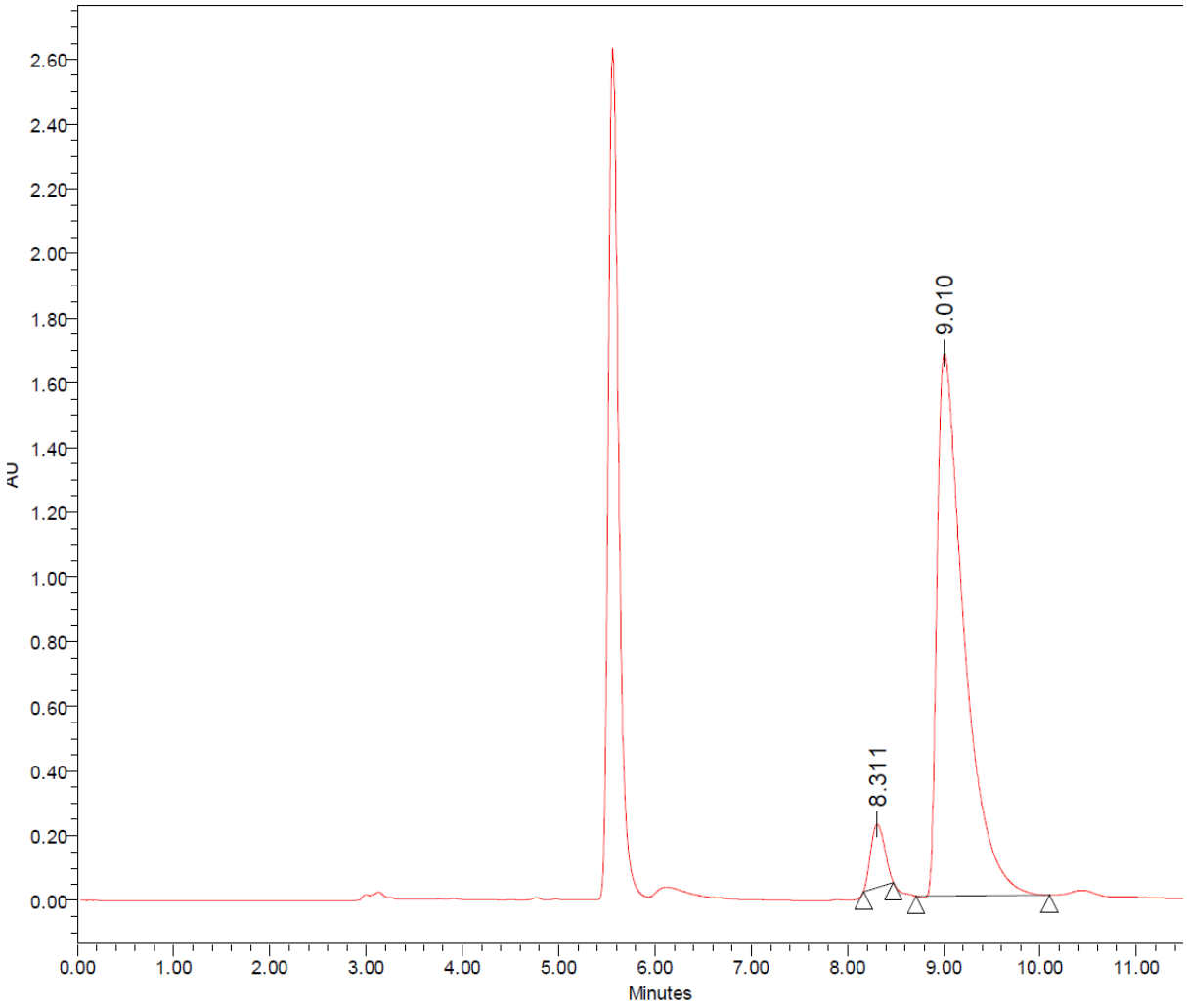


Sample Name: AB-SP-02MITDEPBU-OD-H-30-01; Date Acquired: 23-09-2024 22:46:12 IST; Vial: 1:A,1; Injection: 1

Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02MITDEPBU-OD-H-30-01	1:A,1	1	11.631	32979747	95.41	1535098
2	AB-SP-02MITDEPBU-OD-H-30-01	1:A,1	1	10.641	1587898	4.59	122178
Mean				11.136			
Std. Dev.				0.700			

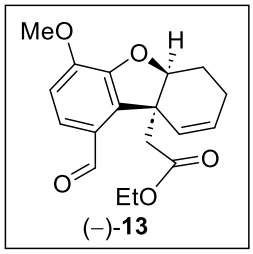
HPLC data of (−)-**14** of reaction condition of entry 3



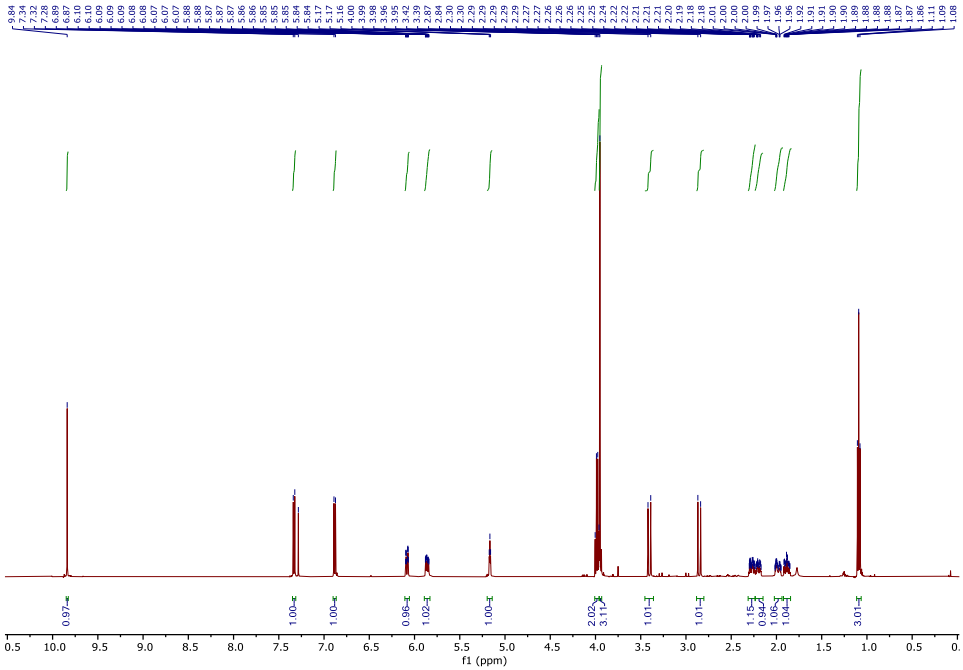
Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB_SP_02382_OD-H_10_01_CHI	1	2	9.010	32723637	94.38	1678628
2	AB_SP_02382_OD-H_10_01_CHI	1	2	8.311	1949747	5.62	195672
Mean				8.660			
Std. Dev.				0.494			

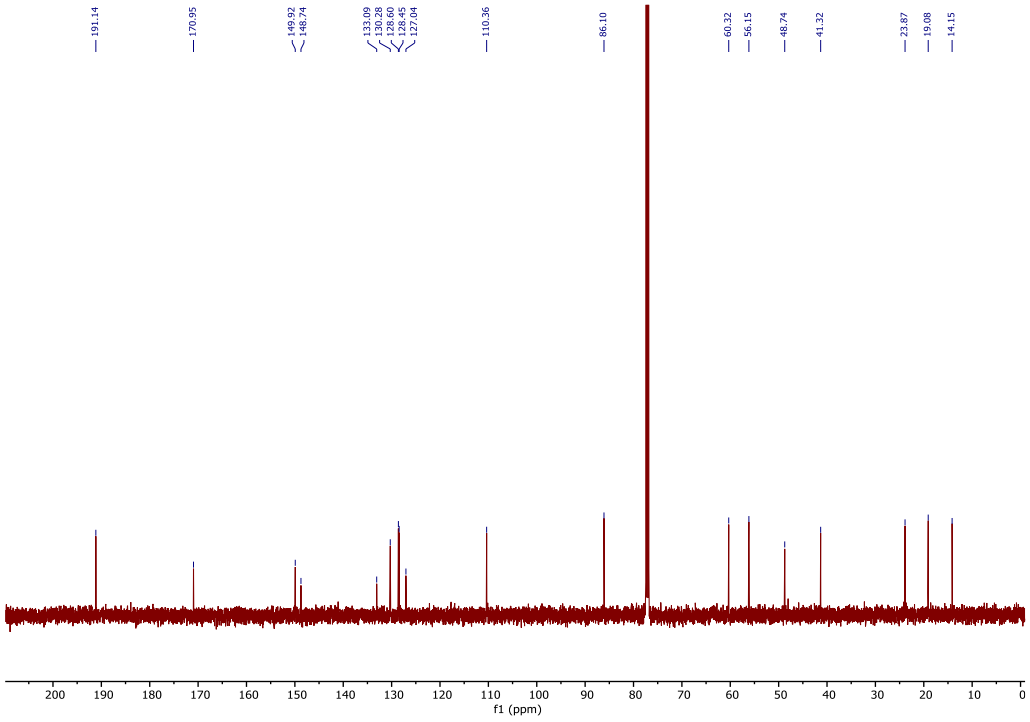
HPLC data of (–)-**14** of reaction condition of entry 9



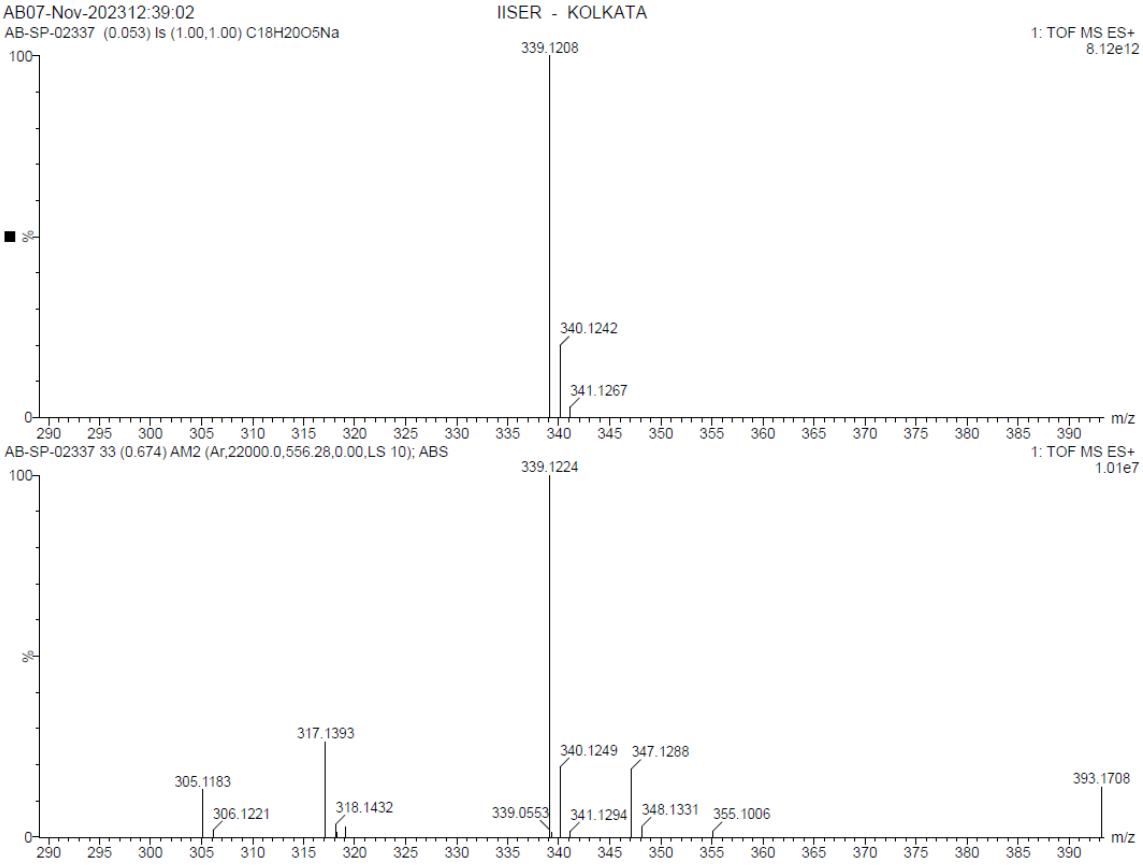
(–)-**13**



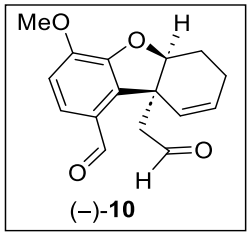
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**13**



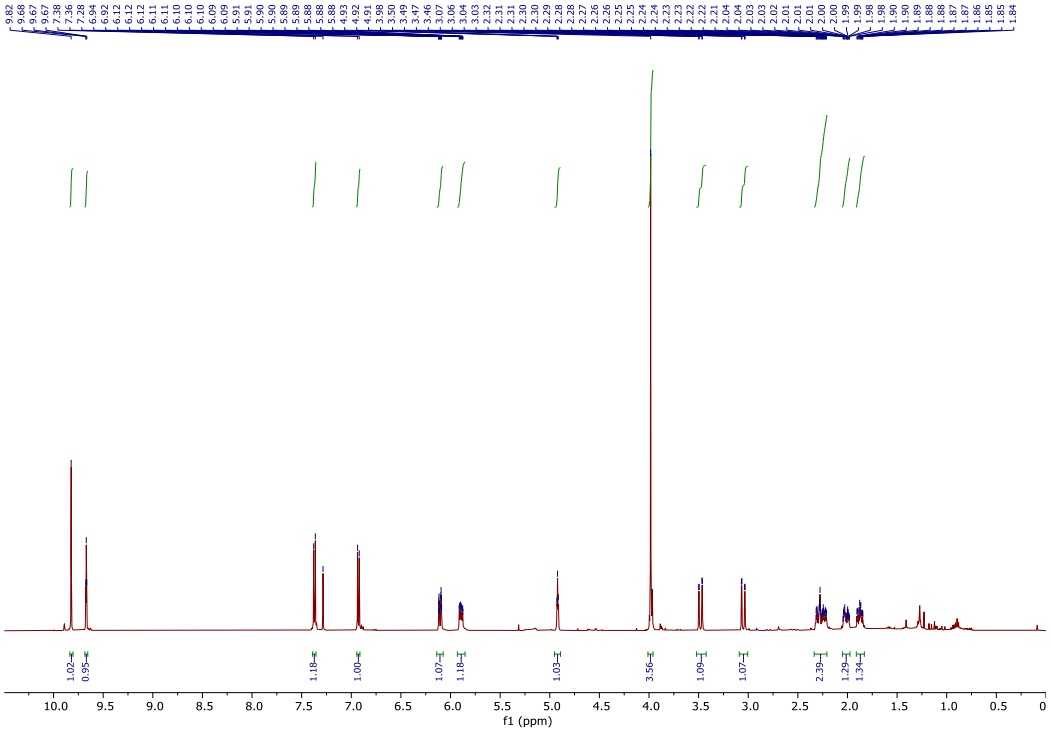
^{13}C {^{1}H} NMR (500 MHz, $CDCl_3$) of (–)-**13**



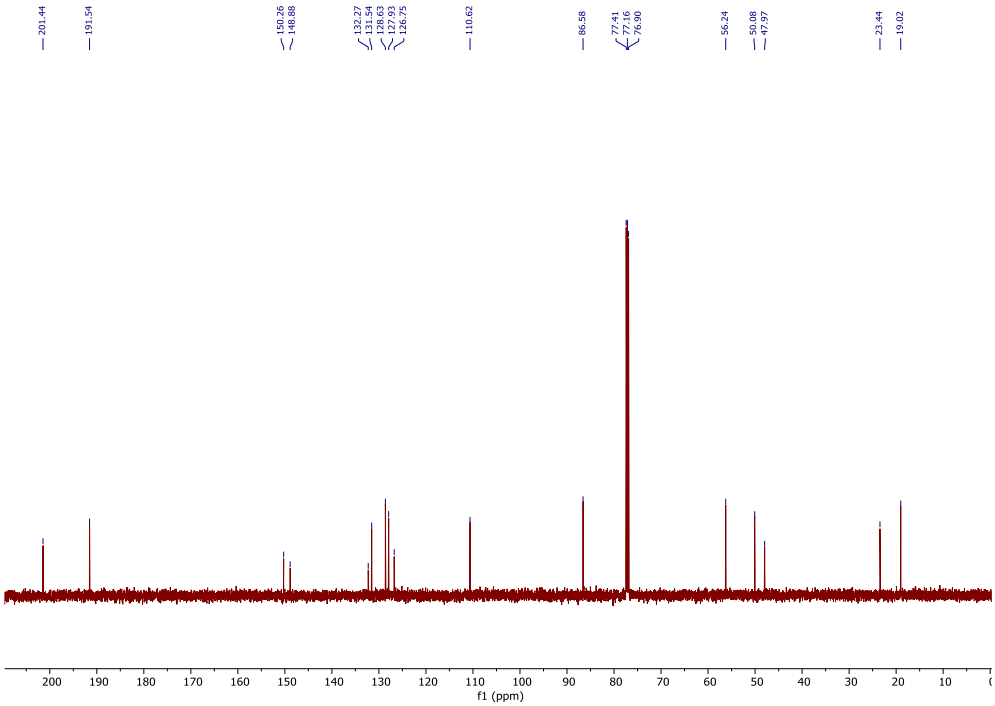
HRMS data of (–)-**13**



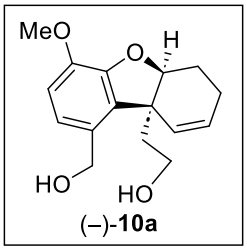
(–)-**10**

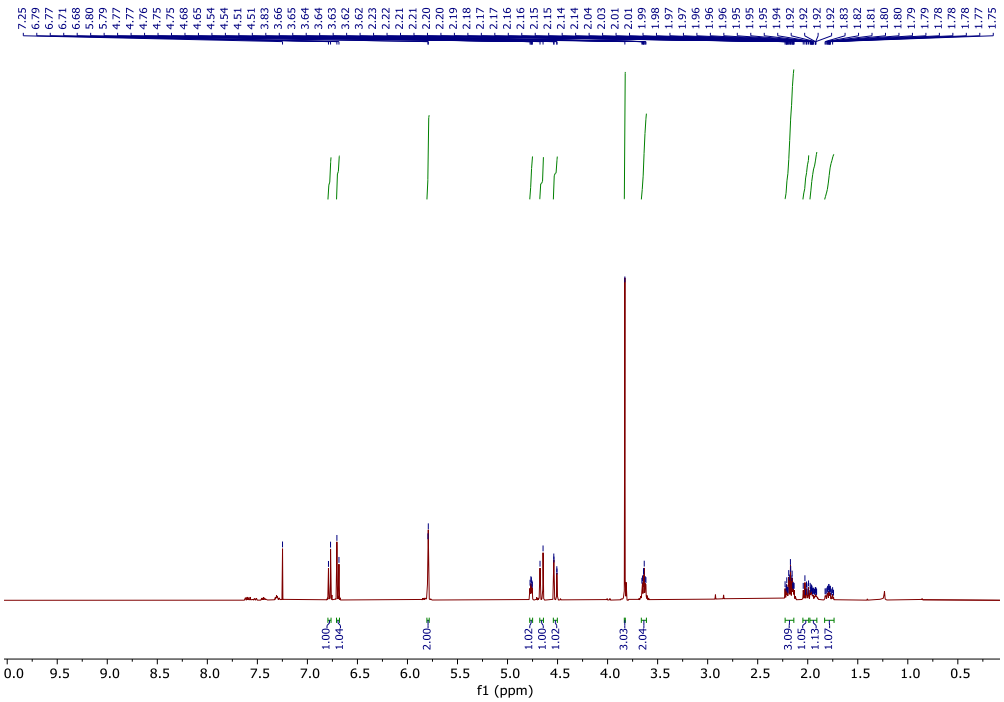


^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**10**

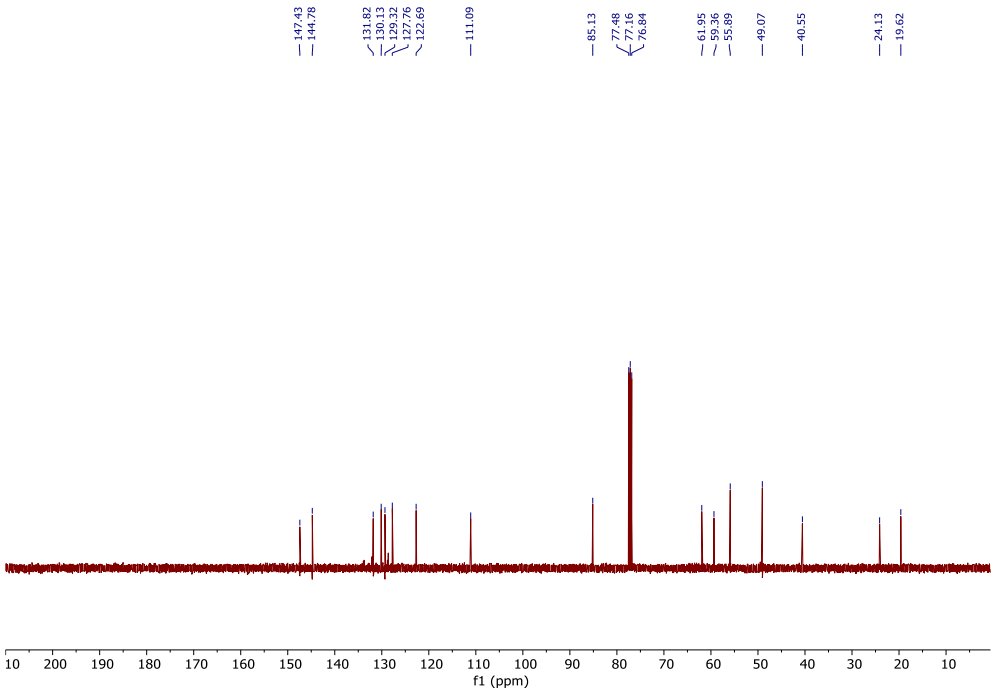


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**10**

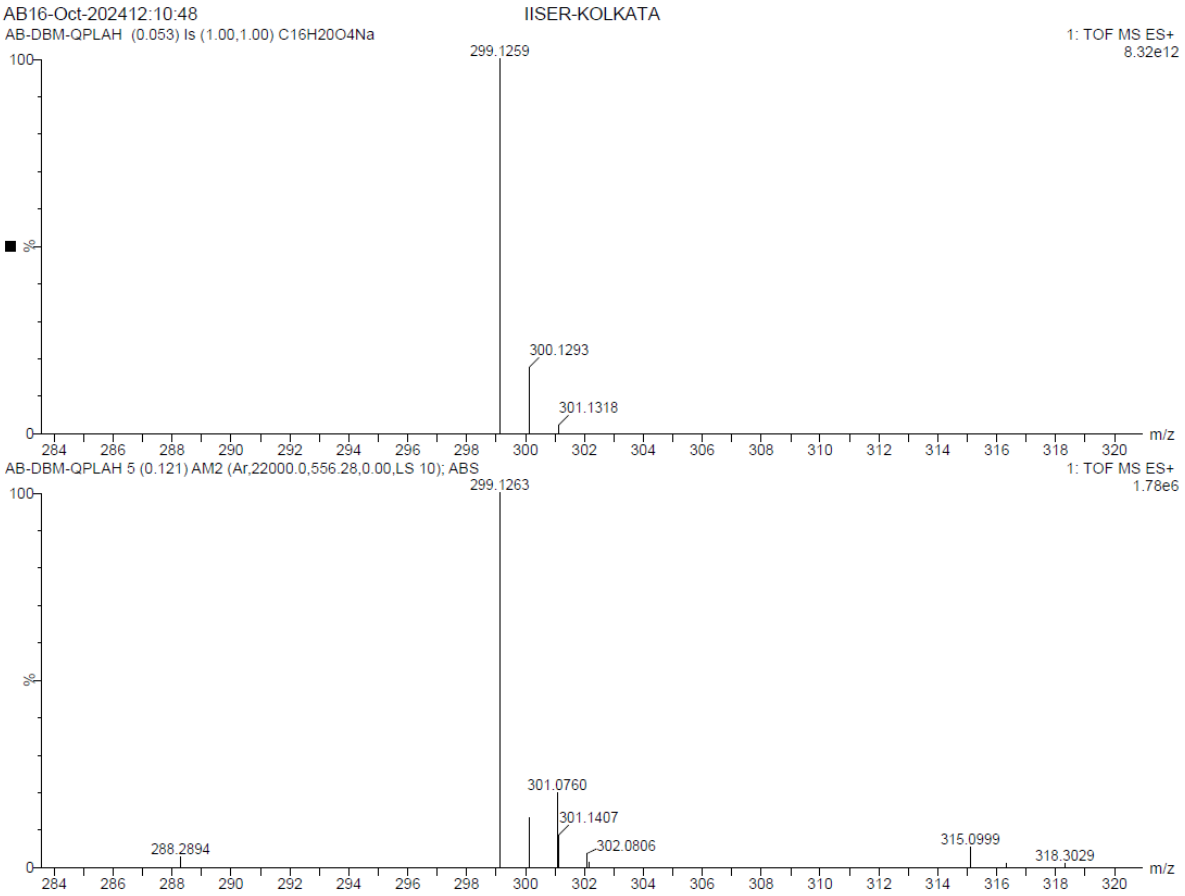




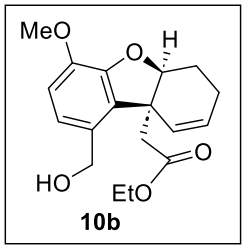
^{1}H NMR (400 MHz, $CDCl_3$) of (–)-**10a**



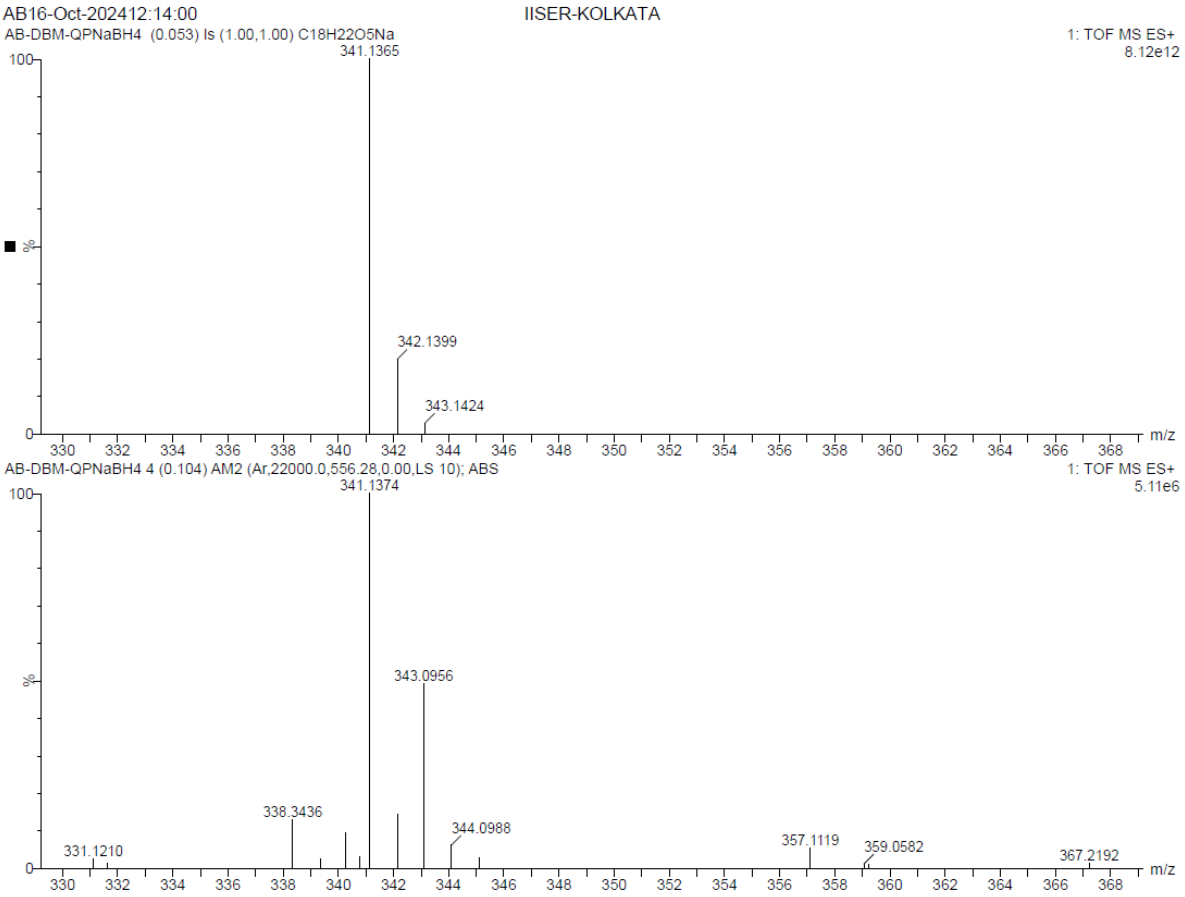
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**10a**



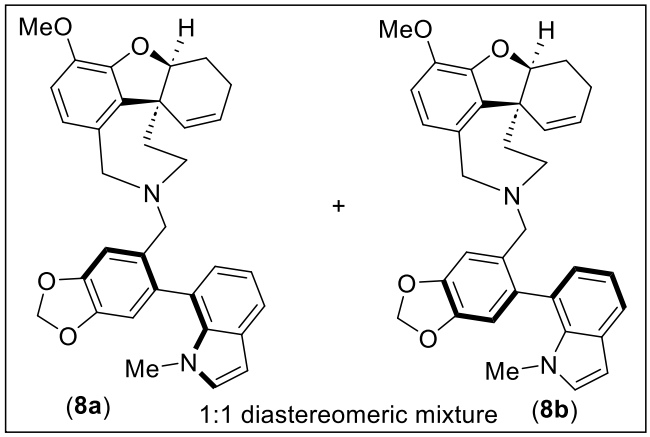
HRMS data of **10a**



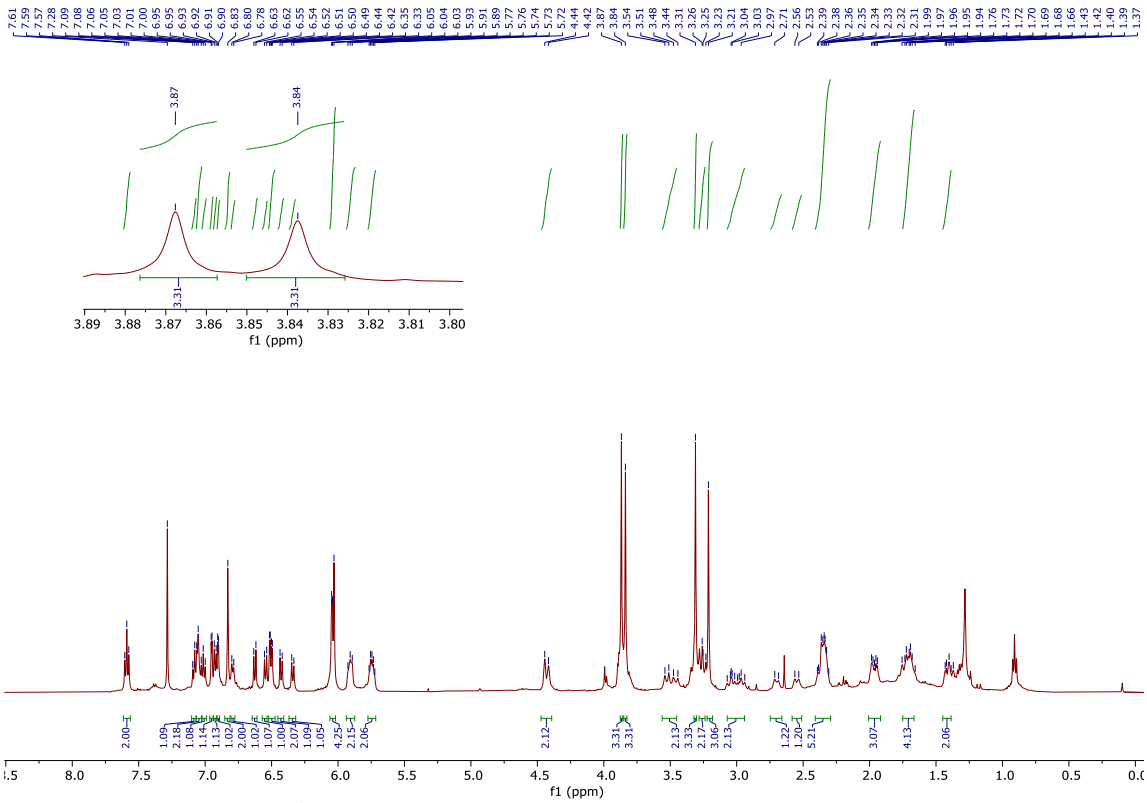
10b



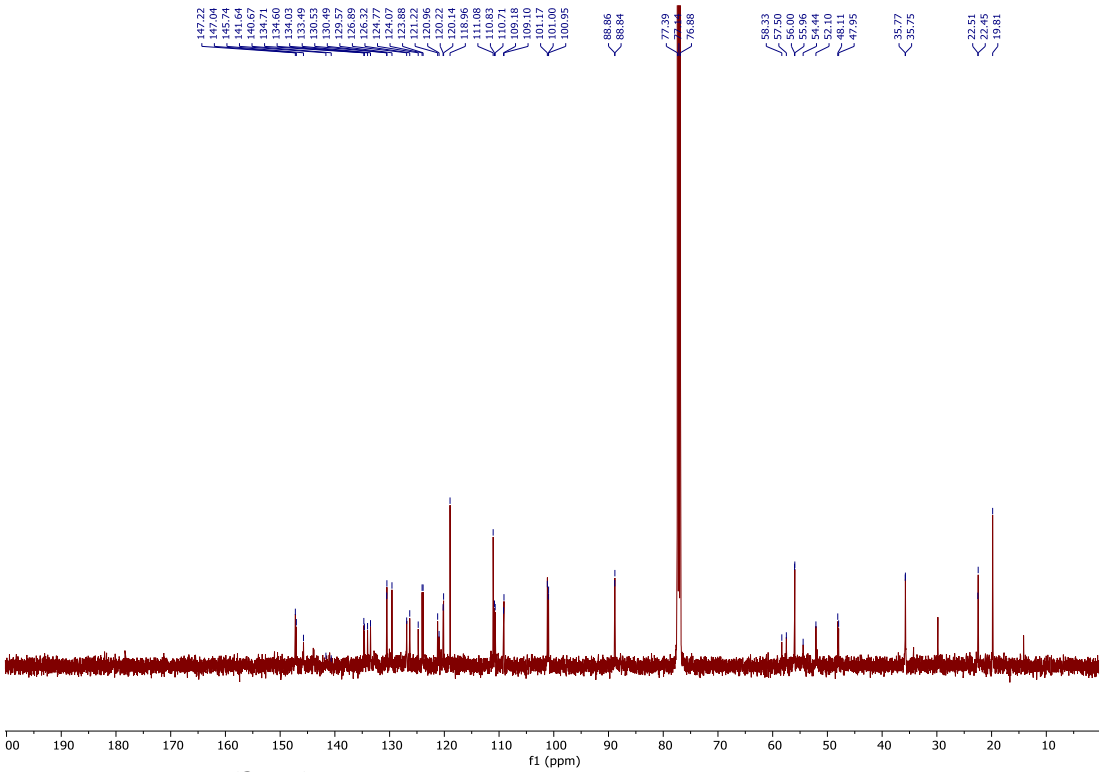
HRMS data of **10b**



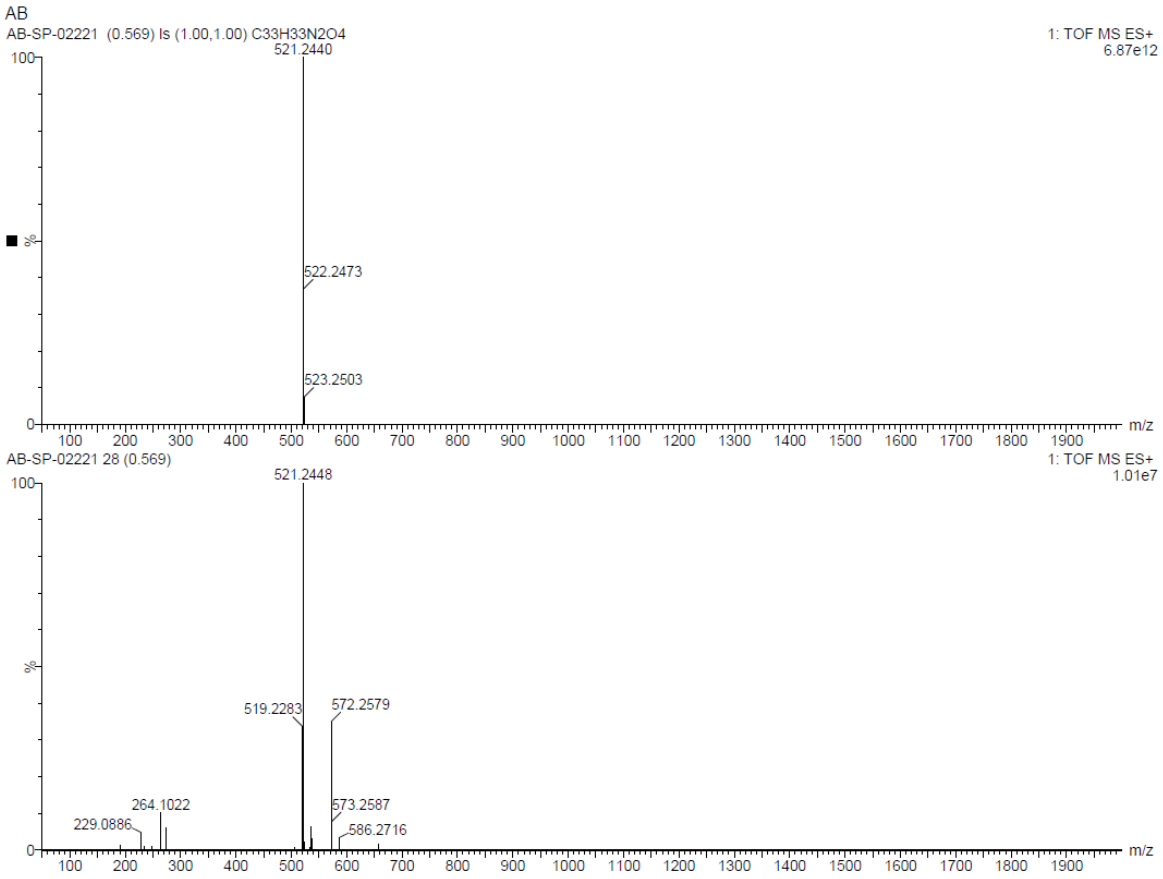
(**8a**) 1:1 diastereomeric mixture (**8b**)



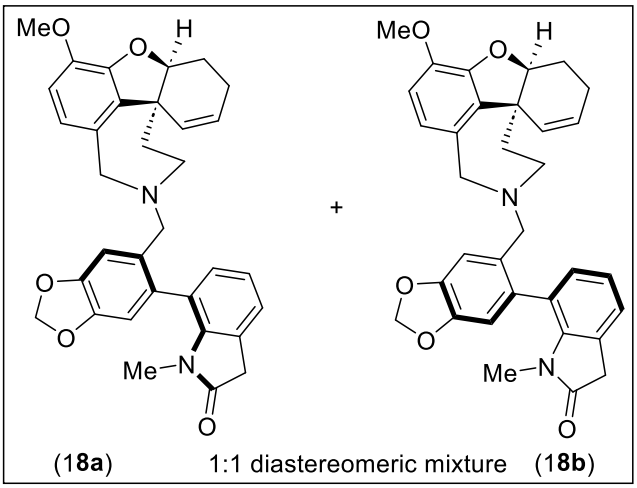
^{1}H NMR (500 MHz, $CDCl_3$) of [**8a** and **8b**]

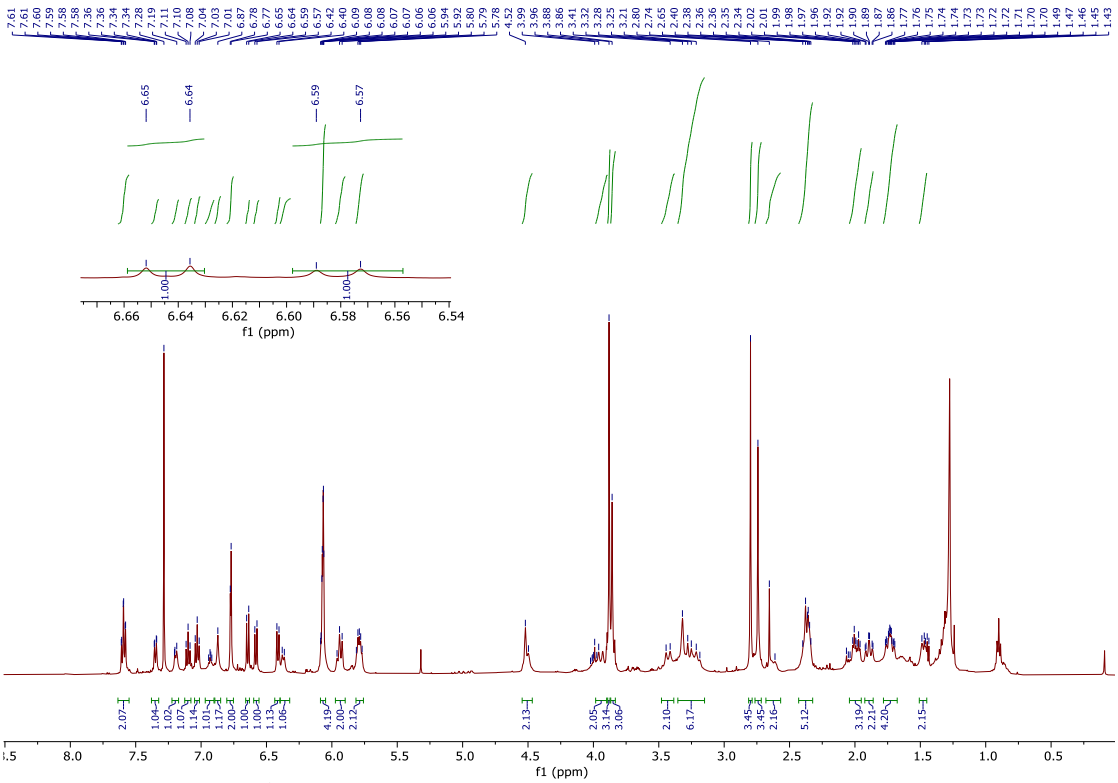


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of [**8a** and **8b**]

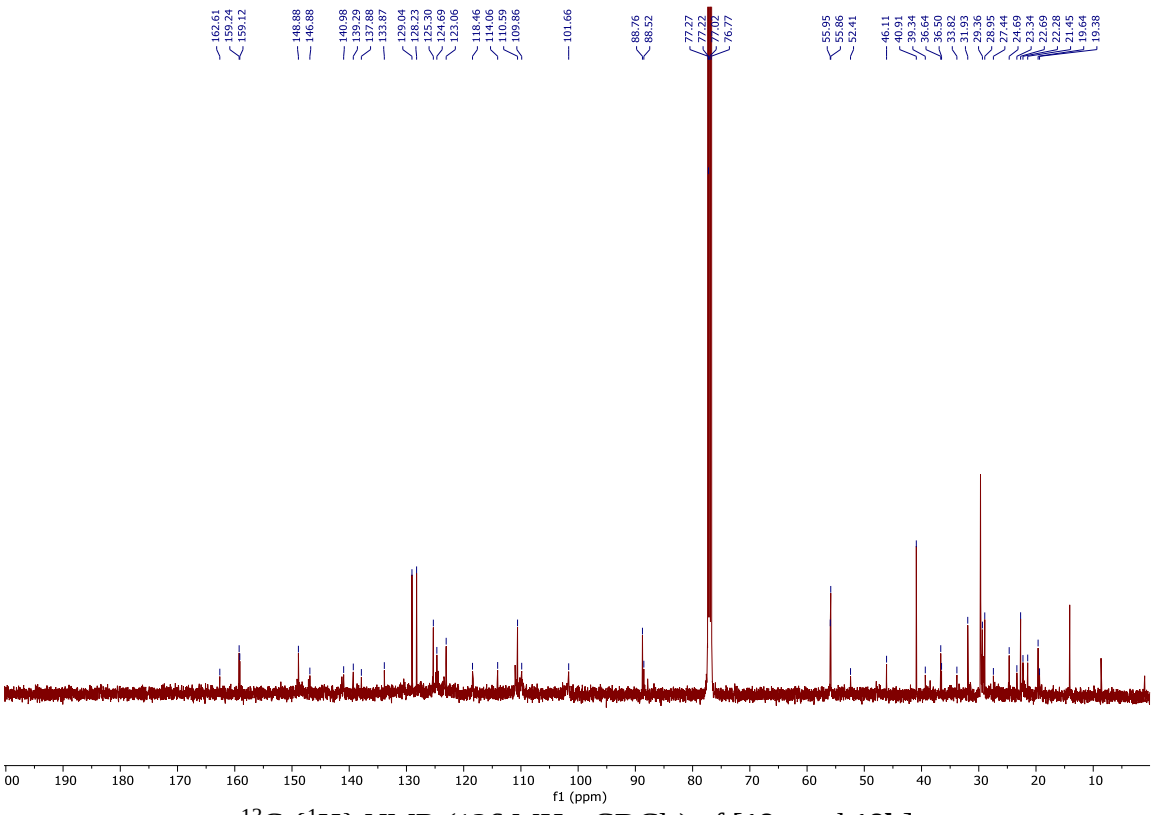


HRMS data of (–)-**8**

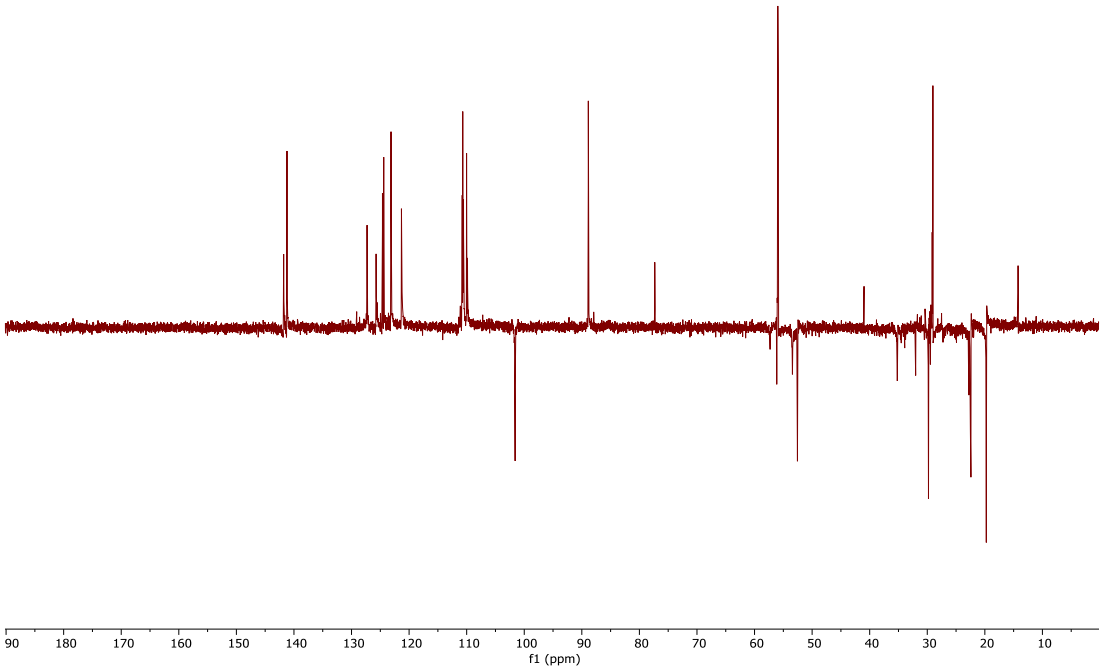




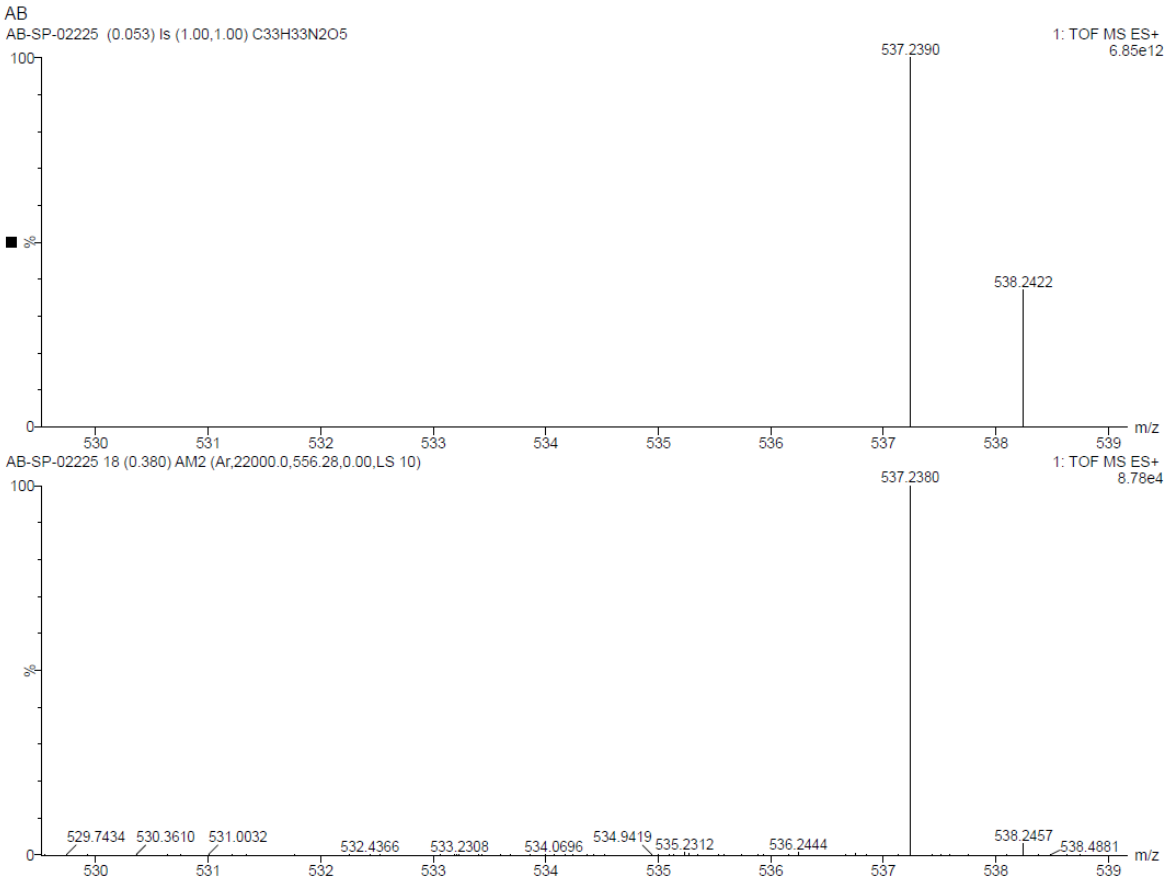
^{1}H NMR (500 MHz, $CDCl_3$) of [**18a** and **18b**]



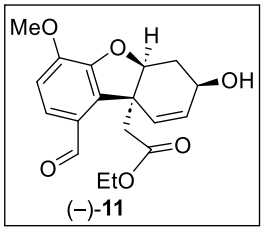
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of [**18a** and **18b**]



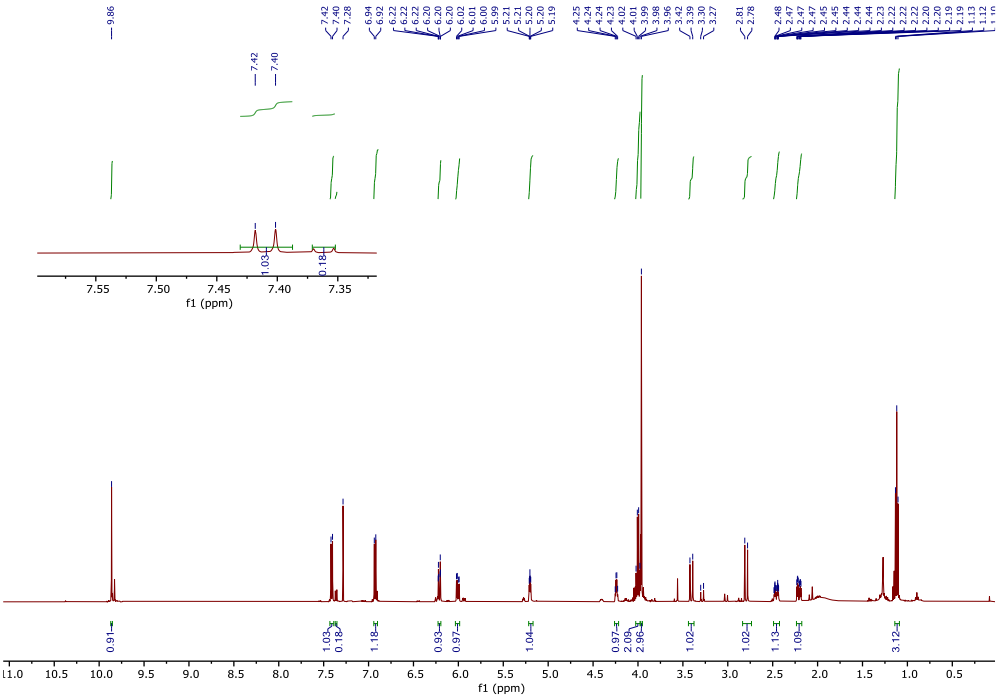
DEPT-135 NMR (126 MHz, $CDCl_3$) of mixtures [**18a** and **18b**]



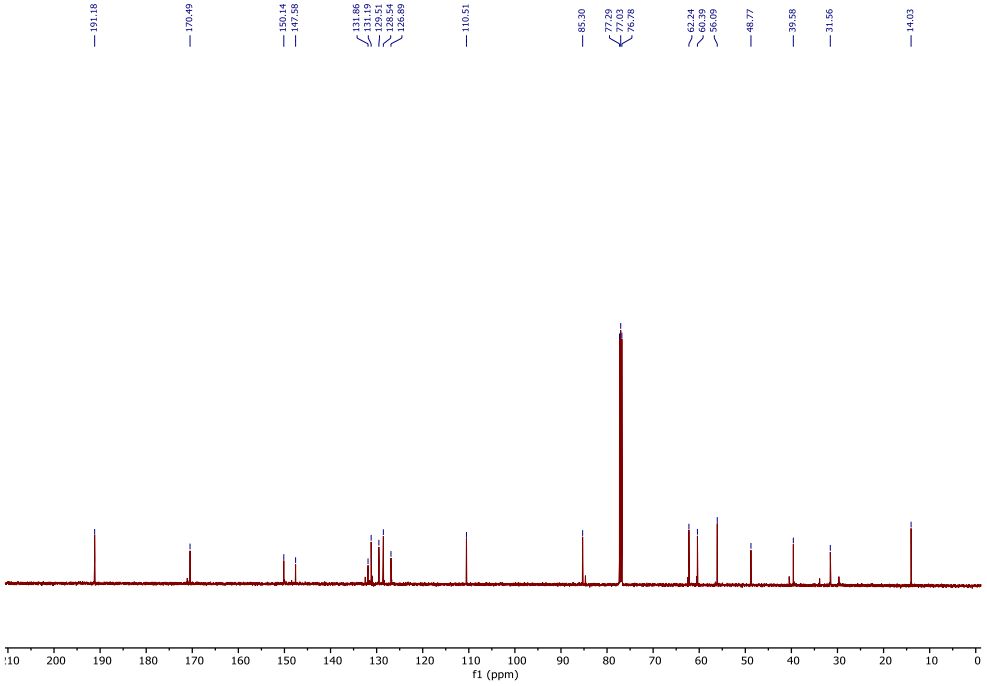
HRMS data of (−)-**18**



(–)-**11**



^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**11**



^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**11**

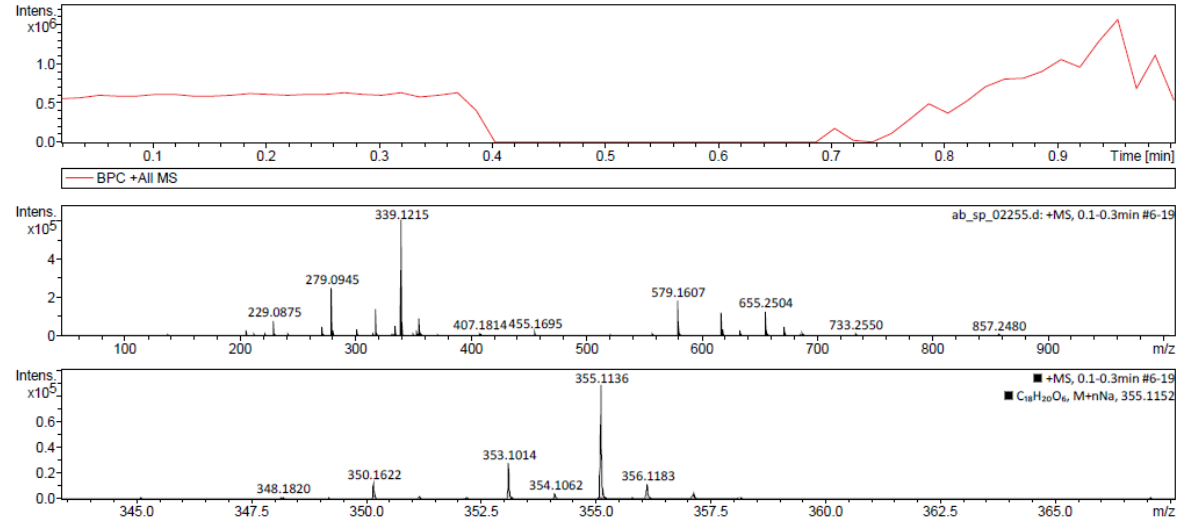
Display Report

Analysis Info

Analysis Name	D:\Data\User data\2023\JAN\ab_sp_02255.d	Acquisition Date	1/30/2023 11:09:05 AM
Method	Tune_pos_Standard_July2022.new.m	Operator	IISER Kolkata
Sample Name	ab_sp_02255	Instrument	maXis impact 8282001.00127
Comment			

Acquisition Parameter

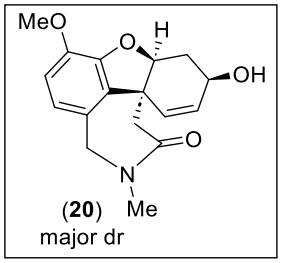
Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	1000 m/z	Set Charging Voltage	2000 V	Set Divert Valve	Source
		Set Corona	0 nA	Set APCI Heater	0 °C



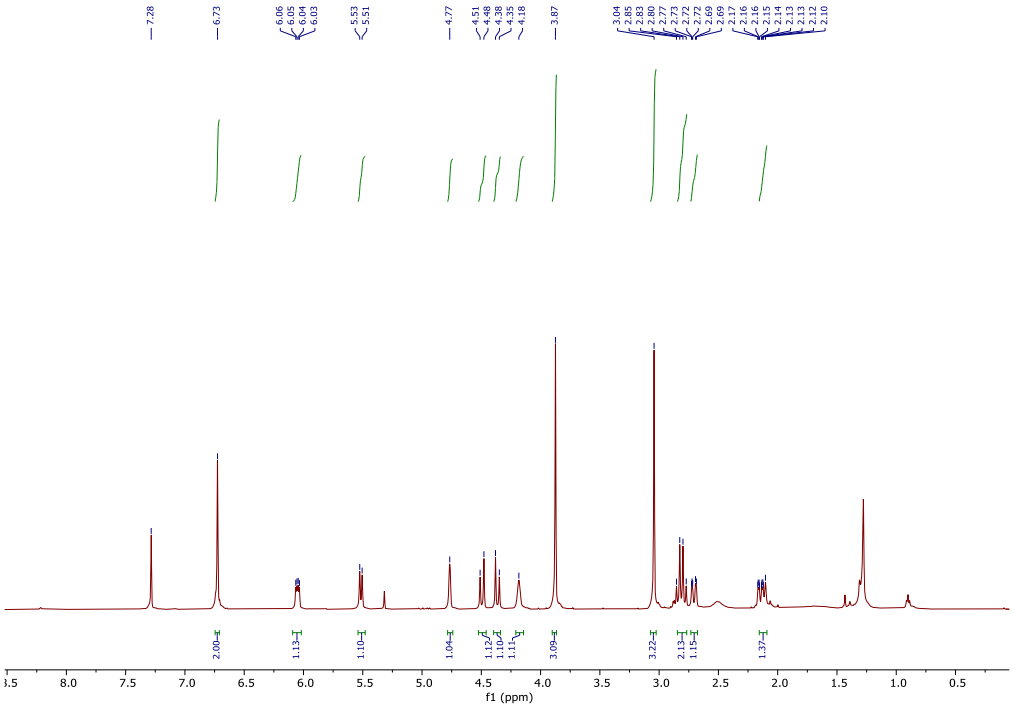
ab_sp_02255.d

Bruker Compass DataAnalysis 4.1 printed: 1/30/2023 11:11:24 AM by: IISER Kolkata Page 1 of 1

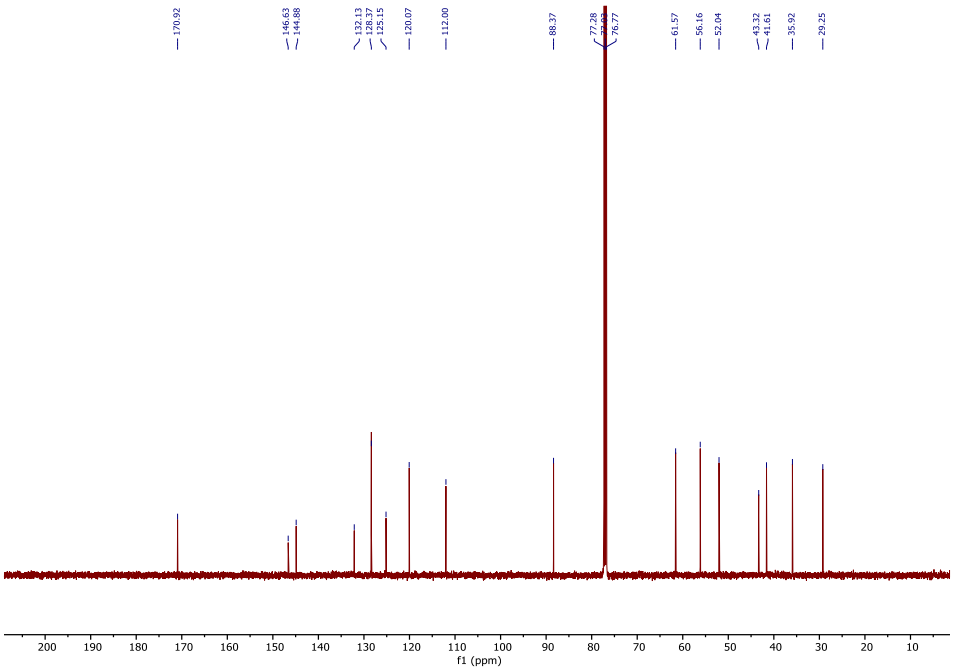
HRMS data of (−)-**11**



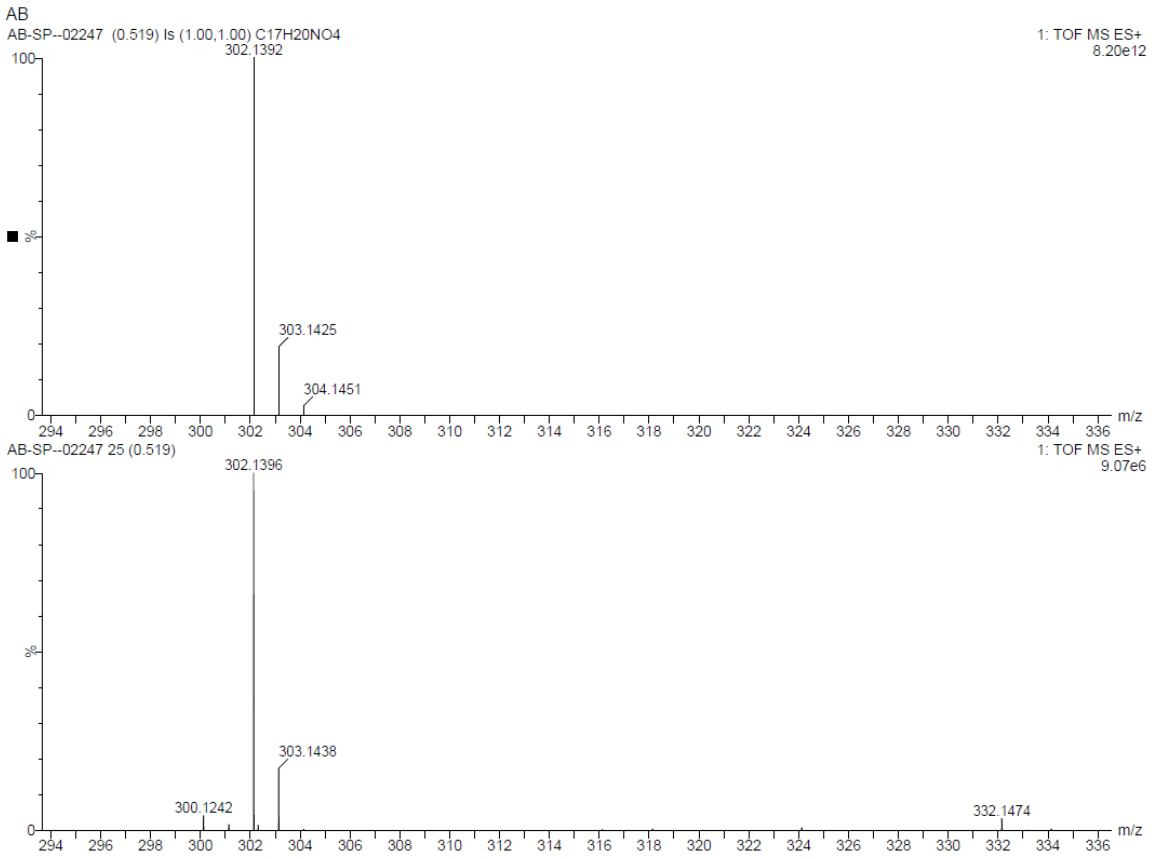
(**20**)
major dr



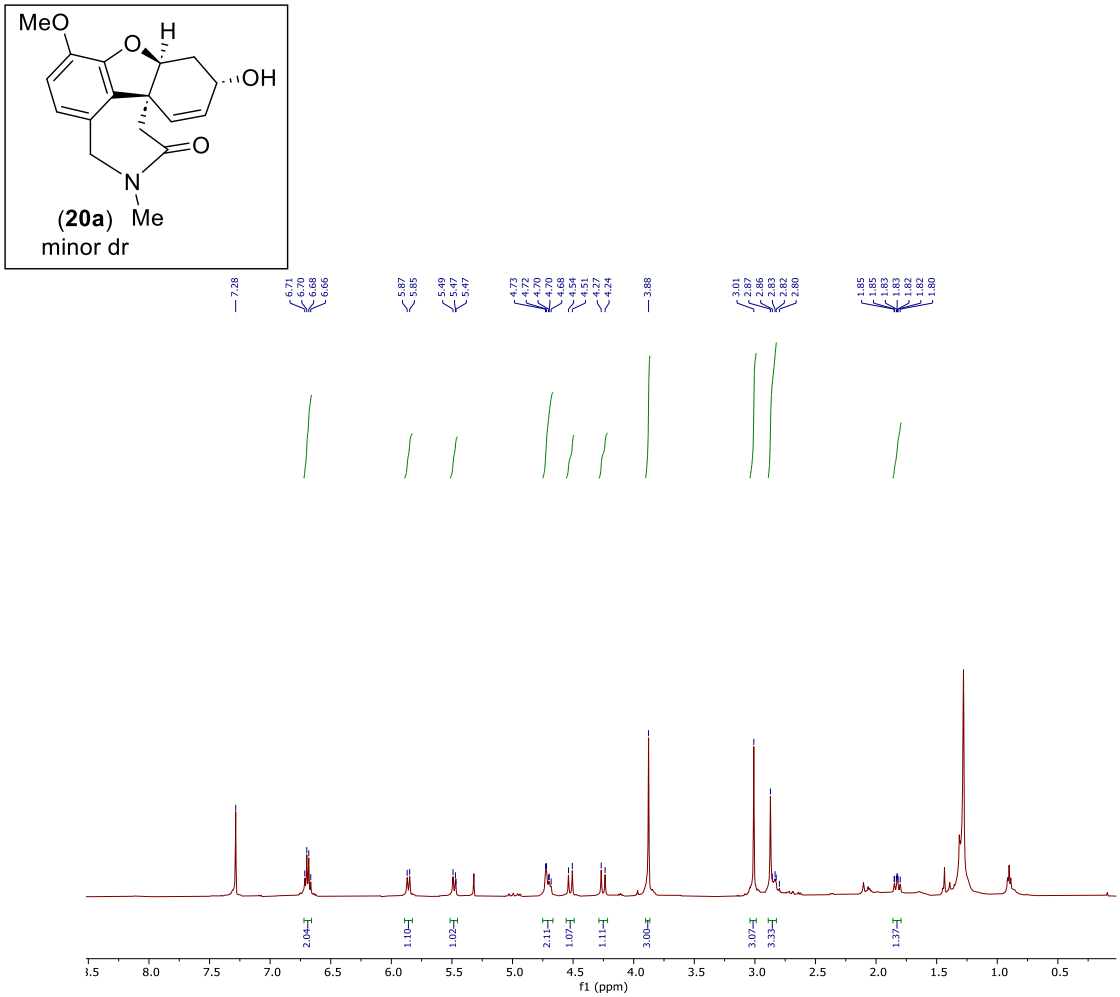
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**20**



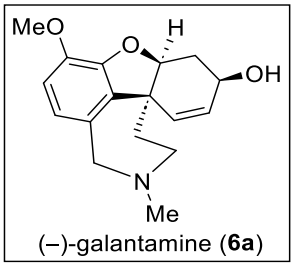
^{13}C NMR (126 MHz, $CDCl_3$) of (–)-**20**



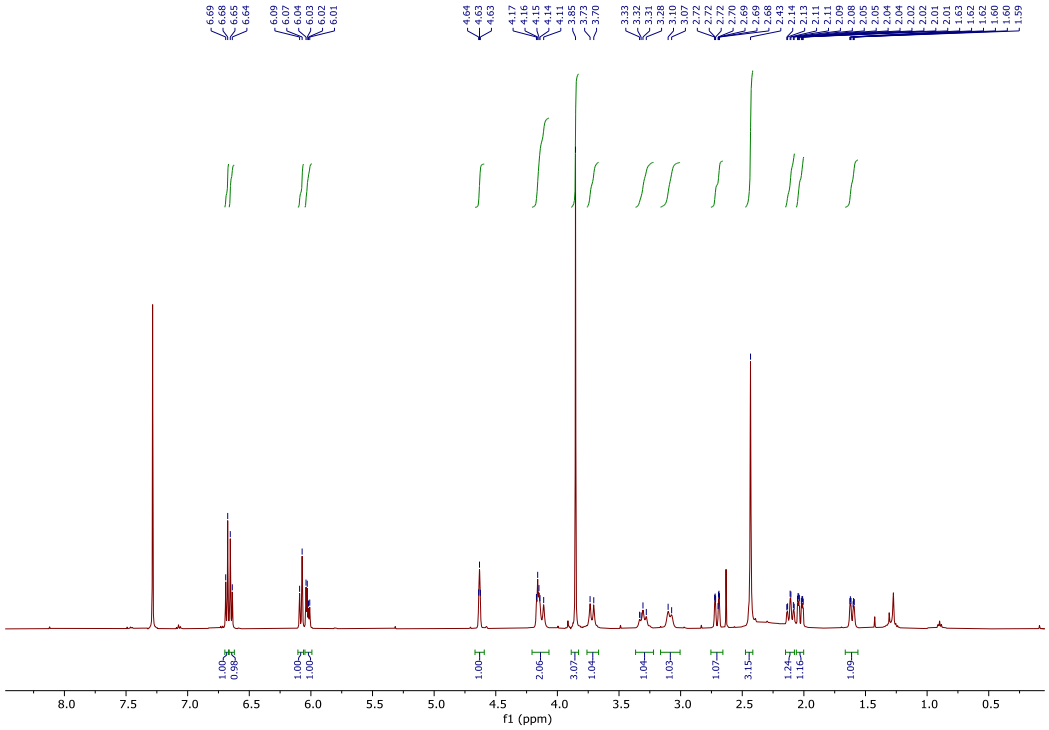
HRMS data of (−)-**20**



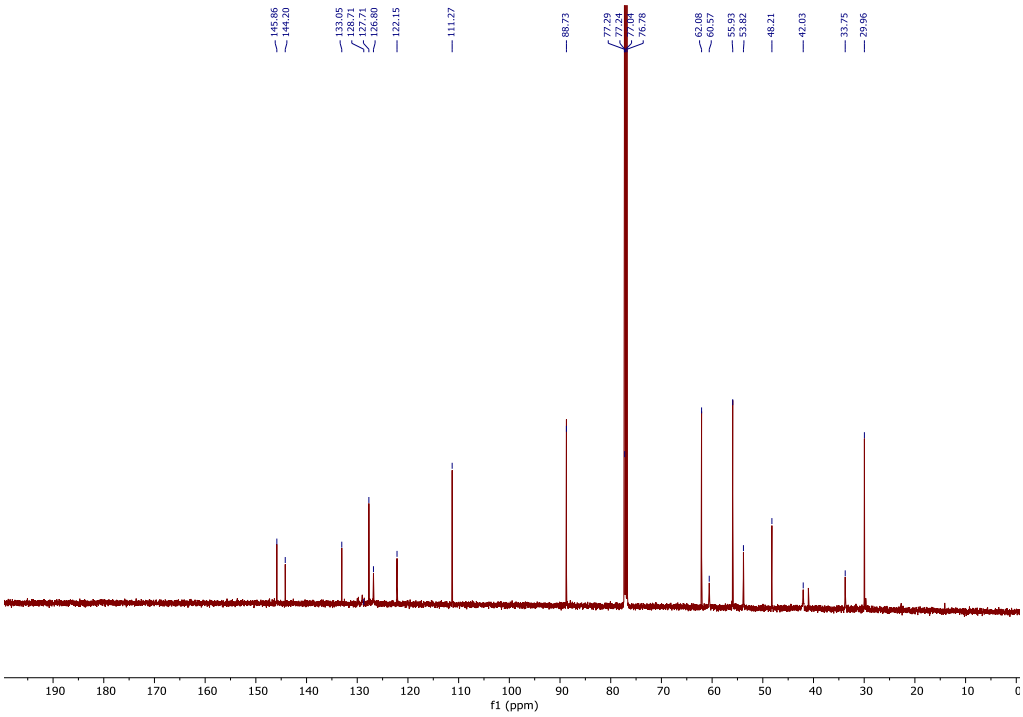
^{1}H NMR (500 MHz, $CDCl_3$) of **20a**



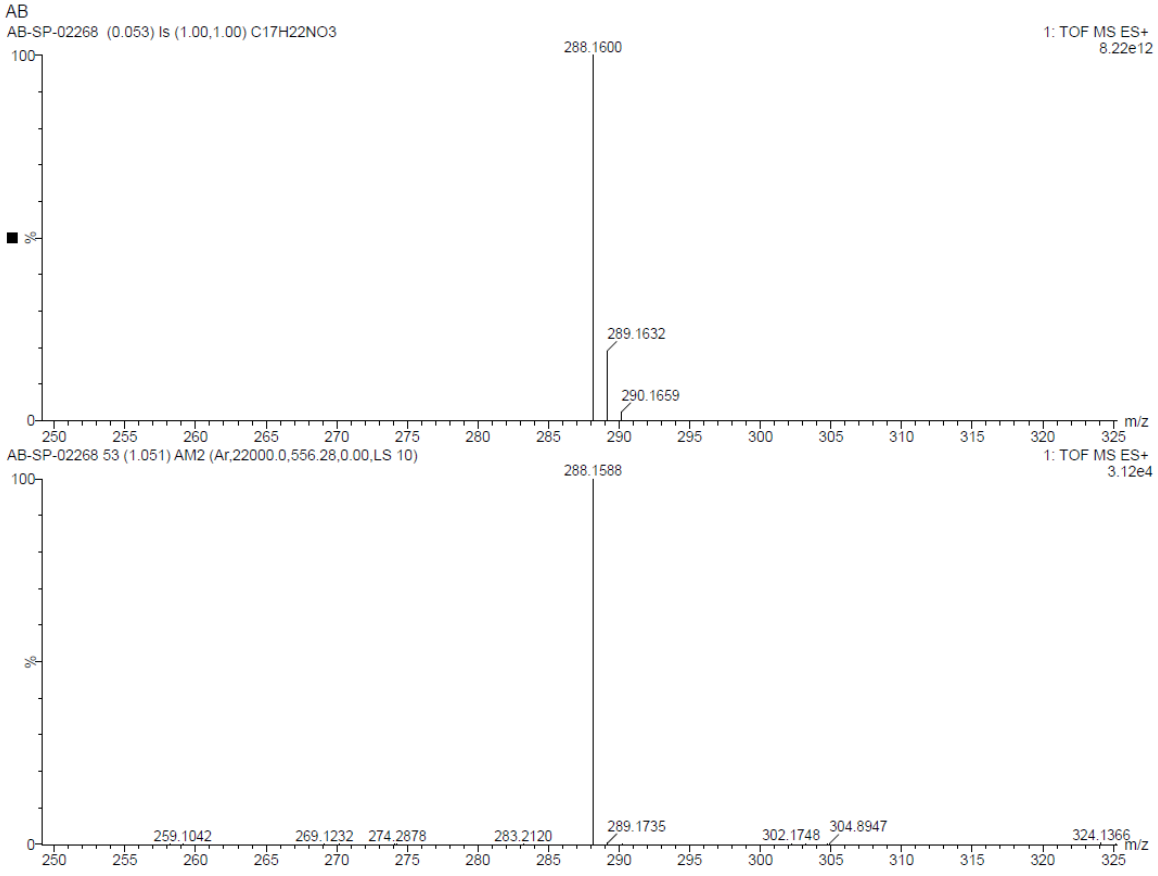
(–)-galantamine (**6a**)



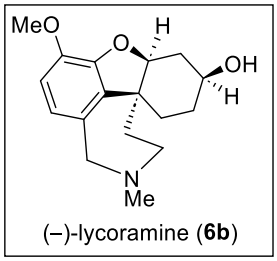
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**6a**



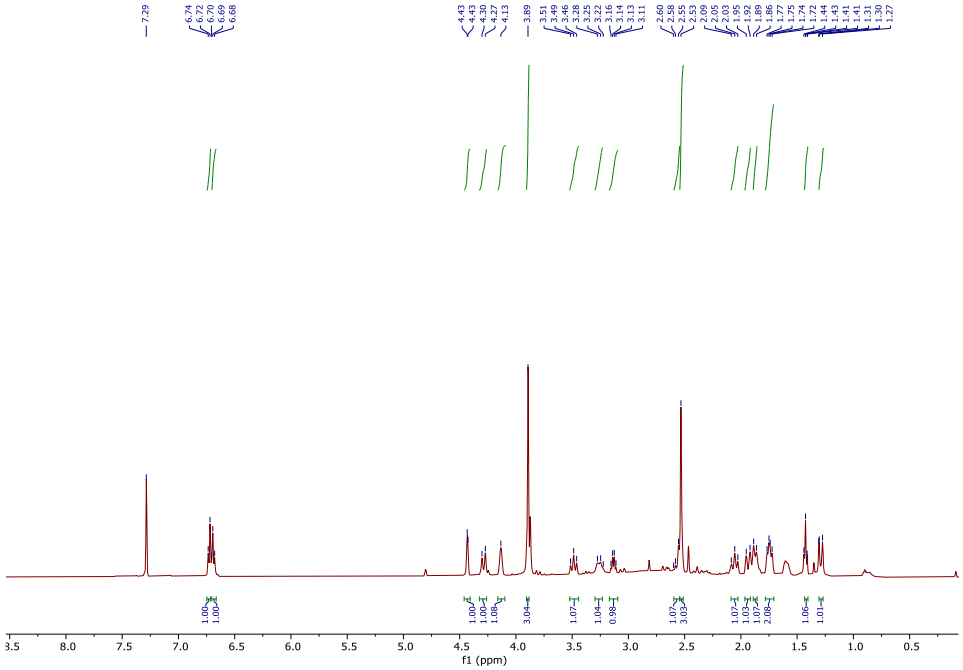
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**6a**



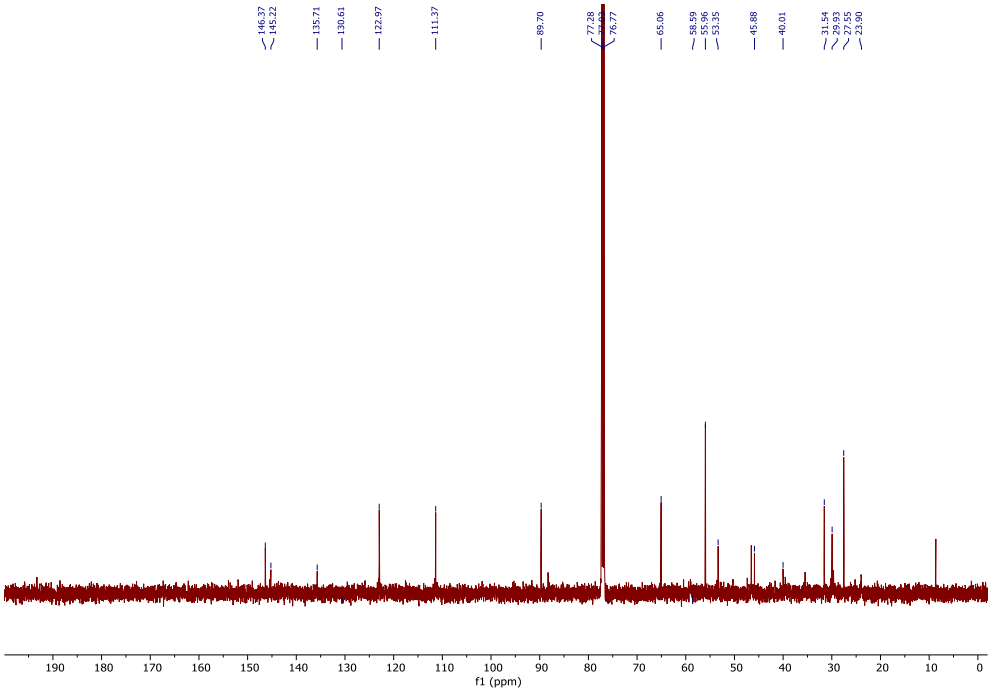
HRMS data of (–)-**6a**



(–)-lycoramine (**6b**)



^{1}H NMR (500 MHz, $CDCl_3$) of lycoramine (–)-**6b**



^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of lycoramine (–)-**6b**

Display Report

Analysis Info

Analysis Name	D:\Data\User data\2021\SEPT\AB_SP_02002.d	Acquisition Date	9/28/2021 12:58:43 PM
Method	Tune_pos_Standard.m	Operator	IISER Kolkata
Sample Name	AB_SP_02002	Instrument	maXis impact 8282001.00127
Comment			

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.5 Bar
Focus	Active	Set Capillary	3400 V	Set Dry Heater	200 °C
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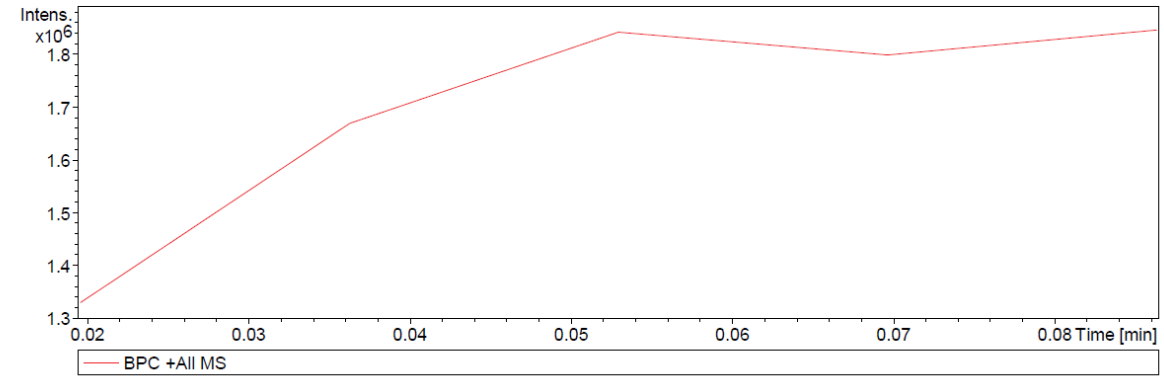
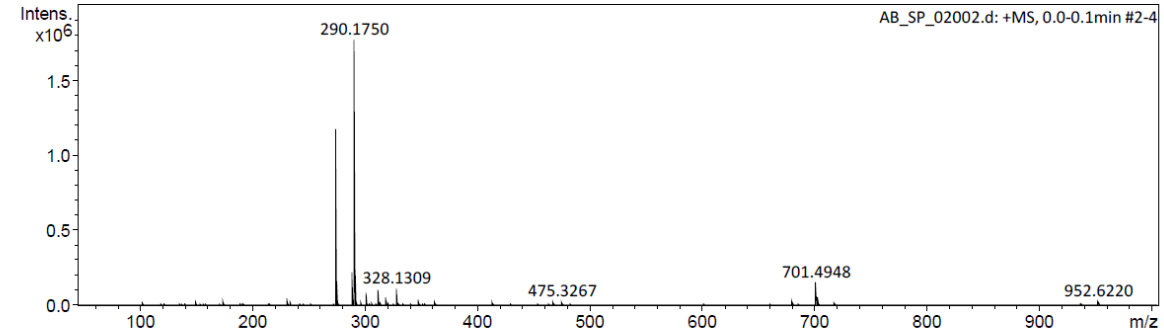
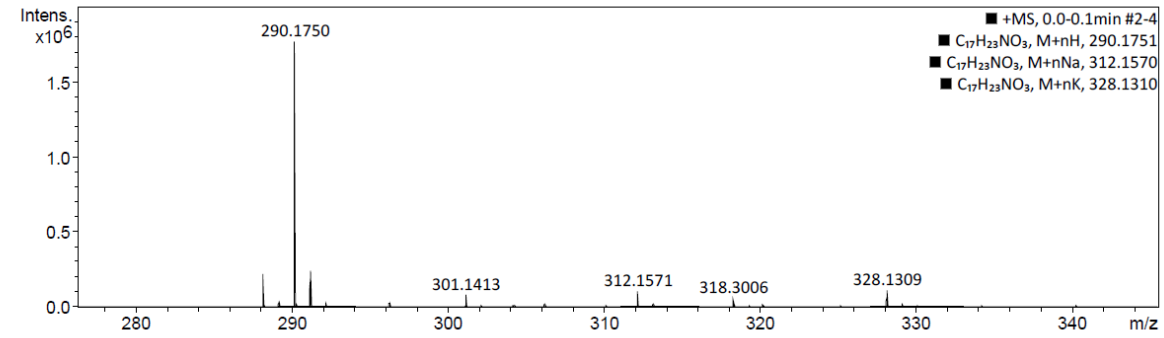
Scan End	1000 m/z	Set Charging Voltage	2000 V	Set Divert Valve	Source
		Set Corona	0 nA	Set APCI Heater	0 °C



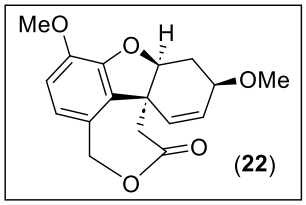


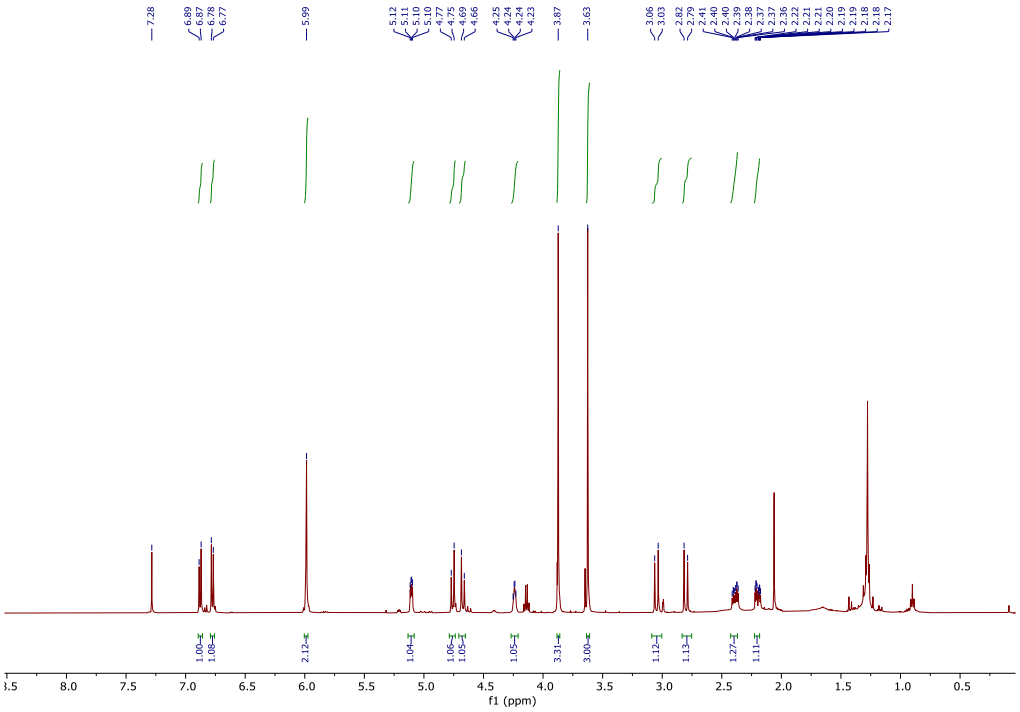


AB_SP_02002.d

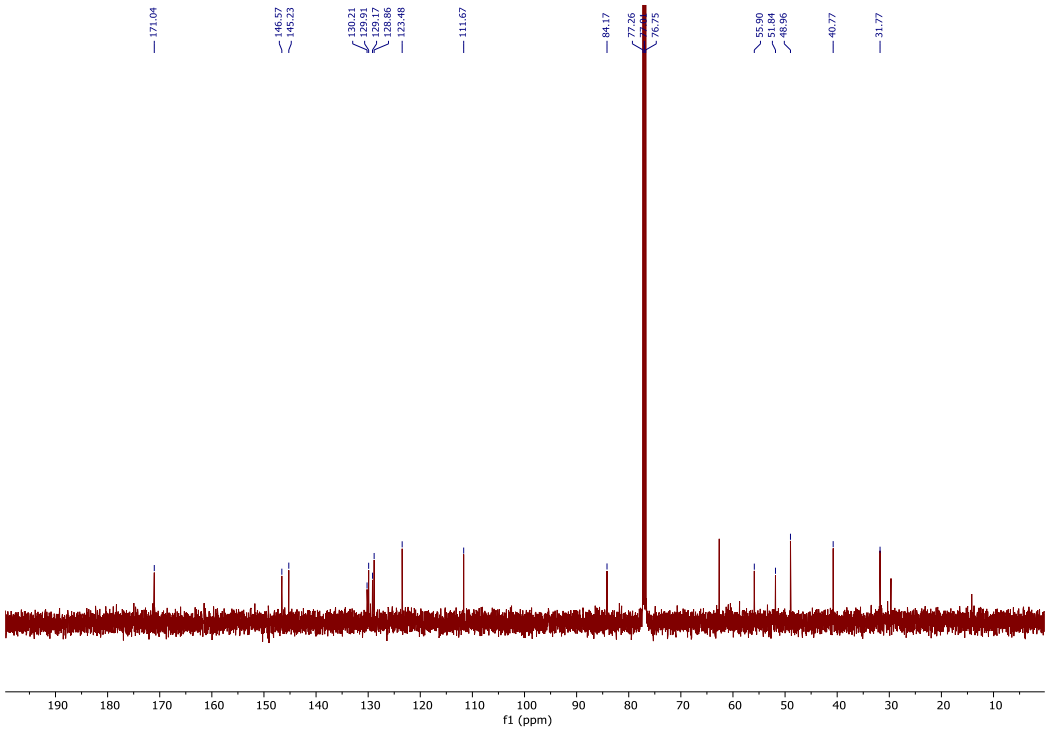
Bruker Compass DataAnalysis 4.1 printed: 9/28/2021 1:01:57 PM by: IISER Kolkata Page 1 of 1

HRMS data of (−)-**6b**

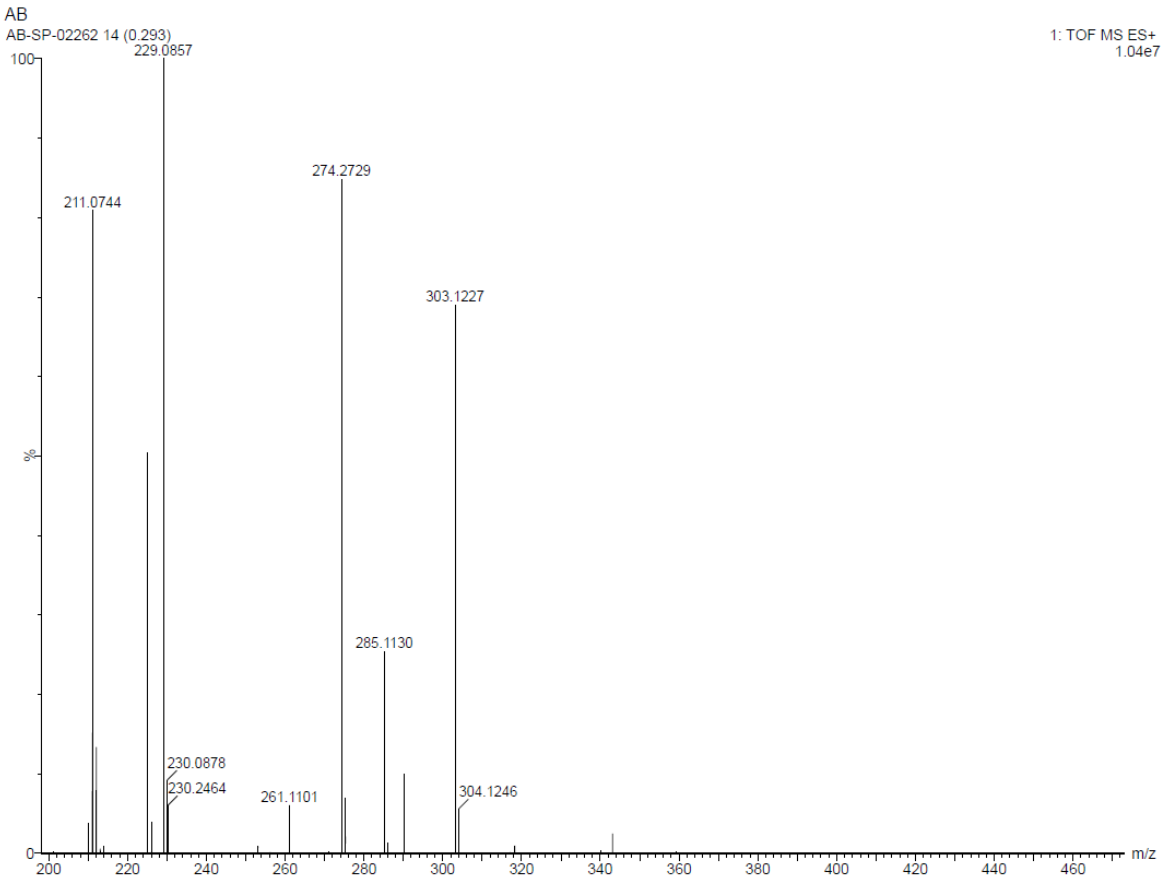




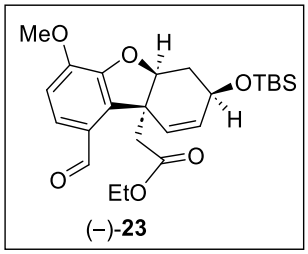
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**22**



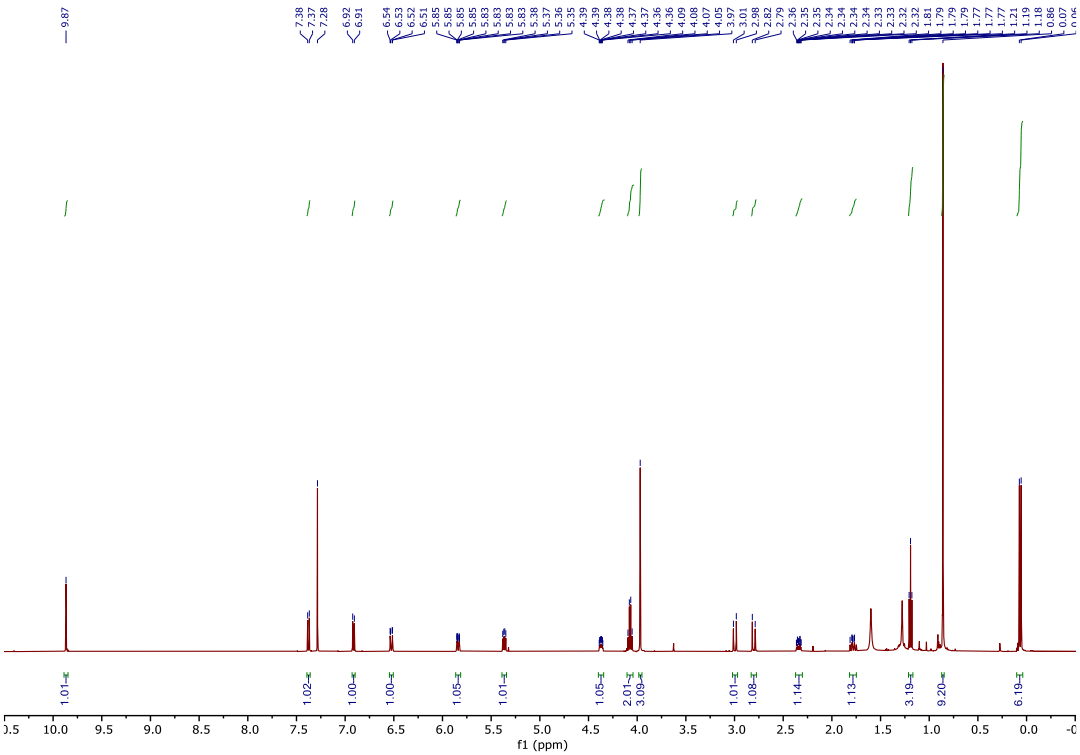
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**22**



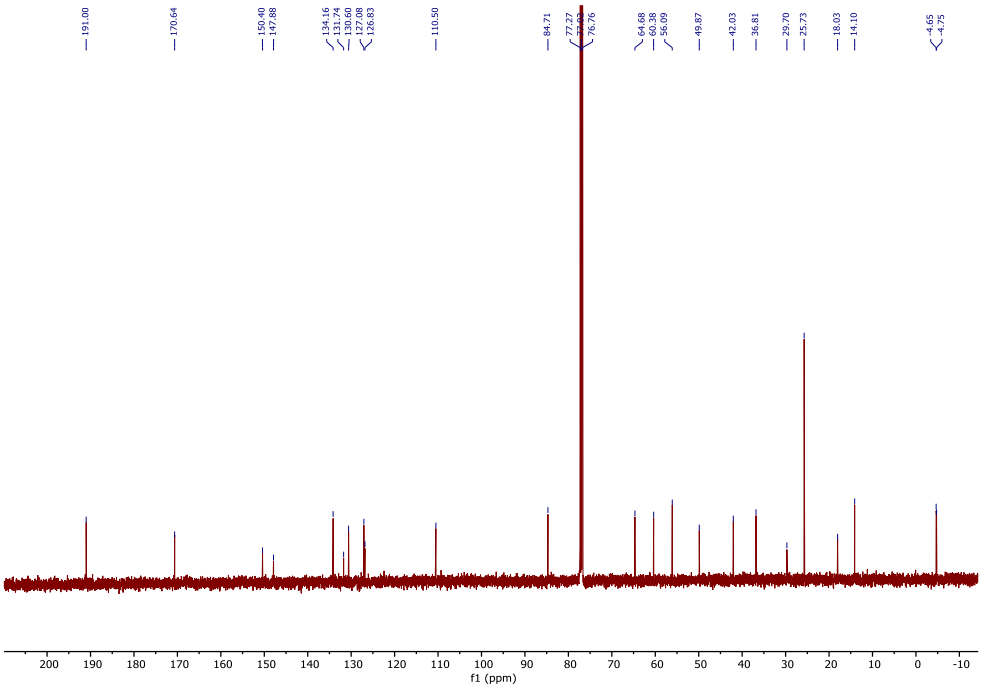
HRMS data of (–)-**22**



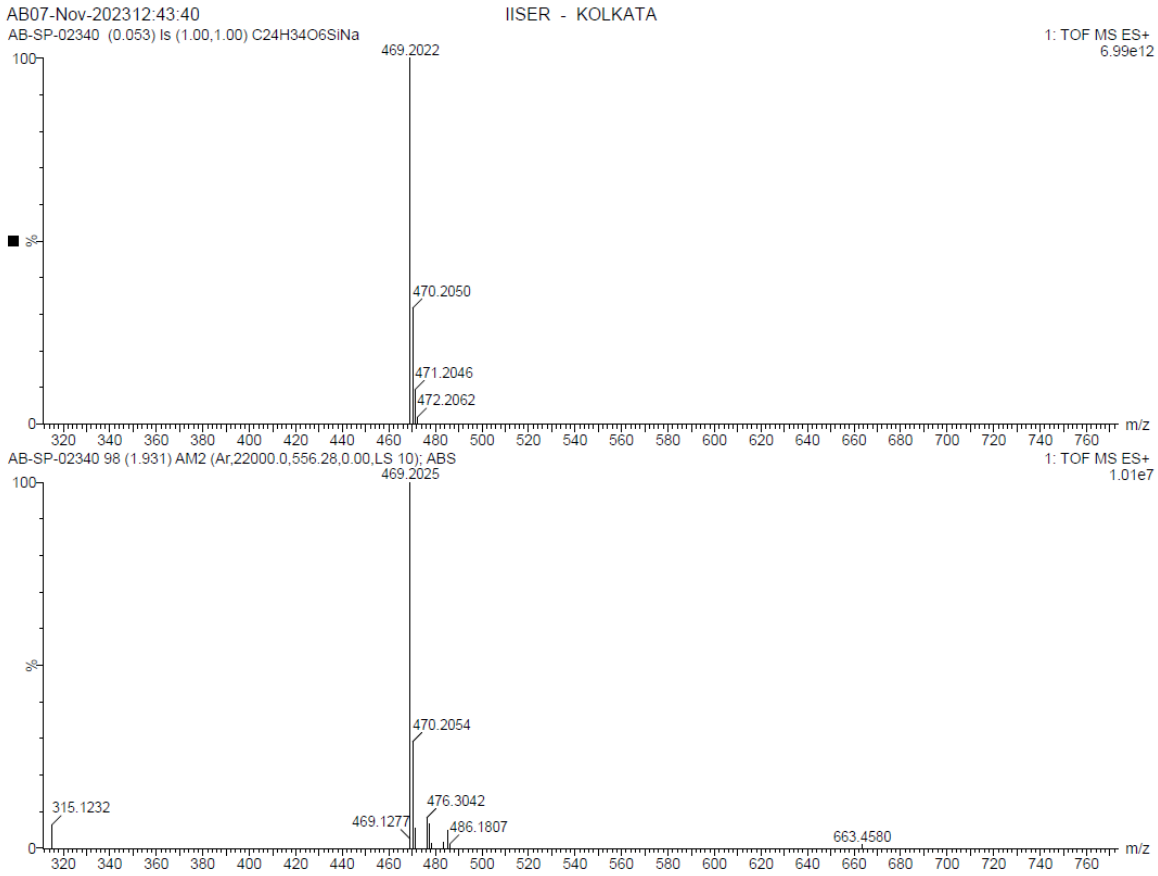
(–)-**23**



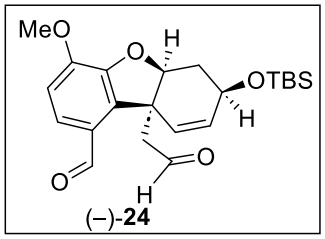
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**23**

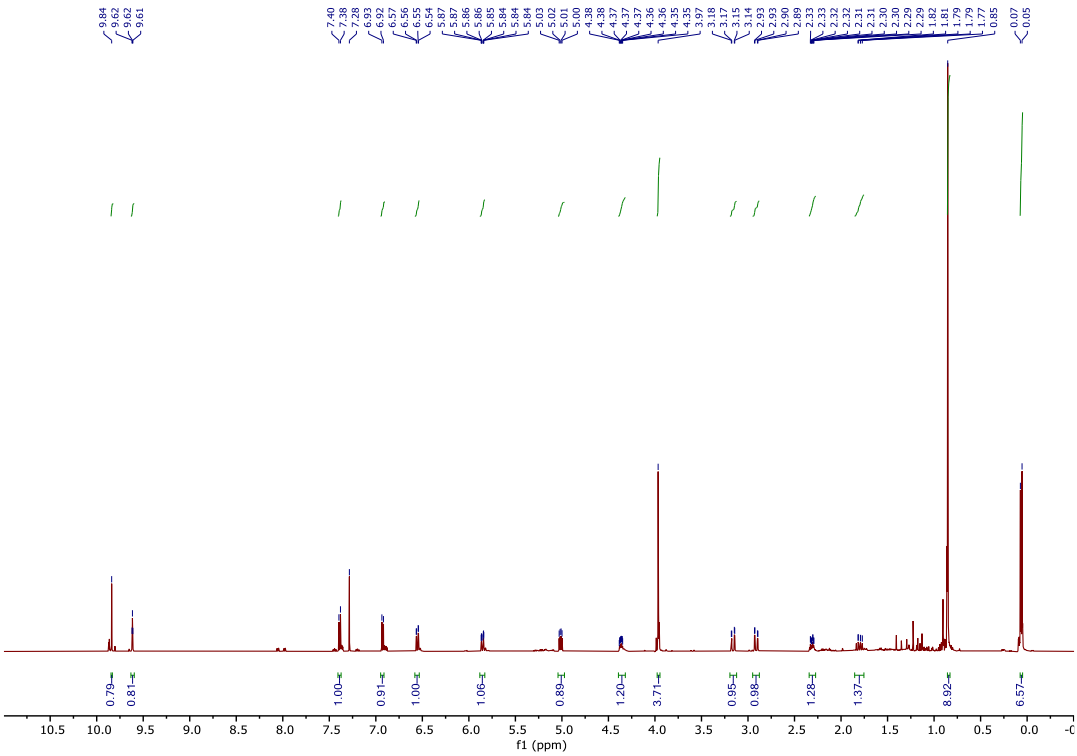


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**23**

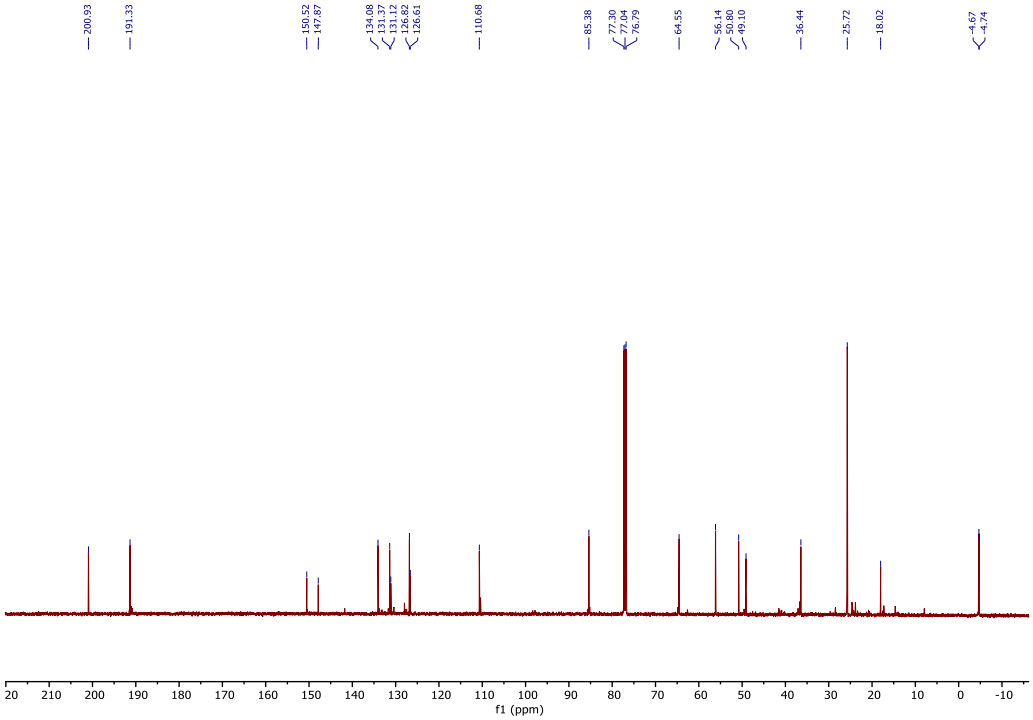


HRMS data of (−)-**23**

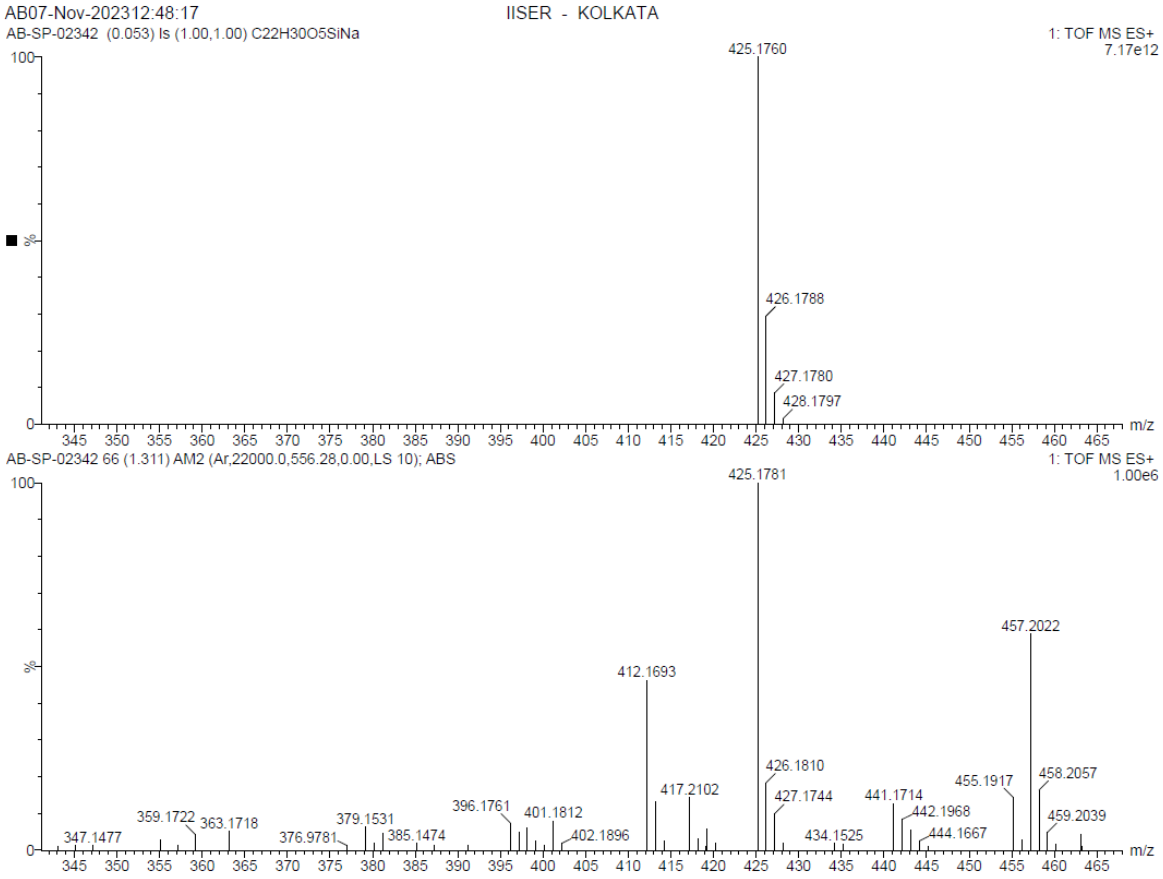




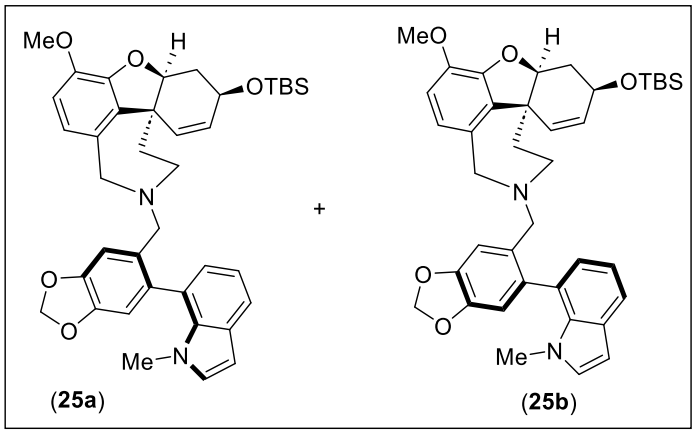
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-**24**

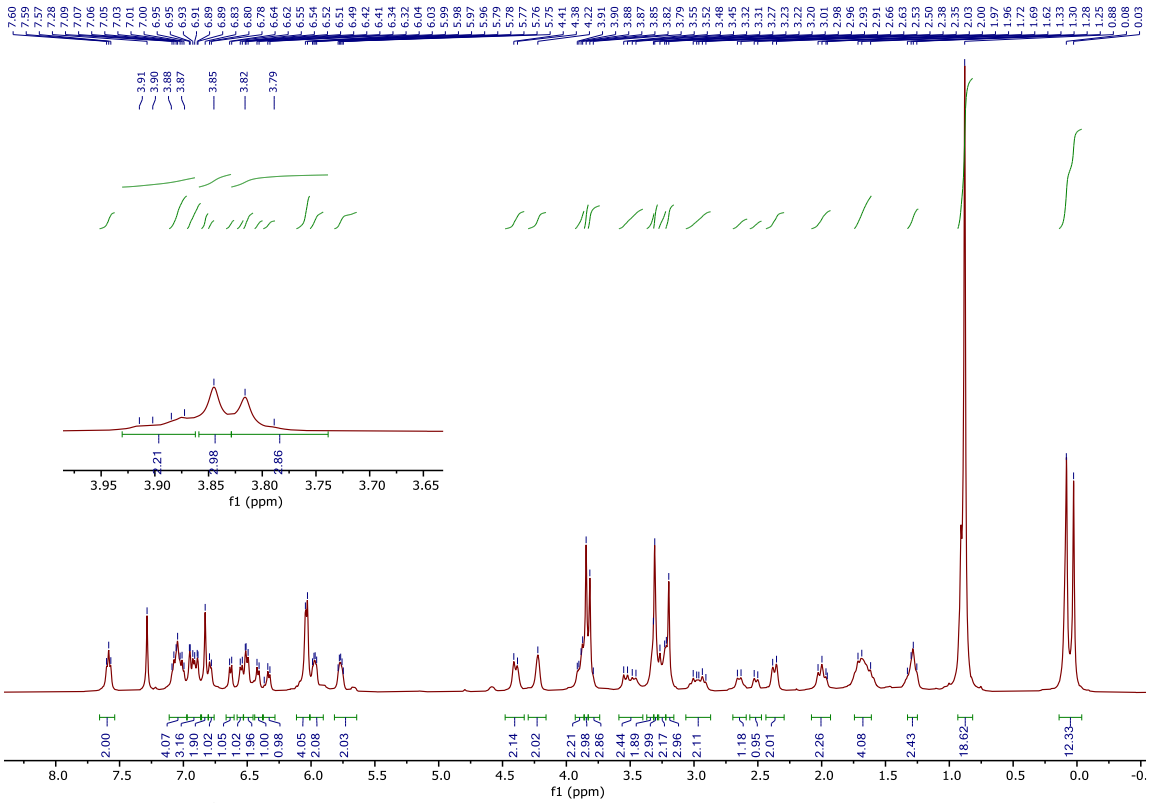


^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-**24**

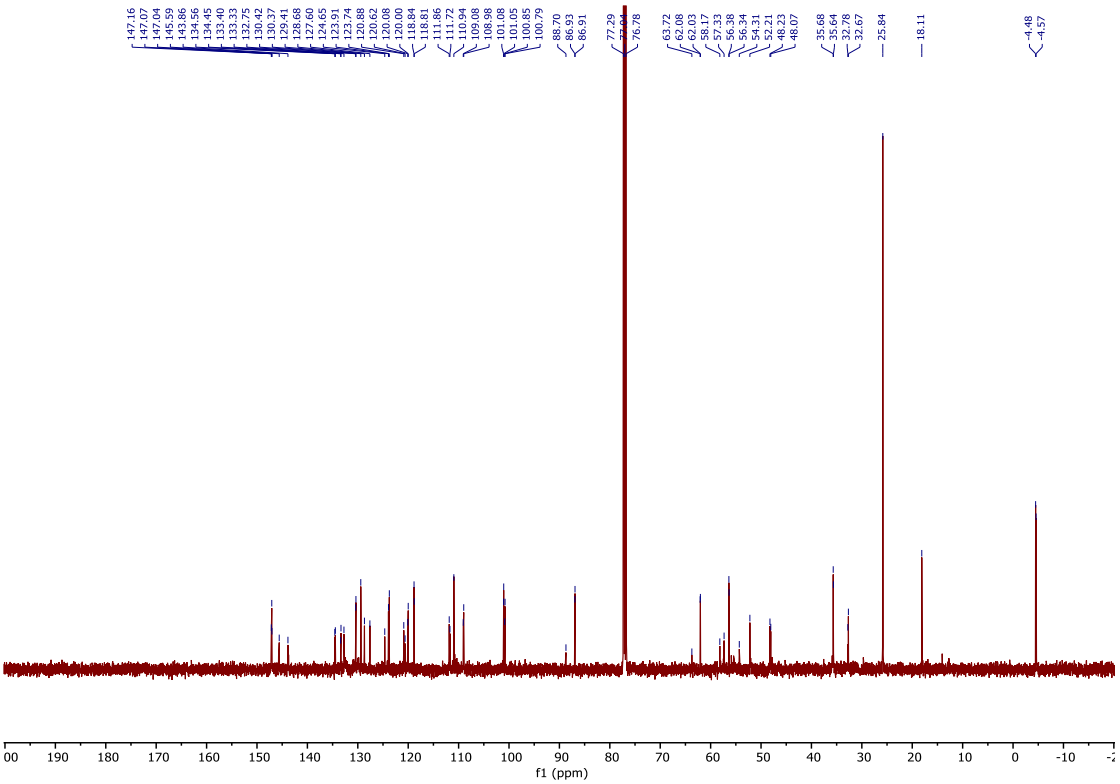


HRMS data of (−)-**24**

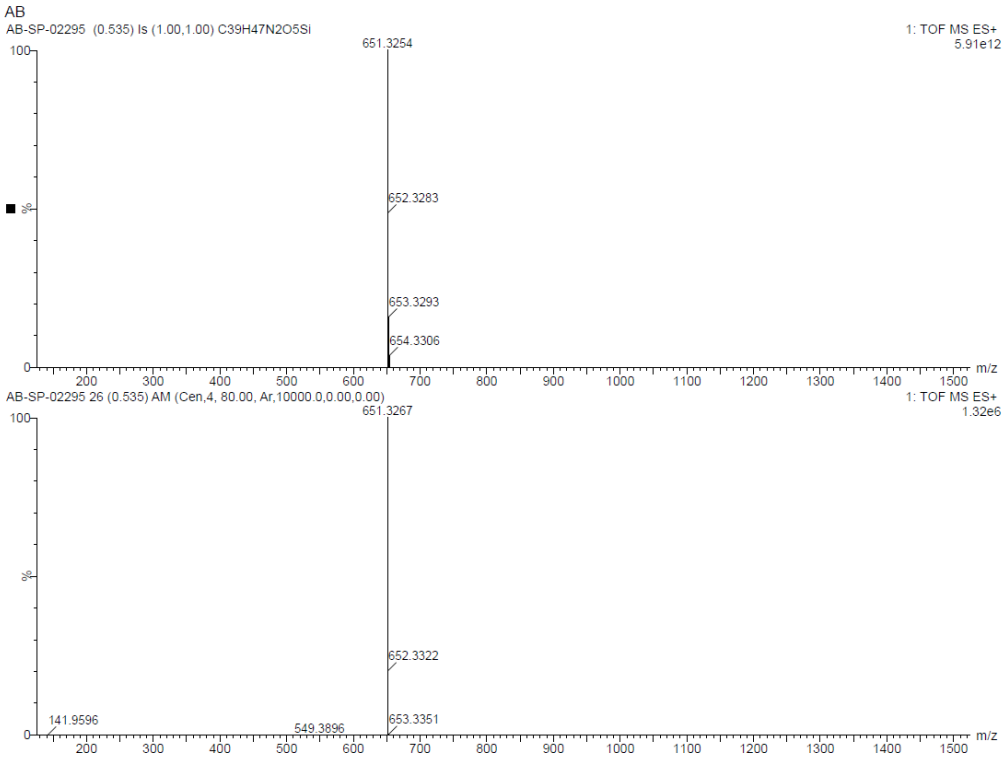




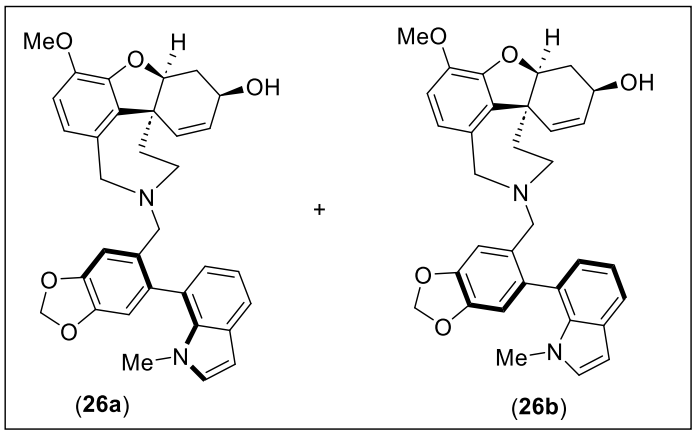
^{1}H NMR (500 MHz, $CDCl_3$) of compound (**25a** and **25b**)



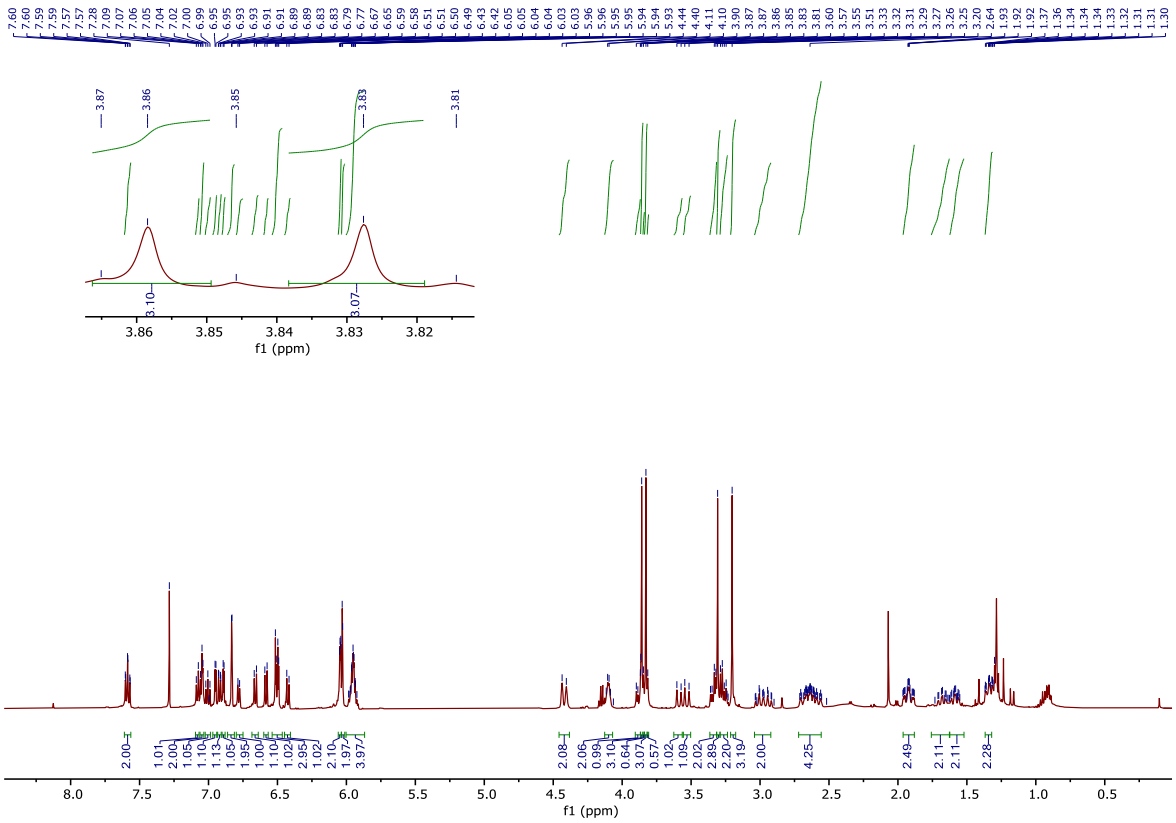
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of Compound (**25a** and **25b**)



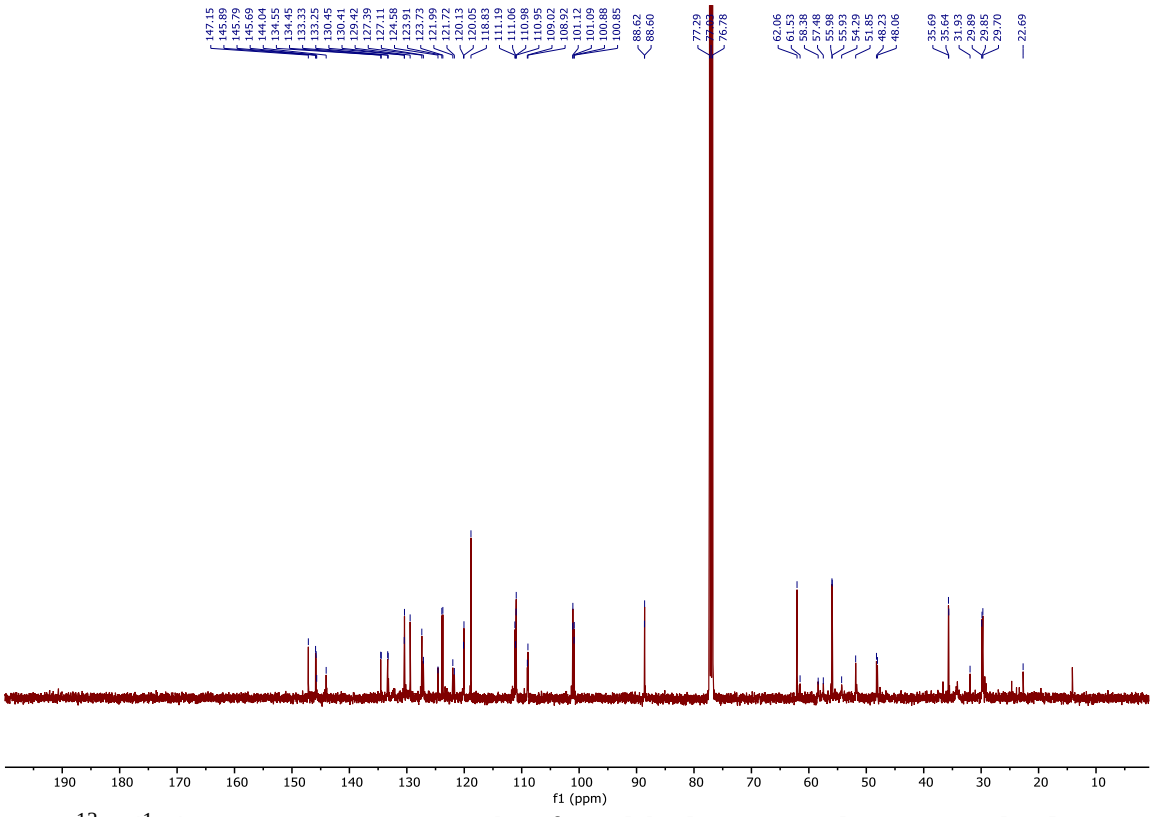
HRMS data of (–)-**25**



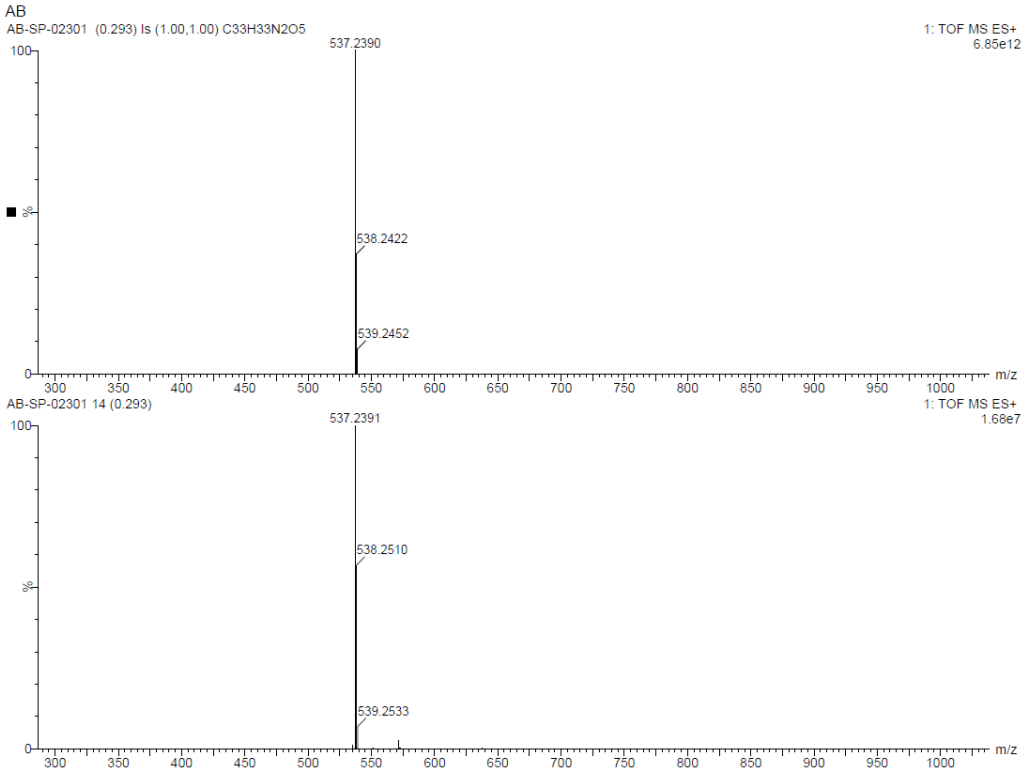
(**26a**) (**26b**)



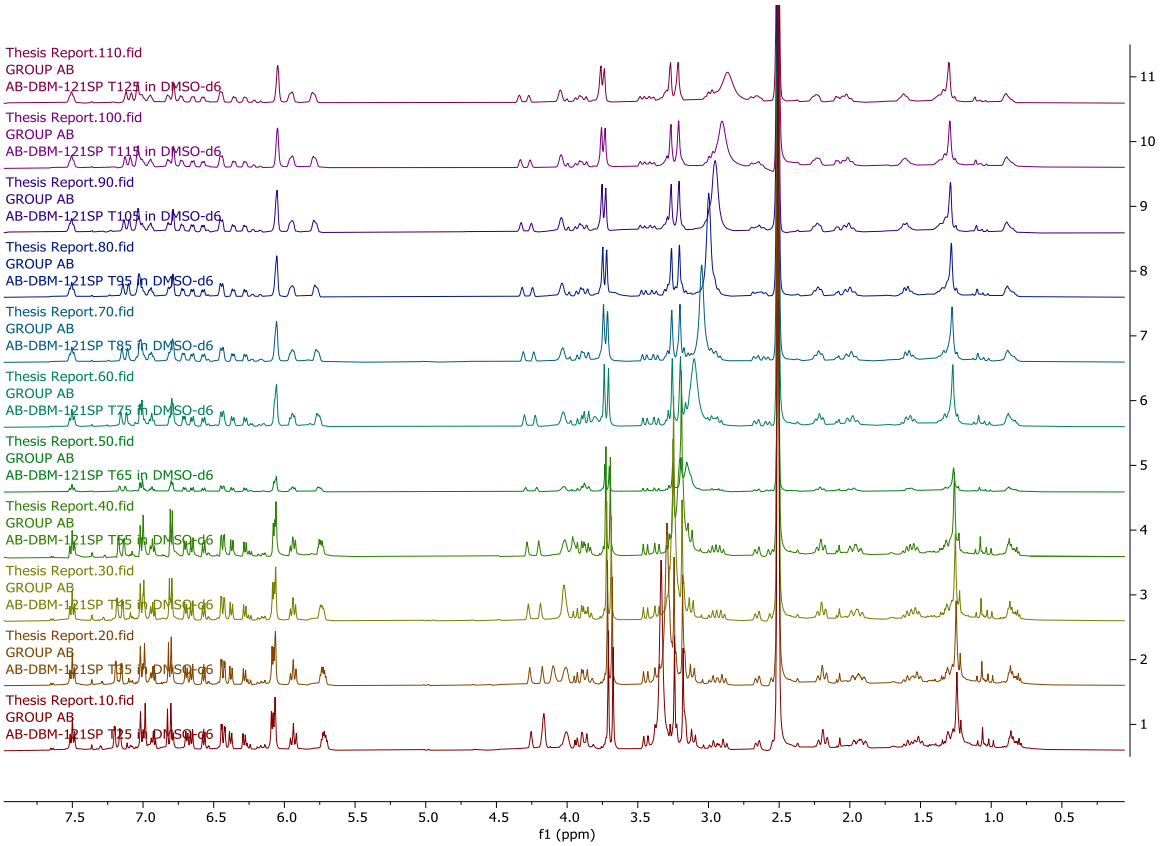
^{1}H NMR (500 MHz, $CDCl_3$) of (–)-dehydro narcipavline (**26a** and **26b**)



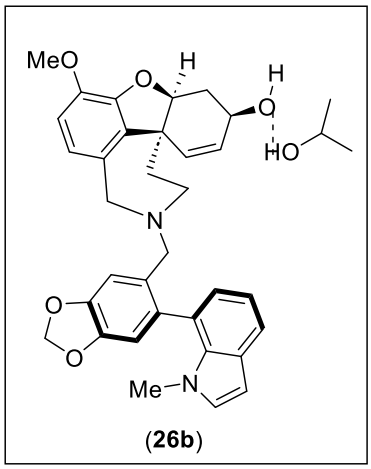
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-dehydro narcipavline (**26a** and **26b**)



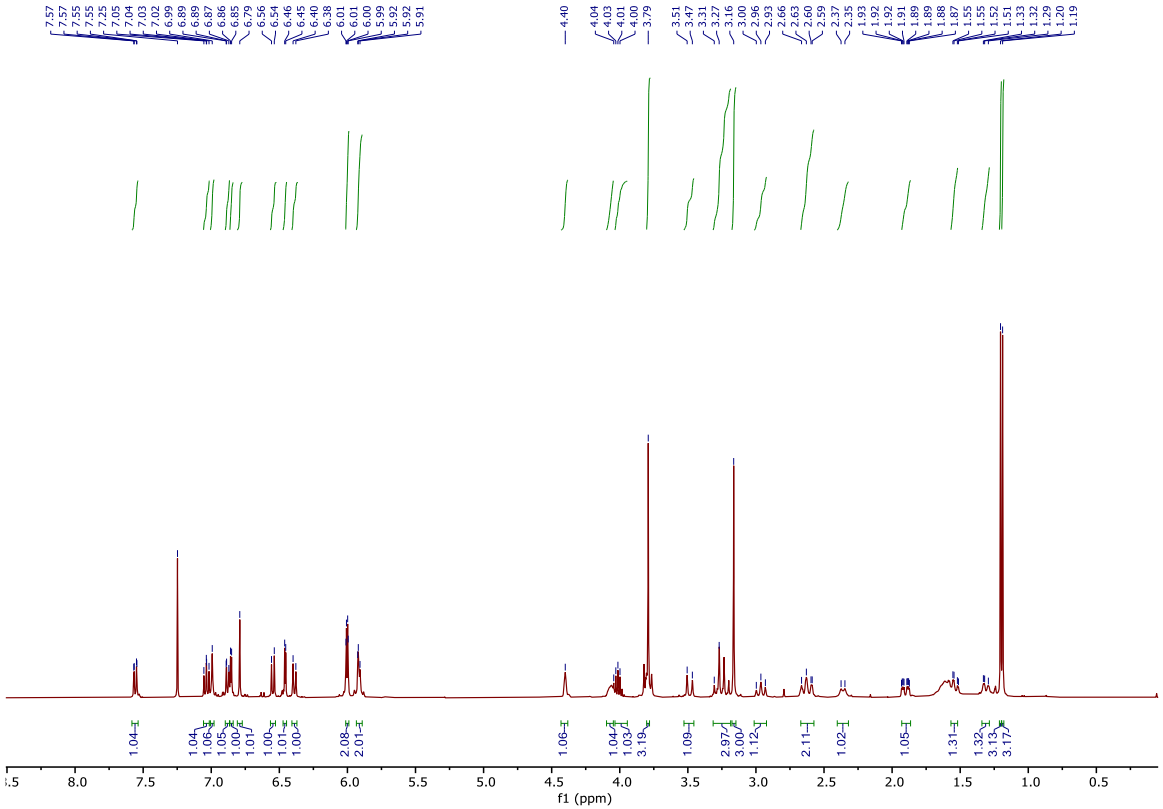
HRMS data of dehydro-Narcipavline (–)-**26**



VT experiment spectrum of dehydronarcipavline [**26**] at 298k, 308k, 318k, 328k, 338k, 348k, 358k, 368k, 378k, 388k, 398k in DMSO-d_6 solvent (500 MHz)

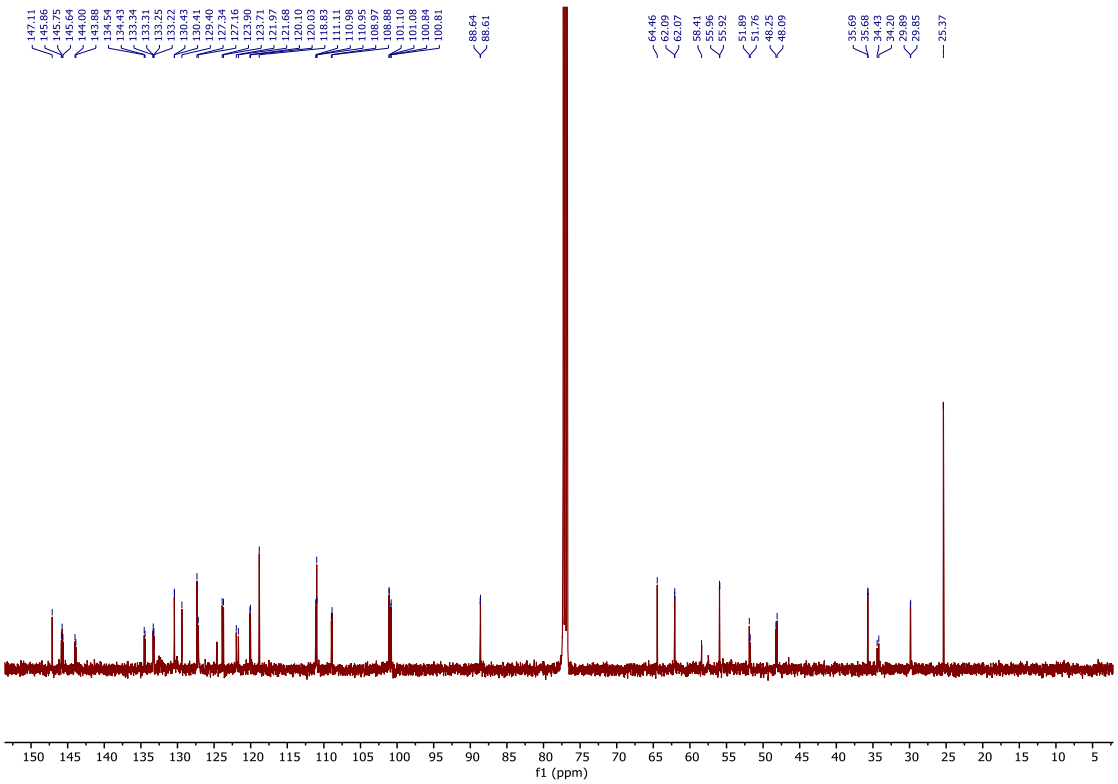


(**26b**)

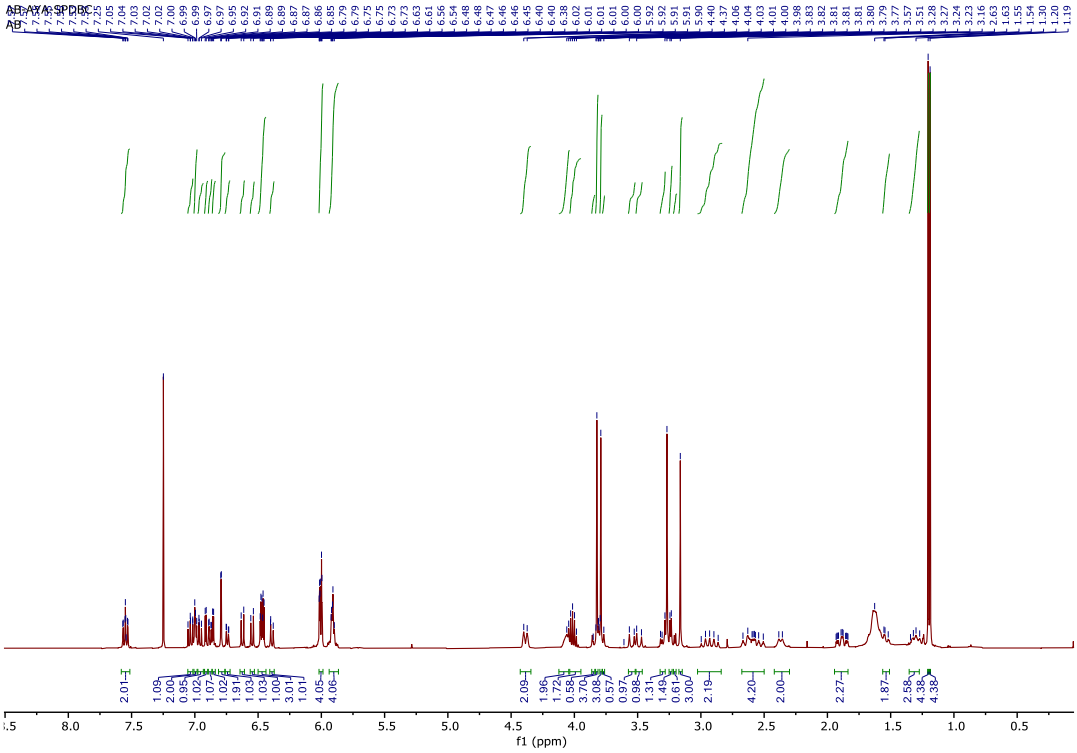


^{1}H NMR (500 MHz, $CDCl_3$) of (±)-dehydro narcipavline (**26b**) [Racemic crystal]

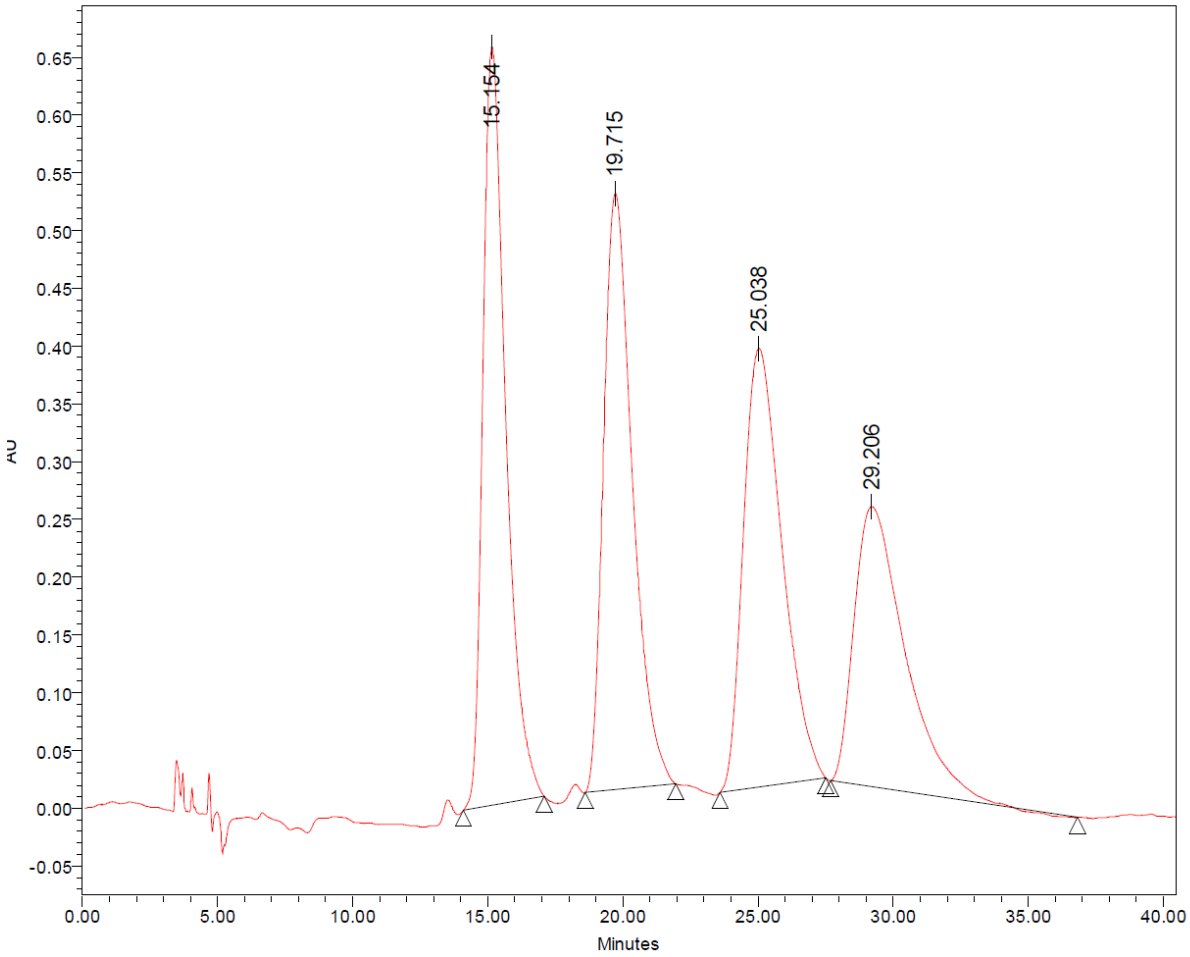
After 24 h



^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-dehydro narcipavline (**26b**) after 24 h of recording the ^{1}H NMR (500 MHz, $CDCl_3$) [Racemic crystal]



^{1}H NMR spectra of (±)-dehydro narcipavline (**26b**) after 24 h in $CDCl_3$ showed ~1:1 diastereomeric mixtures



Sample Name: AB-SP-02DEHNPV-OD-H-30-01-RAC1; Date Acquired: 05-10-2024 15:18:03 IST; Vial: 1:A,1
Injection: 1

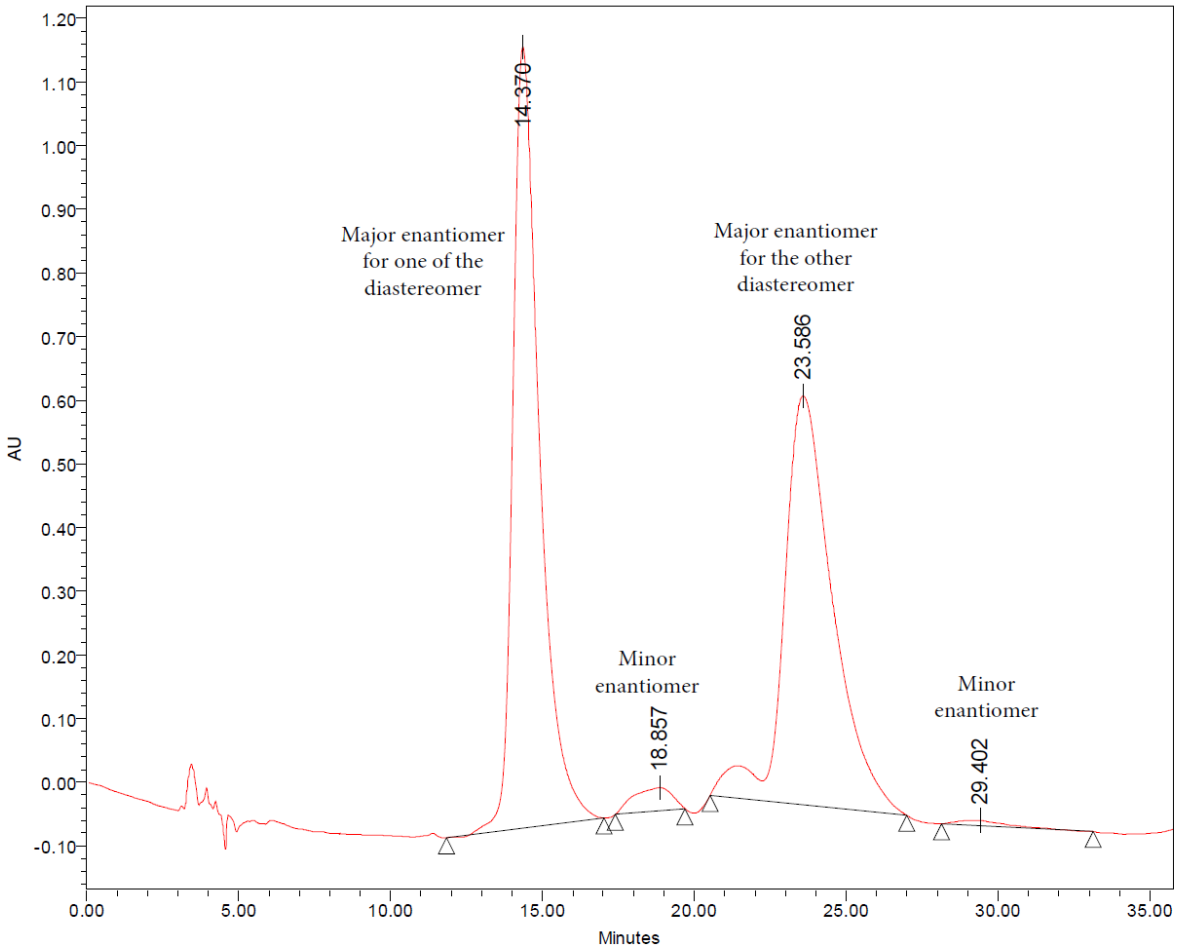
Peak Summary with Statistics
Name:

	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02DEHNPV-OD-H-30-01-RAC1	1:A,1	1	15.154	38594942	26.31	656546
2	AB-SP-02DEHNPV-OD-H-30-01-RAC1	1:A,1	1	29.206	32092897	21.88	242586
3	AB-SP-02DEHNPV-OD-H-30-01-RAC1	1:A,1	1	25.038	37554722	25.60	379346
4	AB-SP-02DEHNPV-OD-H-30-01-RAC1	1:A,1	1	19.715	38440678	26.21	515965

Reported by User: System
Report Method: Peak Summary Report
Report Method ID: 2585
Page: 1 of 2

Project Name: AB Research Group
Date Printed:
05-10-2024
16:10:28 Asia/Kolkata

HPLC data of (±)-**26** (diastereomeric mixtures)



Sample Name: AB-SP-02dhnpv_OD-H-30-01-CHI_RE; Date Acquired: 07-10-2024 18:31:31 IST; Vial: 1:A,1; Injection: 1

Peak Summary with Statistics
Name:

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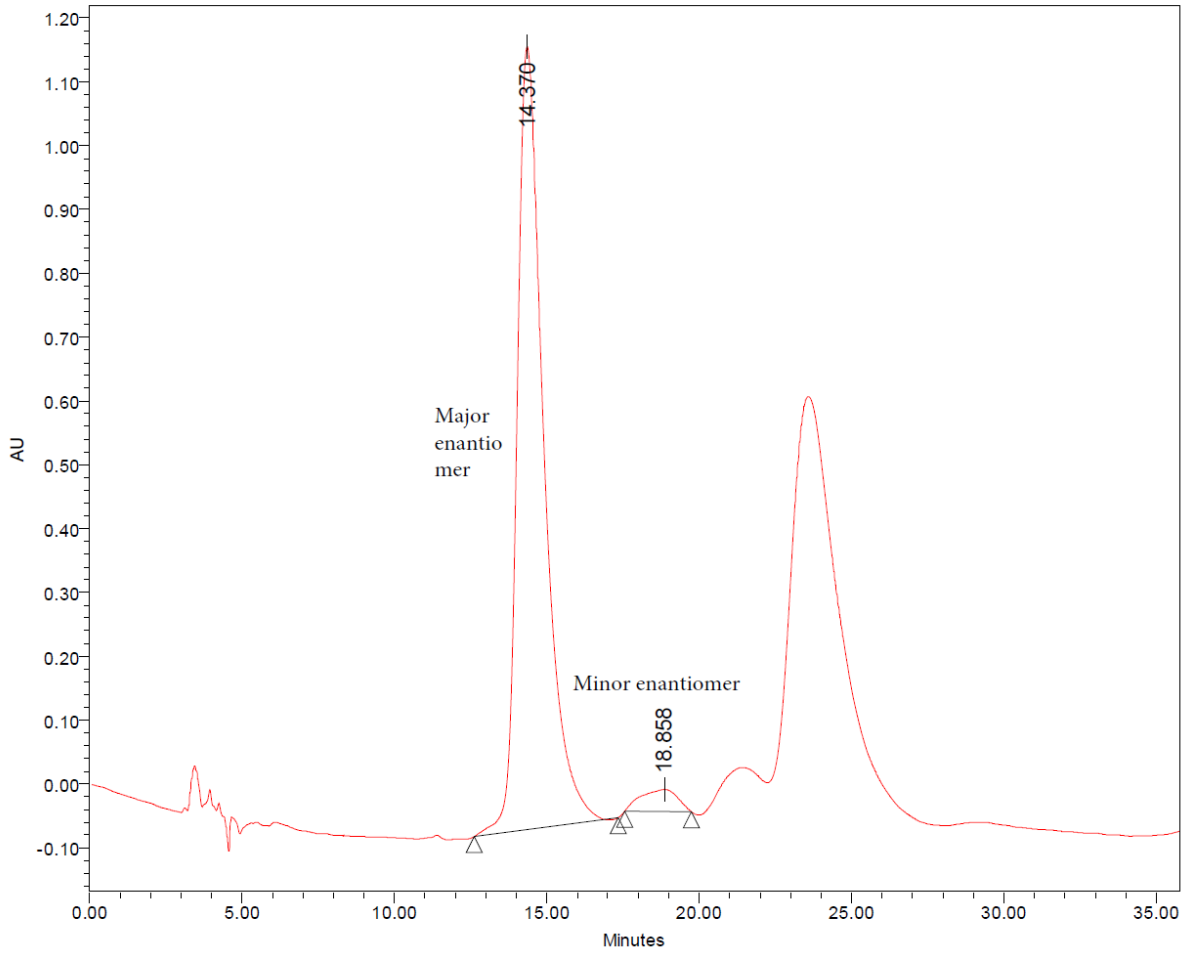
1	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	14.370	75012959	49.46	1227625
2	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	29.402	982372	0.65	8619
3	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	23.586	72394760	47.73	642156
4	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	18.857	3283296	2.16	36603

Reported by User: System
Report Method: Peak Summary Report
Report Method ID: 2585
Page: 1 of 2

Project Name: AB Research Group
Date Printed:
07-10-2024
19:15:43 Asia/Kolkata

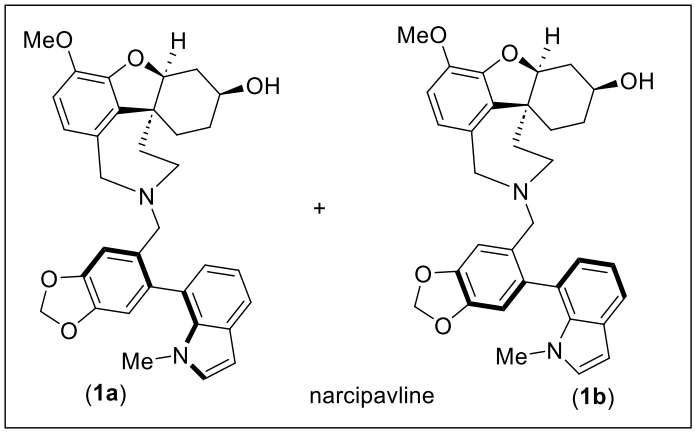
HPLC data of (–)-**26** (diastereomeric mixtures)

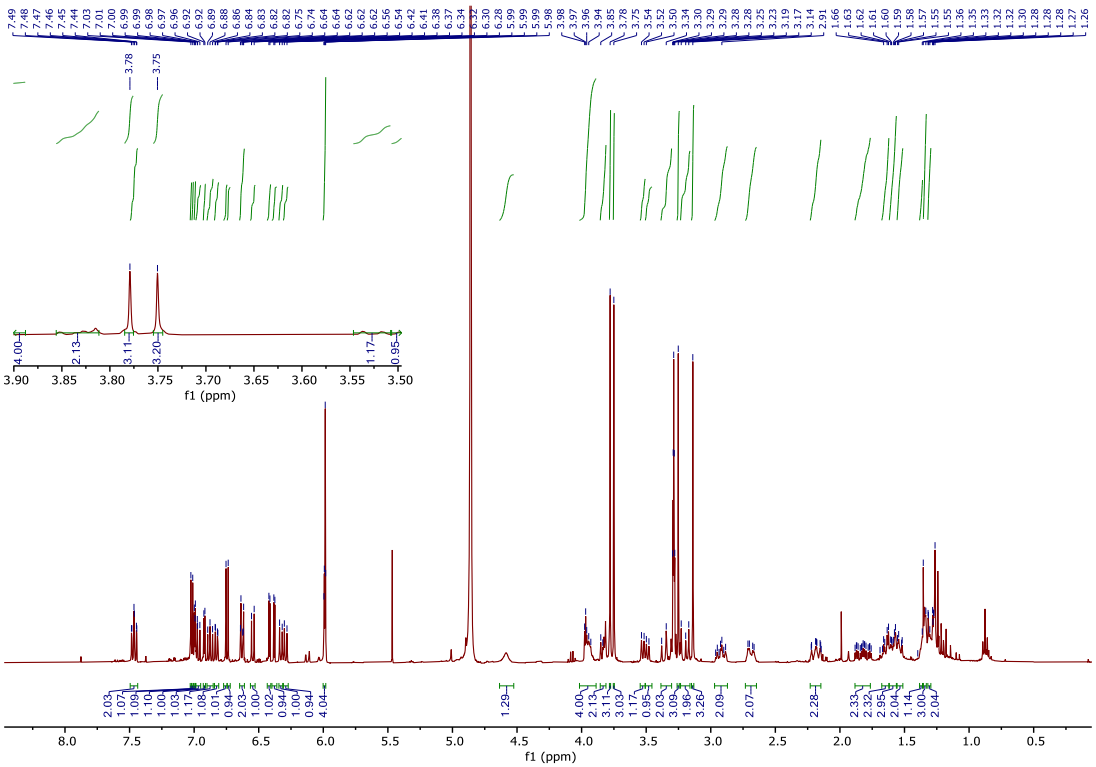


Peak Summary with Statistics
Name:

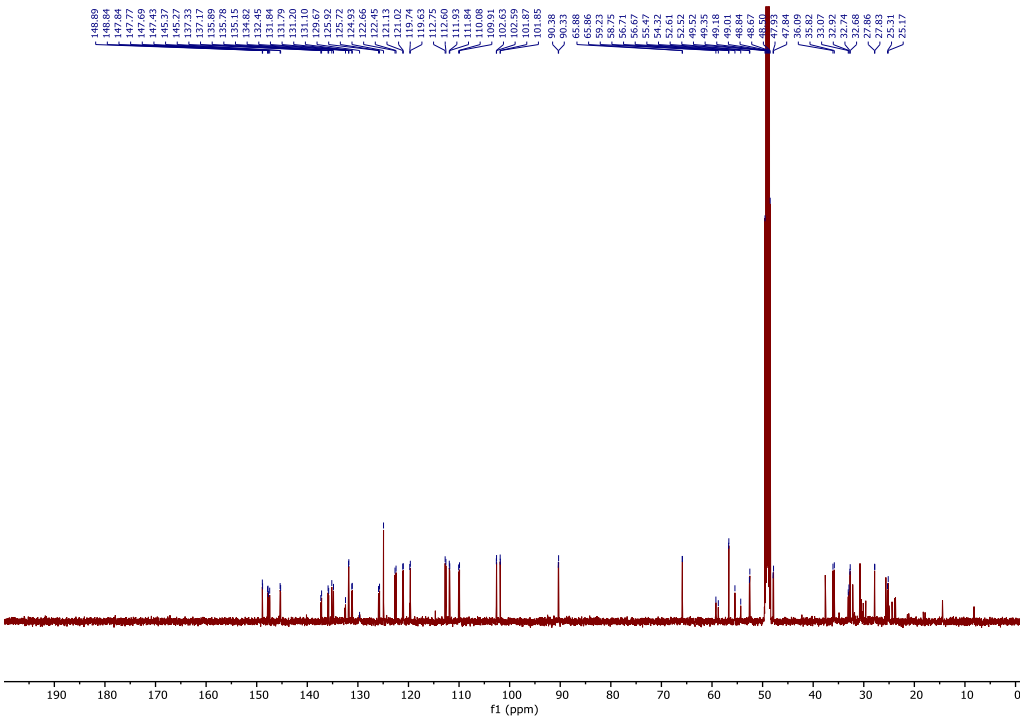
	Sample Name	Vial	Inj	Retention Time (min)	Area	% Area	Height
1	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	18.858	2896381	3.73	34807
2	AB-SP-02dhnpv_OD-H-30-01-CHI_RE	1:A,1	1	14.370	74739034	96.27	1226782
Mean				16.614			
Std. Dev.				3.173			

HPLC data of (–)-**26** (diastereomeric mixtures) which shows the enantiopurity (93% ee) of the atropodiastreomer

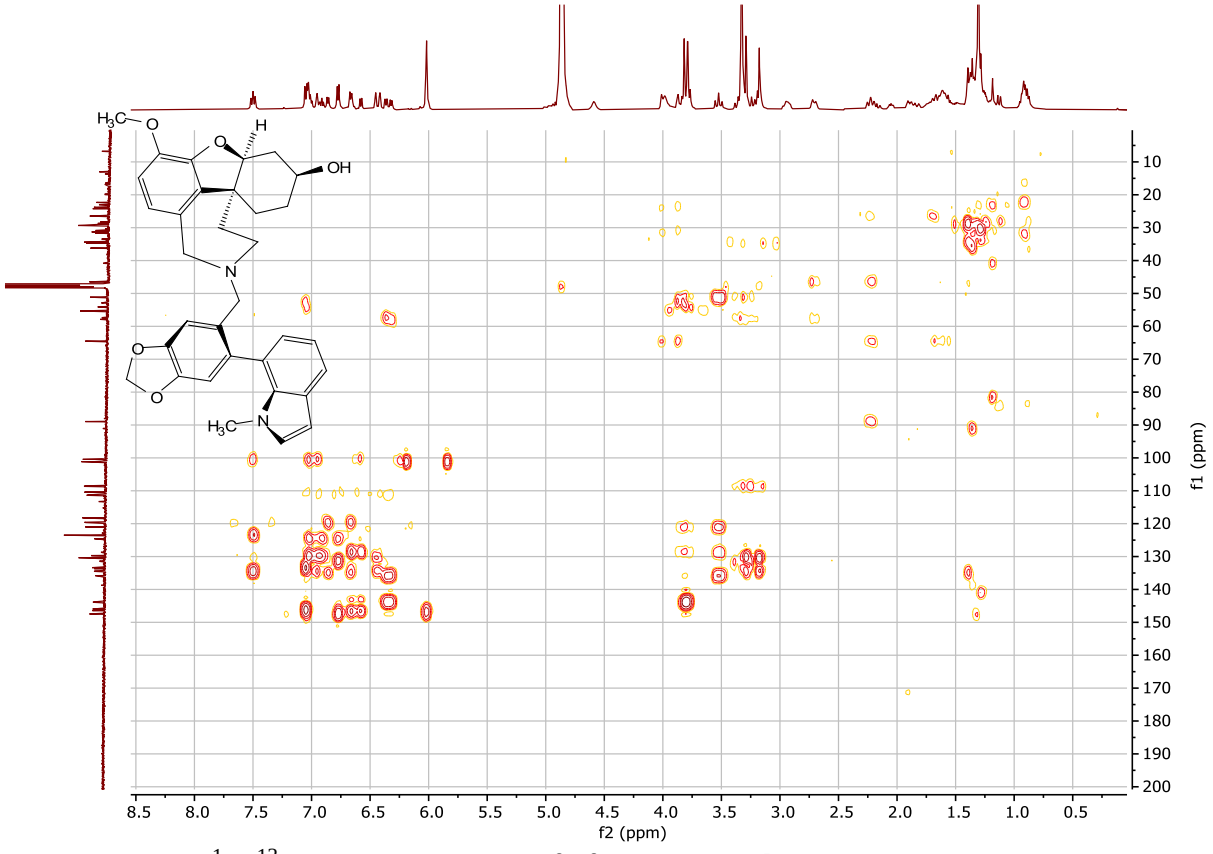




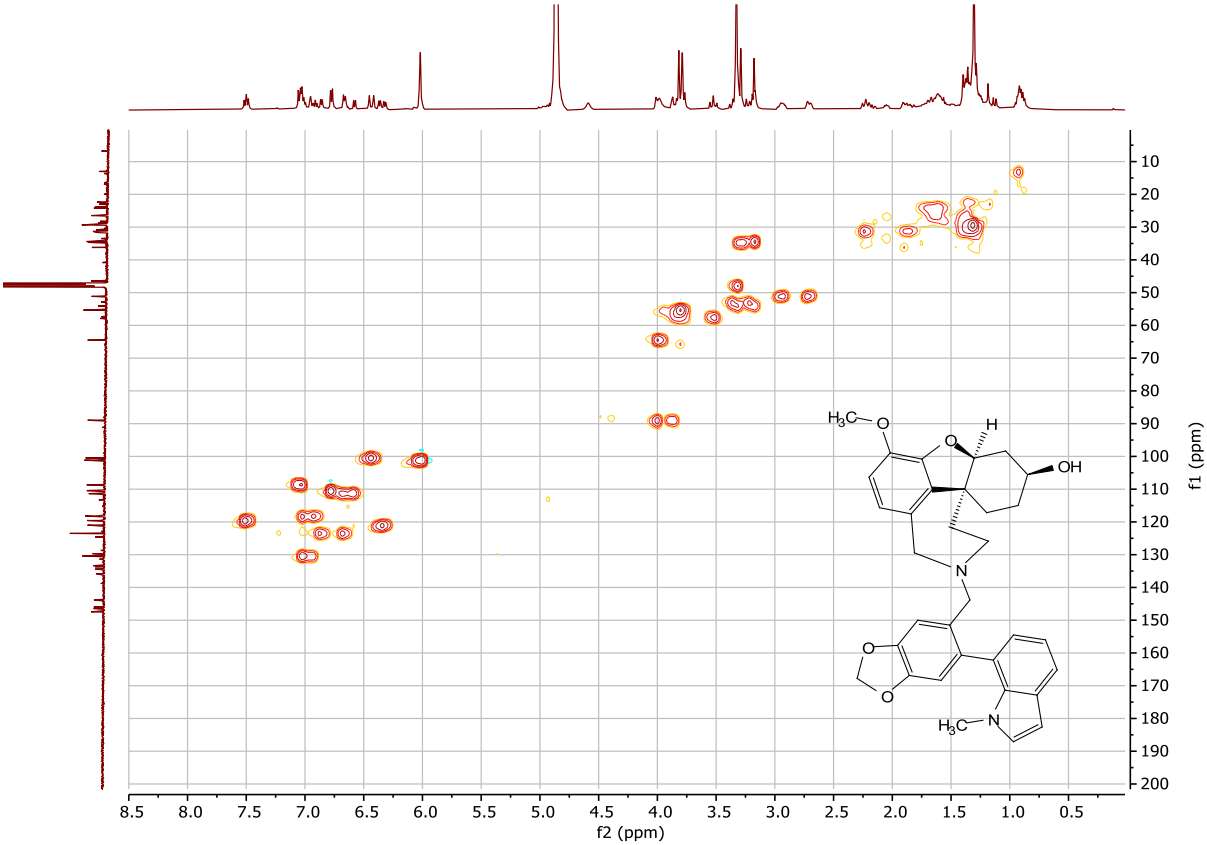
^{1}H NMR (400 MHz, CD_3OD) of (–)-narcipavline (**1a** and **1b**)



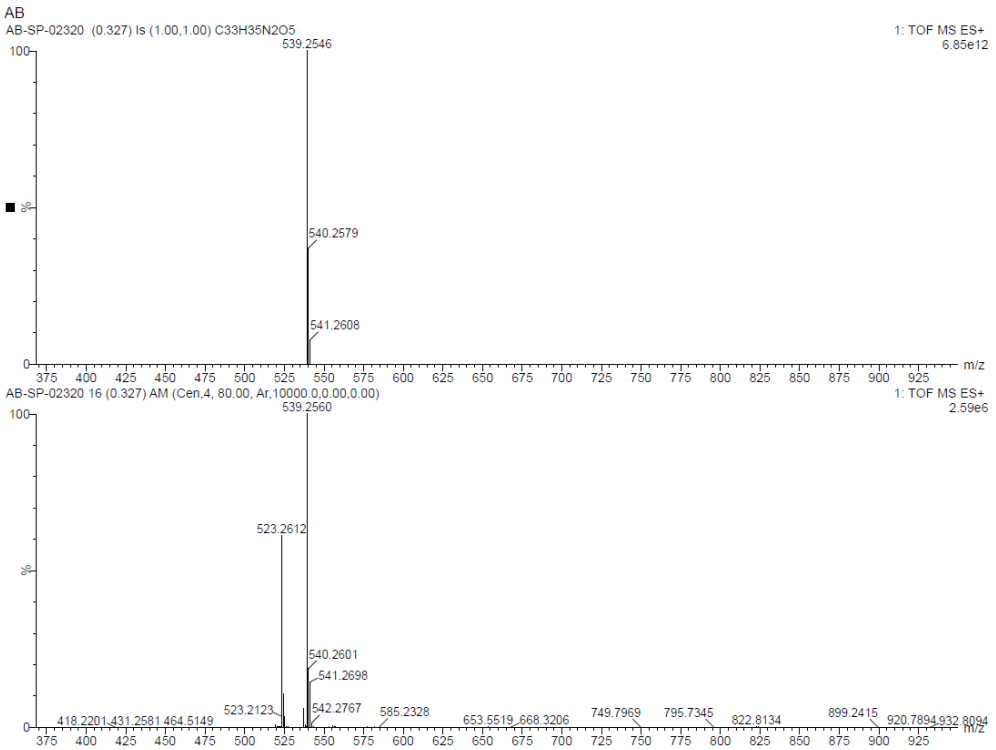
^{13}C {^{1}H} NMR (126 MHz, CD_3OD) of (–)-narcipavline (**1a** and **1b**)



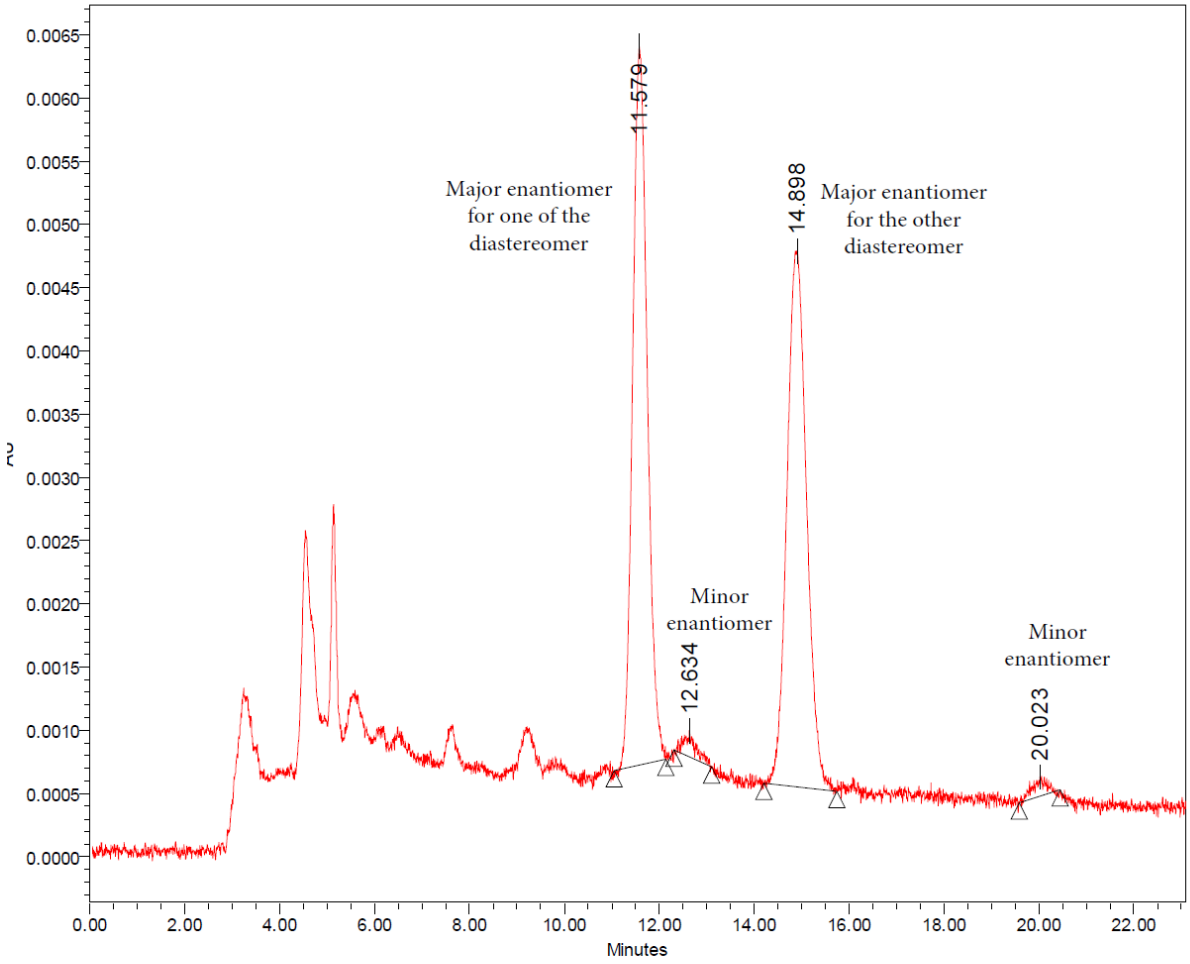
^{1}H-^{13}C HMBC spectrum of of (–)-narcipavline (**1**) in CD_3OD



^{1}H-^{13}C HSQC spectrum of of (–)-narcipavline (**1**) in CD_3OD



HRMS data of (–)-Narcipavline (**1**)



Sample Name: AB_SP_NPV_OD-H_40_01_DR_CHI; Date Acquired: 18-05-2024 19:48:10 IST; Vial: 1
Injection: 2

Peak Summary with Statistics
Name:

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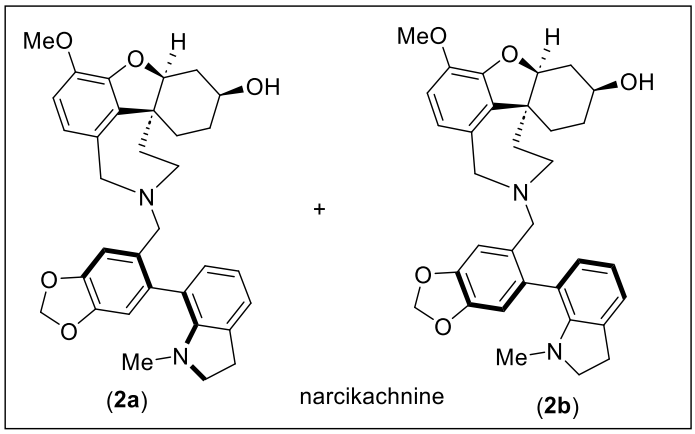
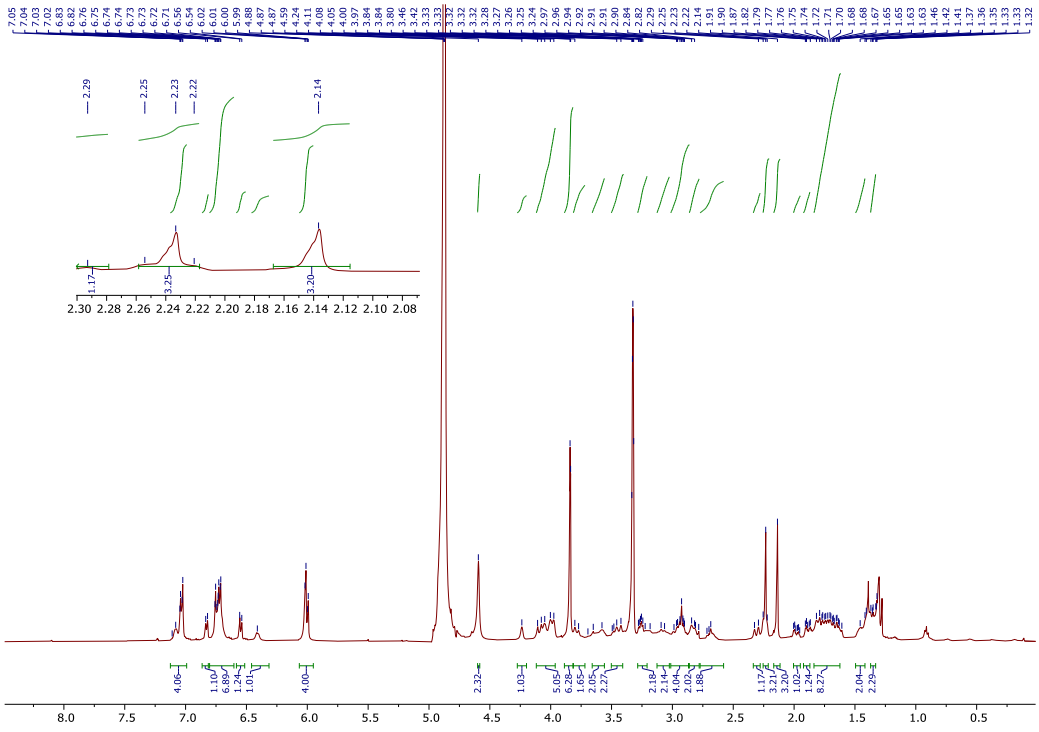
3	AB_SP_NPV_OD-H_40_01_DR_CHI	1	2	14.898	122419	48.60	4238
4	AB_SP_NPV_OD-H_40_01_DR_CHI	1	2	12.634	3623	1.44	210

Reported by User: System
Report Method: Peak Summary Report
Report Method ID 7327
Page: 1 of 2

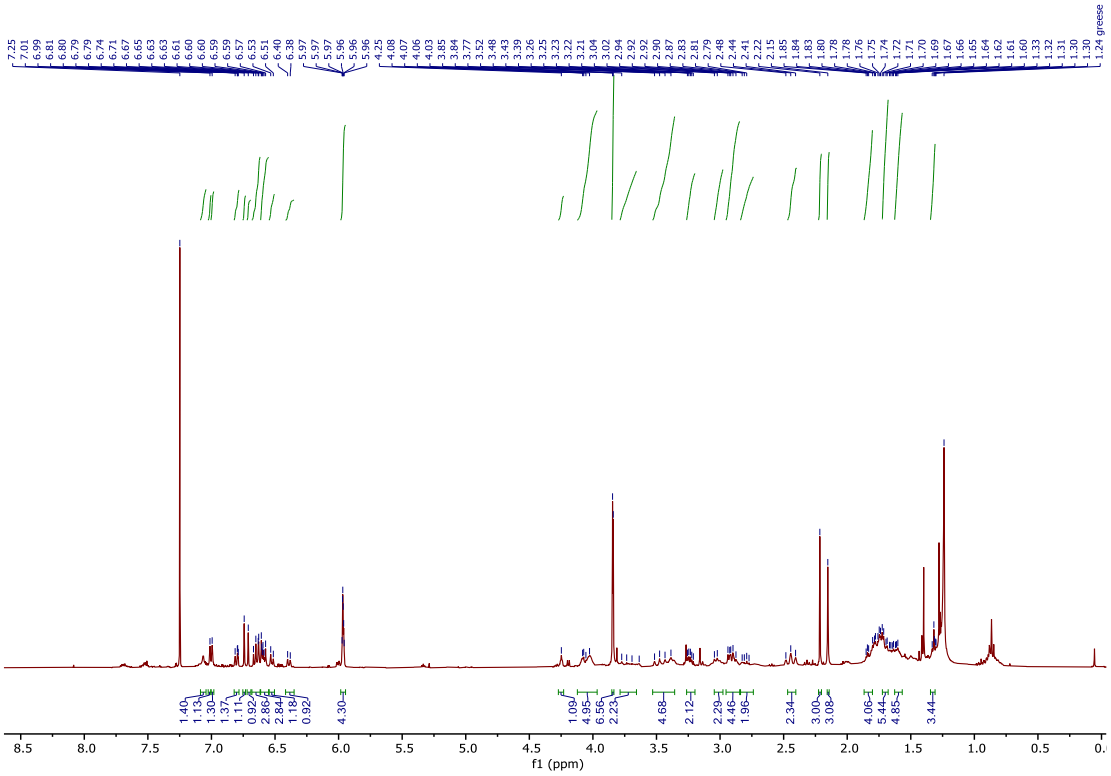
Project Name: AB Research Group
Date Printed:
07-10-2024
23:29:54 Asia/Calcutta

HPLC data of (–)-narcipavline (**1**)

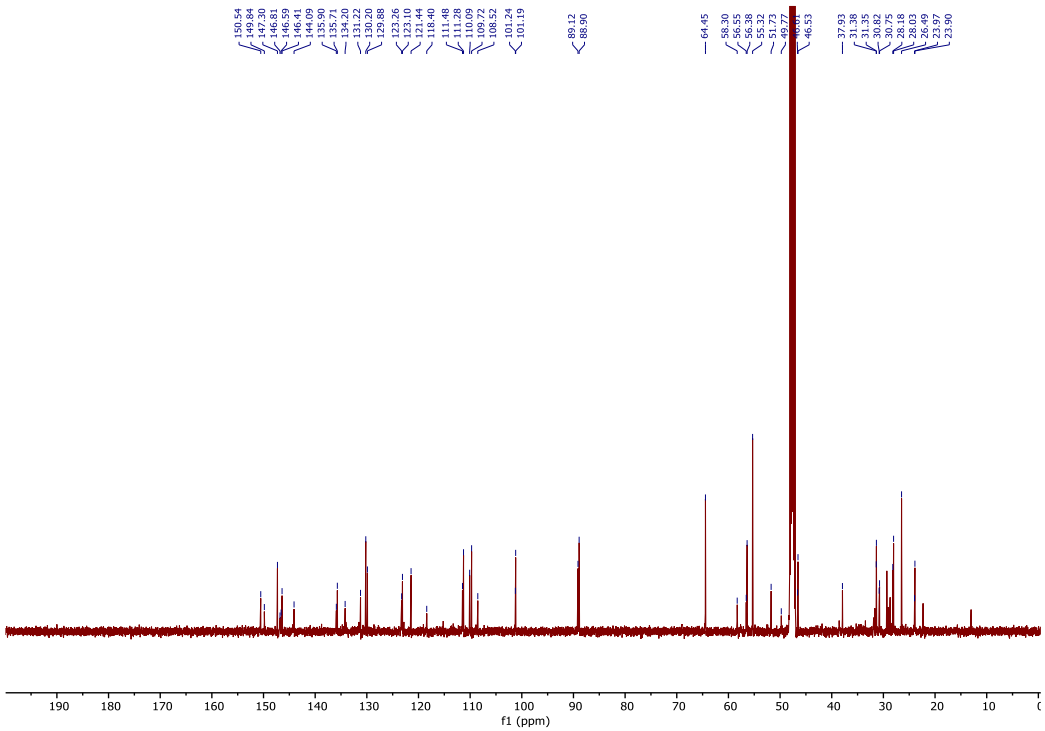




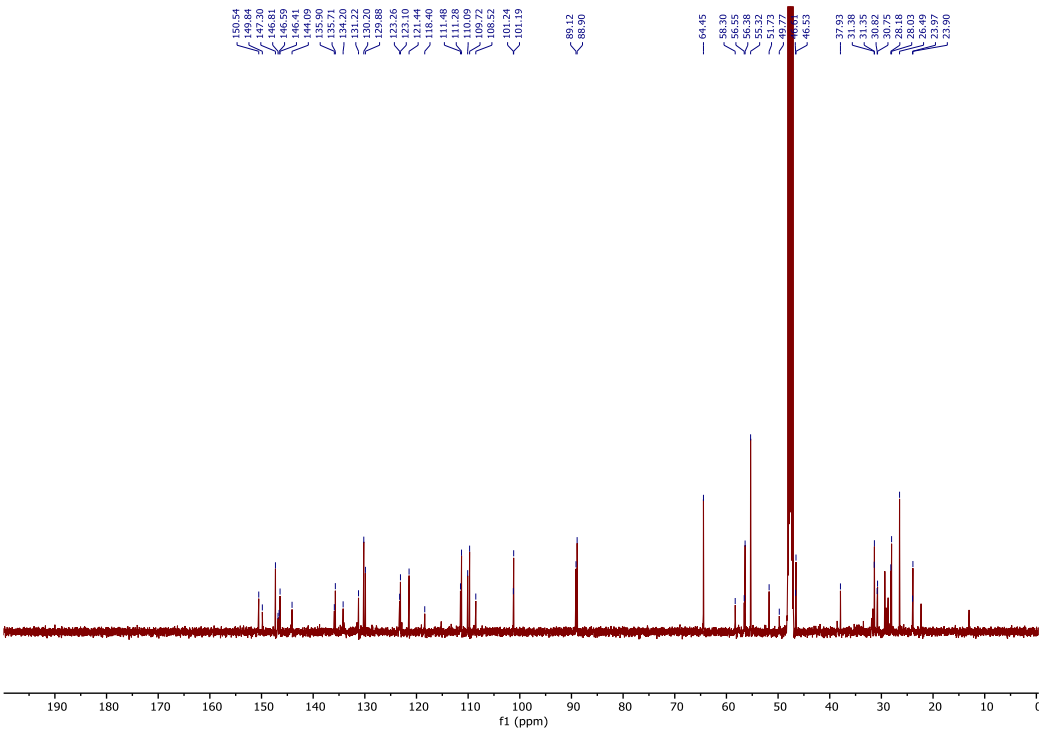
^{1}H NMR (500 MHz, CD_3OD) of (–)-narcikachnine (1:1 dr of **2a** and **2b**)



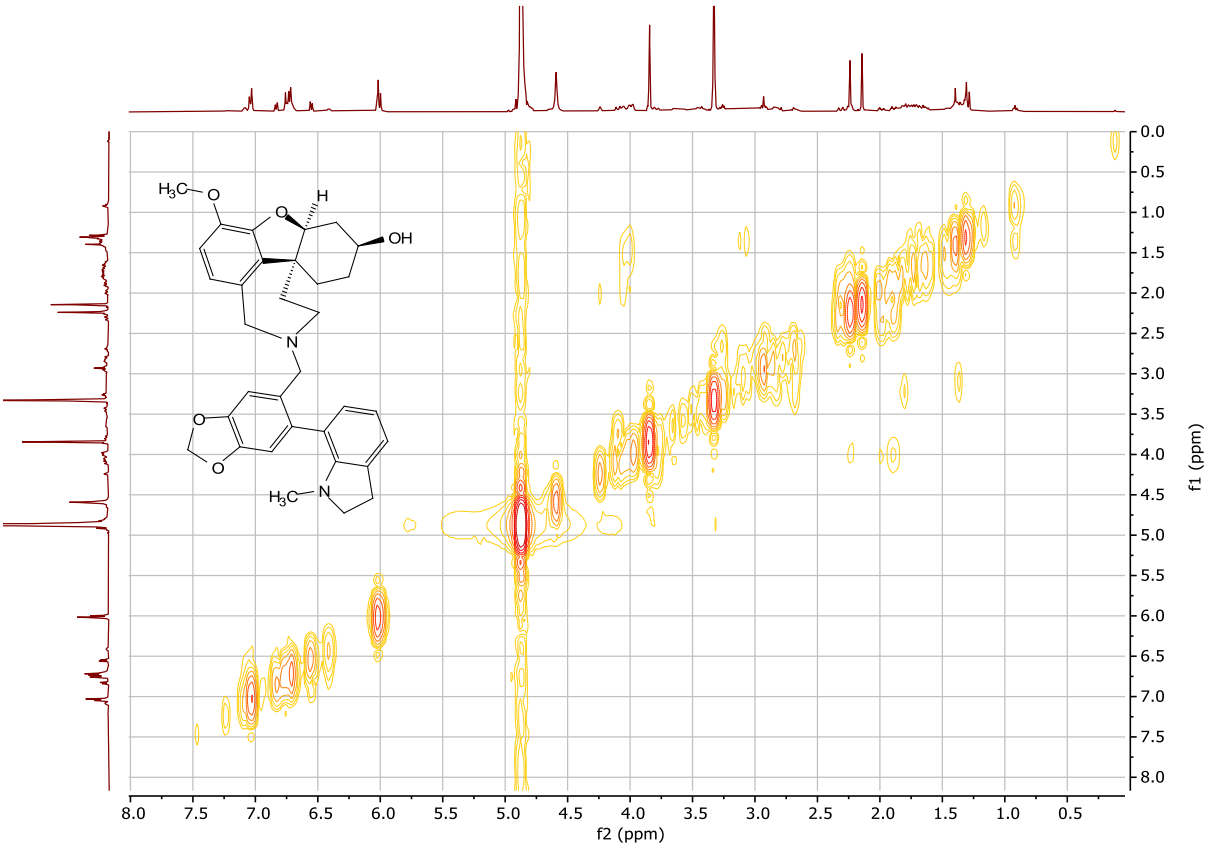
^{1}H NMR (400 MHz, $CDCl_3$) of (–)-narcikachnine (1:1 dr of **2a** and **2b**)



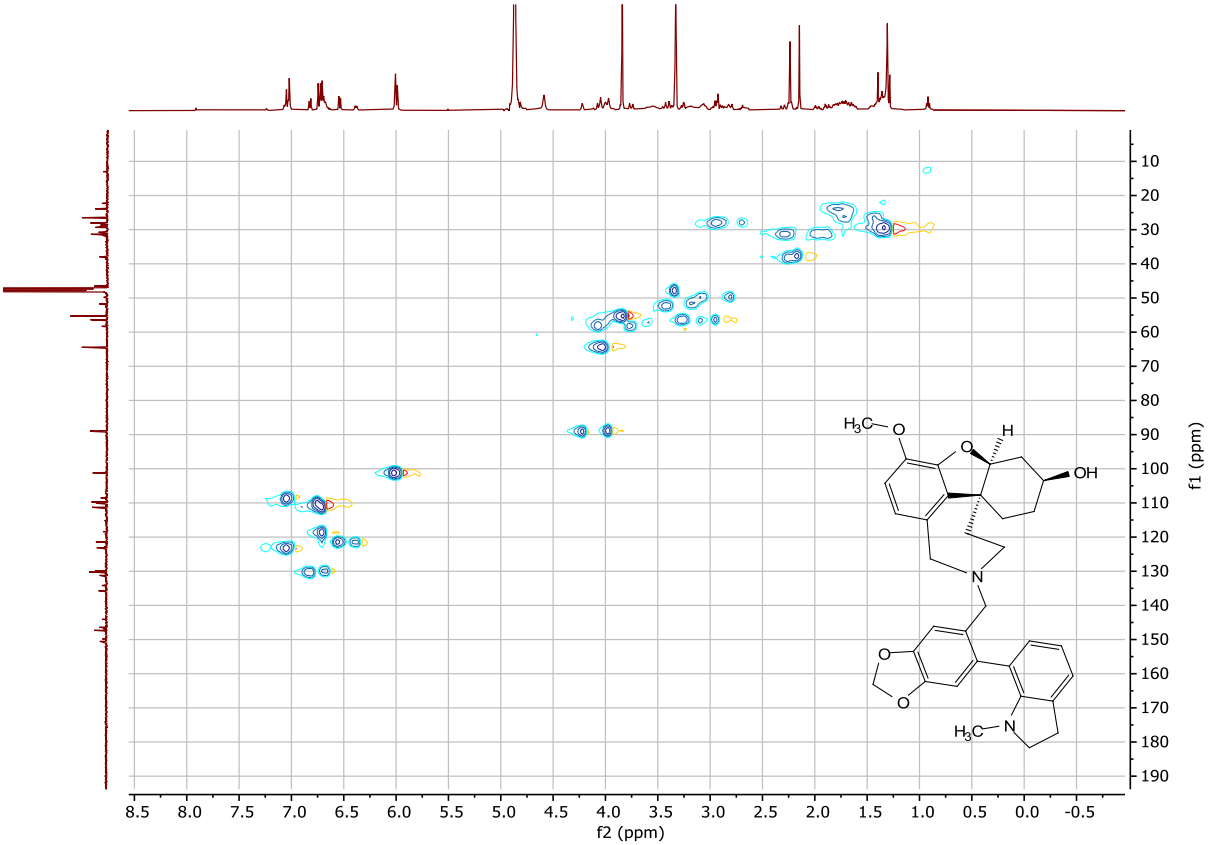
^{13}C {^{1}H} NMR (126 MHz, CD_3OD) of (–)-narcikachnine (1:1 dr of **2a** and **2b**)



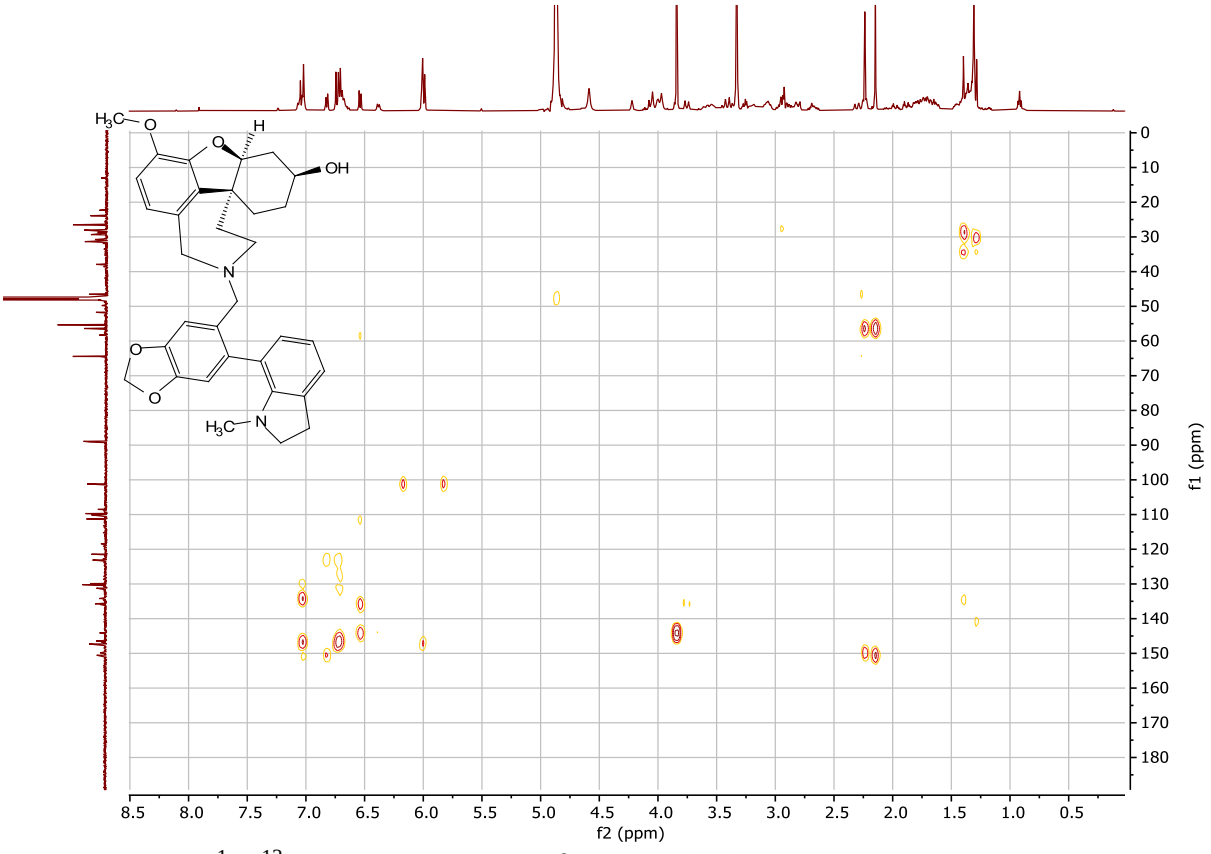
^{13}C {^{1}H} NMR (126 MHz, $CDCl_3$) of (–)-narcikachnine (1:1 dr of **2a** and **2b**)



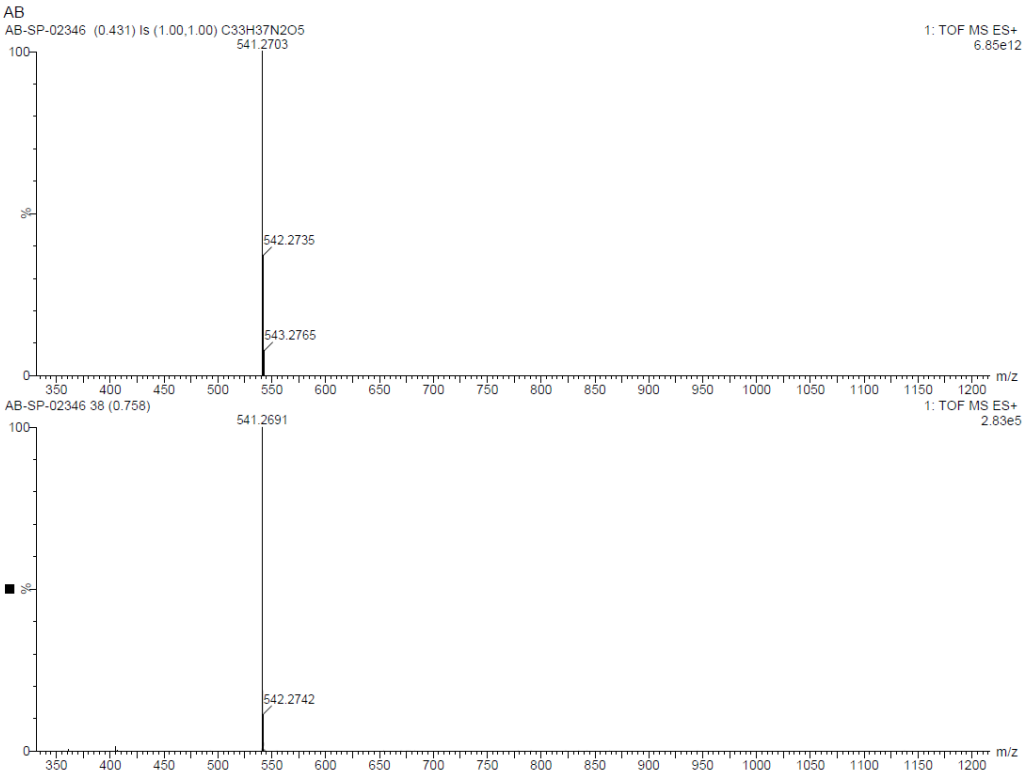
^{1}H-^{1}H COSY spectrum of (–)-narcikachnine (**2**) in CD_3OD



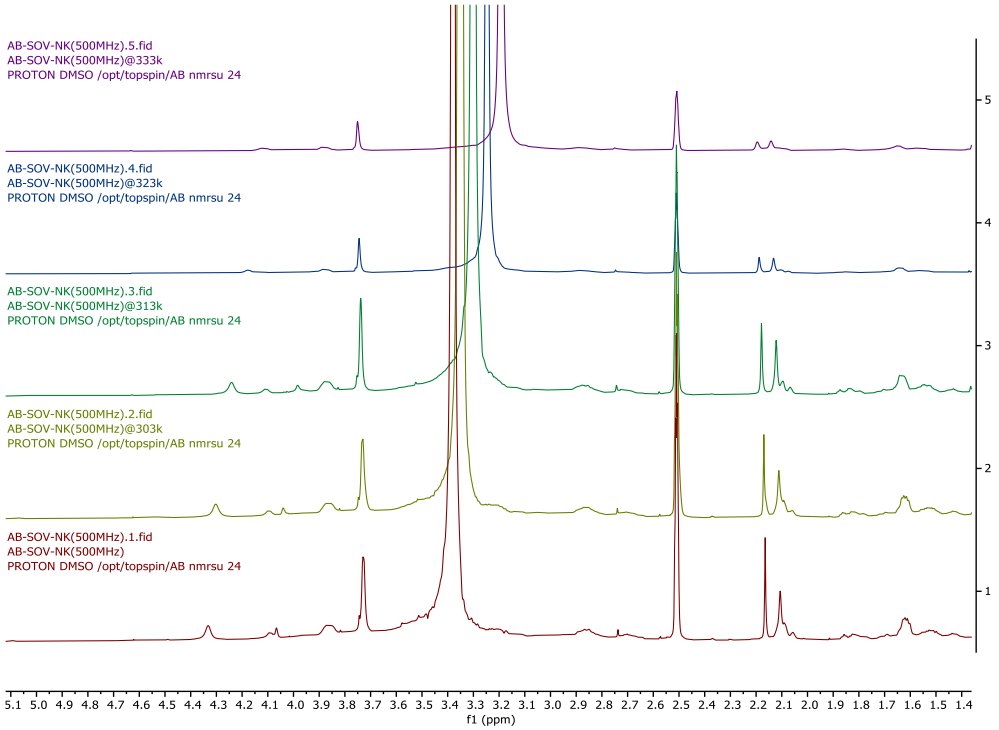
^{1}H-^{13}C HSQC spectrum of (–)-narcikachnine (**2**) in CD_3OD



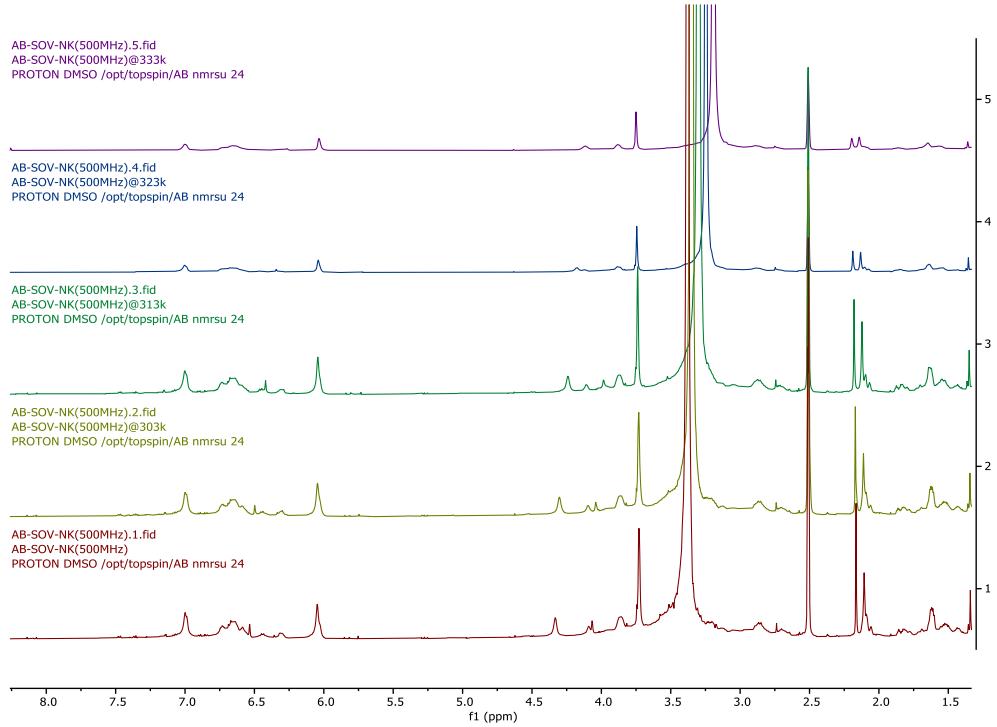
^{1}H-^{13}C HMBC spectrum of (–)-narcikachnine (**2**) in CD_3OD



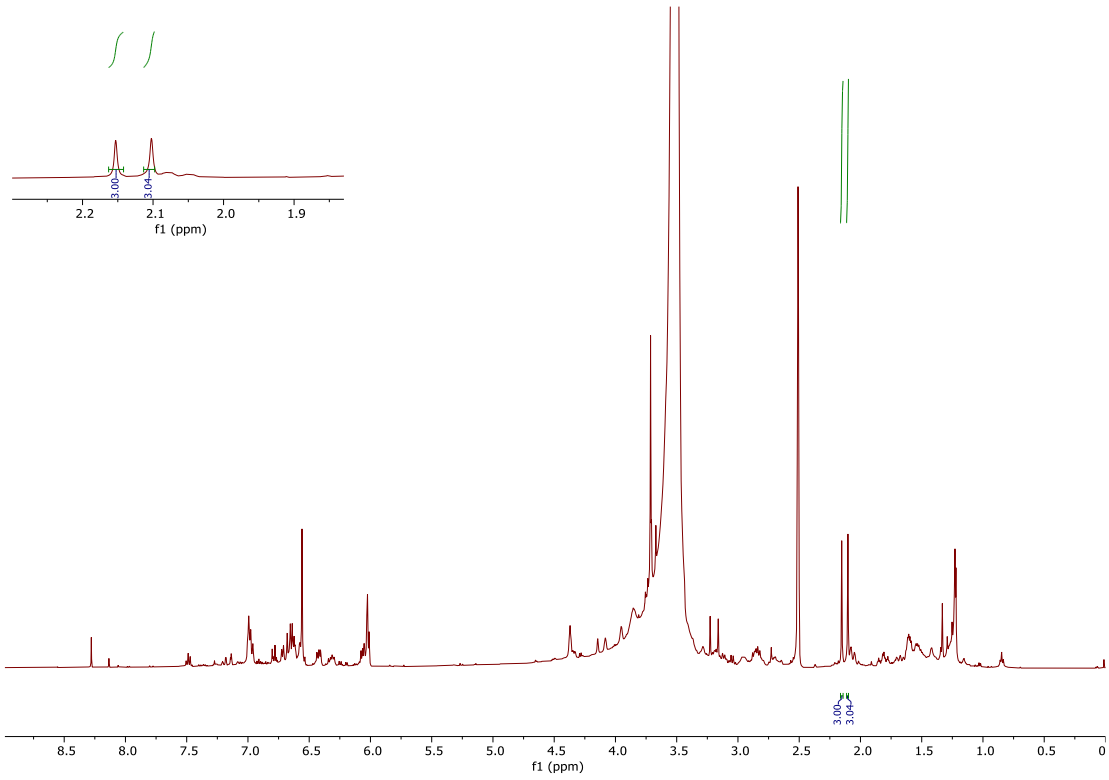
HRMS data of Narcikachnine (–)-**2**



VT experiment spectrum of Narcikachnine [(–)-**2**] at 298k, 303k, 313k, 323k, 333k, in DMSO-d_6 solvent (500 MHz) [zoomed 1.5-5.0 ppm]



VT experiment spectrum of Narcikachnine [(–)-**2**] at 298k, 303k, 313k, 323k, 333k, in DMSO-d_6 solvent (500 MHz)



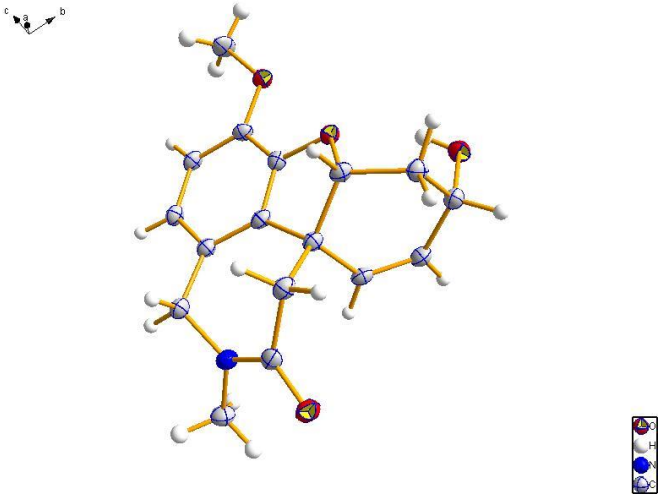
^{1}H NMR of (–)-narcikachnine at 298 k after VT experiment cooling back to RT

SCXRD Data of 20

Crystal Data and Structure Refinement of **20** (**CCDC 2333542**):

A colorless block 0.01 × 0.02 × 0.04 mm in size was mounted on a Cryoloop with Paratone oil. Data were collected in a nitrogen gas stream at 100.15 K using omega scans. Crystal-to detector distance was 42 mm and exposure time was 0.50 seconds per frame at low angles and 2.00 seconds at high angles, using a scan width of 0.5°. The 2Θ range for data collection /° 7.252 to 136.454. A total of 20564 reflections were collected covering the indices $-11 \leq h \leq 9$, $-18 \leq k \leq 18$, $-11 \leq l \leq 11$. 2597 reflections were founded to be symmetry independent, with an Rint of 0.0585. Indexing and unit cell refinement indicated a primitive, monoclinic lattice.

The space group was found to be P 1 21/n 1 CrysAlisPro 1.171.41.115a (Rigaku Oxford Diffraction, 2021) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm. Solution by intrinsic phasing (SHELXT-2018/2) produced a heavy-atom phasing model consistent with the proposed structure. All nonhydrogen atoms were refined anisotropically by least-squares (SHELXL-2018/3). All hydrogen atoms were placed using a riding model. Their positions were constrained relative to their parent atom using the appropriate HFIX command in SHELXL-2018/3.



ORTEP Diagram of **20**

Table 1 Crystal data and structure refinement for AB_AYA_SP02261BR_auto.	
Identification code	AB_AYA_SP02261BR_auto
Empirical formula	$C_{17}H_{19}NO_4$

Formula weight	301.33
Temperature/K	100.01(15)
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	9.7354(2)
b/Å	15.3138(2)
c/Å	9.9359(2)
α/°	90
β/°	105.393(2)
γ/°	90
Volume/Å^3	1428.17(5)
Z	4
ρ_{calc}g/cm^3	1.401
μ/mm^{-1}	0.821
F(000)	640.0
Crystal size/mm^3	0.04 × 0.02 × 0.01
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	10.894 to 136.478
Index ranges	$-11 \le h \le 9$, $-18 \le k \le 18$, $-11 \le l \le 11$
Reflections collected	20564
Independent reflections	2597 [R_{int} = 0.0585, R_{sigma} = 0.0270]
Data/restraints/parameters	2597/0/202
Goodness-of-fit on F^2	1.057
Final R indexes [I>=2σ (I)]	R_1 = 0.0376, wR_2 = 0.0999
Final R indexes [all data]	R_1 = 0.0408, wR_2 = 0.1028
Largest diff. peak/hole / e Å^{-3}	0.24/-0.27

Table 2 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for AB_AYA_SP02261BR_auto. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
O3	5322.1(10)	8290.0(6)	3304.9(9)	18.5(2)
O4	5004.7(10)	8232.5(6)	6006.8(10)	22.0(2)
O2	3650.0(11)	5863.7(6)	−1258.9(10)	23.5(2)
O1	4014.4(11)	9713.4(6)	1574.5(10)	25.3(3)
N1	3382.6(12)	5420.0(7)	841.6(12)	20.1(3)
C11	4443.7(14)	6892.8(9)	2890.5(13)	17.6(3)
C12	4764.8(14)	7576.1(9)	3824.2(14)	17.9(3)
C16	3908.1(14)	6005.2(9)	4636.1(14)	19.4(3)
C15	4183.8(14)	6705.7(9)	5571.9(14)	19.9(3)

Table 2 Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($Å^2 \times 10^3$) for AB_AYA_SP02261BR_auto. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
C5	4701.7(14)	7202.6(9)	1529.9(13)	17.2(3)
C10	4046.6(14)	6077.8(9)	3277.0(14)	18.1(3)
C7	4055.9(14)	5871.1(8)	28.8(14)	19.0(3)
C4	3304.8(14)	7577.0(9)	638.4(13)	17.8(3)
C6	5278.5(14)	6465.3(9)	772.9(14)	19.3(3)
C1	5743.7(14)	8684.5(9)	1085.4(14)	20.1(3)
C3	3112.2(14)	8409.3(9)	258.6(14)	19.9(3)
C14	4634.5(14)	7508.7(9)	5181.4(14)	18.6(3)
C13	5764.1(14)	7946.9(9)	2093.9(13)	17.7(3)
C9	3981.2(15)	5285.5(9)	2354.4(14)	20.6(3)
C2	4265.1(15)	9089.7(9)	574.1(14)	20.8(3)
C8	2067.4(15)	4950.3(10)	195.9(15)	24.6(3)
C17	5211.1(18)	8115.3(10)	7470.6(15)	28.8(4)

Table 3 Anisotropic Displacement Parameters ($Å^2 \times 10^3$) for AB_AYA_SP02261BR_auto. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
O3	21.9(5)	20.2(5)	14.4(5)	0.0(4)	6.6(4)	-1.8(4)
O4	29.7(5)	22.1(5)	15.0(5)	-1.9(4)	7.1(4)	-1.5(4)
O2	27.4(5)	27.0(5)	16.2(5)	-1.6(4)	5.9(4)	2.6(4)
O1	29.2(6)	21.6(5)	25.1(5)	-1.9(4)	7.2(4)	1.6(4)
N1	21.4(6)	21.6(6)	16.4(6)	-1.1(4)	3.5(5)	-0.4(5)
C11	14.4(6)	22.9(7)	15.2(6)	1.0(5)	3.6(5)	2.0(5)
C12	16.5(6)	19.7(6)	17.7(6)	2.5(5)	4.6(5)	0.8(5)
C16	18.5(7)	21.1(7)	19.1(7)	3.1(5)	5.8(5)	-0.2(5)
C15	20.2(7)	25.6(7)	15.0(6)	2.2(5)	6.5(5)	1.2(5)
C5	17.1(6)	20.0(6)	14.6(6)	0.9(5)	4.6(5)	0.0(5)
C10	15.3(6)	21.1(7)	17.5(7)	0.6(5)	3.7(5)	0.9(5)
C7	21.3(7)	19.0(7)	17.5(7)	-1.0(5)	6.4(5)	5.0(5)
C4	16.5(7)	23.5(7)	13.3(6)	-1.7(5)	3.7(5)	-0.7(5)
C6	19.9(7)	22.3(7)	16.7(6)	0.5(5)	6.7(5)	1.2(5)
C1	21.7(7)	23.1(7)	16.4(6)	0.7(5)	6.8(5)	-3.4(5)
C3	17.7(7)	24.0(7)	17.4(7)	0.3(5)	3.4(5)	1.1(5)
C14	18.3(7)	20.9(7)	16.6(6)	-2.1(5)	4.8(5)	1.4(5)
C13	17.3(6)	22.1(7)	14.6(6)	-1.2(5)	5.6(5)	-0.4(5)
C9	24.5(7)	20.3(7)	17.0(7)	2.1(5)	5.2(5)	0.2(5)
C2	24.0(7)	20.6(7)	18.0(7)	1.3(5)	5.7(5)	-0.8(5)

Table 3 Anisotropic Displacement Parameters ($Å^2×10^3$) for AB_AYA_SP02261BR_auto. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.						
Atom	**U_{11}**	**U_{22}**	**U_{33}**	**U_{23}**	**U_{13}**	**U_{12}**
C8	22.9(7)	26.5(7)	23.3(7)	-2.6(6)	4.3(6)	-3.4(6)
C17	42.7(9)	29.9(8)	15.6(7)	-3.1(6)	10.9(6)	-6.6(7)

Table 4 Bond Lengths for AB_AYA_SP02261BR_auto.					
Atom	**Atom**	**Length/Å**	**Atom**	**Atom**	**Length/Å**
O3	C12	1.3799(16)	C16	C15	1.3982(19)
O3	C13	1.4778(15)	C16	C10	1.3967(19)
O4	C14	1.3691(16)	C15	C14	1.3947(19)
O4	C17	1.4257(16)	C5	C4	1.5242(17)
O2	C7	1.2349(16)	C5	C6	1.5428(18)
O1	C2	1.4452(16)	C5	C13	1.5412(18)
N1	C7	1.3565(18)	C10	C9	1.5118(18)
N1	C9	1.4752(17)	C7	C6	1.5246(19)
N1	C8	1.4603(18)	C4	C3	1.3283(19)
C11	C12	1.3781(19)	C1	C13	1.5065(18)
C11	C5	1.5152(18)	C1	C2	1.5255(19)
C11	C10	1.3905(19)	C3	C2	1.5023(19)
C12	C14	1.3915(19)			

Table 5 Bond Angles for AB_AYA_SP02261BR_auto.							
Atom	**Atom**	**Atom**	**Angle/°**	**Atom**	**Atom**	**Atom**	**Angle/°**
C12	O3	C13	104.55(9)	C11	C10	C9	121.53(12)
C14	O4	C17	116.91(11)	C16	C10	C9	121.54(12)
C7	N1	C9	123.72(11)	O2	C7	N1	122.68(13)
C7	N1	C8	119.68(11)	O2	C7	C6	120.13(12)
C8	N1	C9	116.23(11)	N1	C7	C6	116.98(11)
C12	C11	C5	107.53(11)	C3	C4	C5	124.25(12)
C12	C11	C10	121.71(12)	C7	C6	C5	109.57(11)
C10	C11	C5	130.66(12)	C13	C1	C2	111.79(11)
O3	C12	C14	124.56(12)	C4	C3	C2	124.40(12)
C11	C12	O3	113.03(11)	O4	C14	C12	116.31(12)
C11	C12	C14	122.23(12)	O4	C14	C15	126.83(12)
C10	C16	C15	122.08(13)	C12	C14	C15	116.83(12)
C14	C15	C16	120.69(12)	O3	C13	C5	104.27(10)
C11	C5	C4	107.62(10)	O3	C13	C1	108.65(10)
C11	C5	C6	111.95(11)	C1	C13	C5	115.06(11)

Table 5 Bond Angles for AB_AYA_SP02261BR_auto.							
Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C11	C5	C13	99.29(10)	N1	C9	C10	116.58(11)
C4	C5	C6	112.09(10)	O1	C2	C1	110.89(11)
C4	C5	C13	110.02(11)	O1	C2	C3	110.41(11)
C13	C5	C6	114.99(11)	C3	C2	C1	111.96(11)
C11	C10	C16	116.34(12)				

Table 6 Torsion Angles for AB_AYA_SP02261BR_auto.									
A	B	C	D	Angle/°	A	B	C	D	Angle/°
O3	C12	C14	O4	4.52(19)	C10	C11	C12	C14	-3.7(2)
O3	C12	C14	C15	−173.59(12)	C10	C11	C5	C4	92.41(16)
O2	C7	C6	C5	110.54(14)	C10	C11	C5	C6	-31.18(19)
N1	C7	C6	C5	-64.20(15)	C10	C11	C5	C13	−153.02(14)
C11	C12	C14	O4	179.23(12)	C10	C16	C15	C14	-1.0(2)
C11	C12	C14	C15	1.1(2)	C7	N1	C9	C10	70.75(17)
C11	C5	C4	C3	115.50(14)	C4	C5	C6	C7	-42.42(14)
C11	C5	C6	C7	78.62(13)	C4	C5	C13	O3	80.35(12)
C11	C5	C13	O3	-32.35(12)	C4	C5	C13	C1	-38.54(15)
C11	C5	C13	C1	−151.24(11)	C4	C3	C2	O1	−111.12(15)
C11	C10	C9	N1	-40.79(18)	C4	C3	C2	C1	12.95(19)
C12	O3	C13	C5	30.96(12)	C6	C5	C4	C3	−120.99(14)
C12	O3	C13	C1	154.13(10)	C6	C5	C13	O3	−151.96(10)
C12	C11	C5	C4	-91.42(12)	C6	C5	C13	C1	89.15(14)
C12	C11	C5	C6	144.99(11)	C13	O3	C12	C11	-16.69(14)
C12	C11	C5	C13	23.15(13)	C13	O3	C12	C14	158.44(12)
C12	C11	C10	C16	3.73(19)	C13	C5	C4	C3	8.29(17)
C12	C11	C10	C9	−167.59(12)	C13	C5	C6	C7	−169.05(11)
C16	C15	C14	O4	−176.70(13)	C13	C1	C2	O1	82.08(13)
C16	C15	C14	C12	1.19(19)	C13	C1	C2	C3	-41.72(15)
C16	C10	C9	N1	148.34(13)	C9	N1	C7	O2	168.44(12)
C15	C16	C10	C11	-1.4(2)	C9	N1	C7	C6	-16.97(18)
C15	C16	C10	C9	169.90(13)	C2	C1	C13	O3	-59.60(14)
C5	C11	C12	O3	-5.04(15)	C2	C1	C13	C5	56.82(15)
C5	C11	C12	C14	179.69(12)	C8	N1	C7	O2	-4.3(2)
C5	C11	C10	C16	179.44(13)	C8	N1	C7	C6	170.27(11)

Table 6 Torsion Angles for AB_AYA_SP02261BR_auto.									
A	B	C	D	Angle/°	A	B	C	D	Angle/°
C5	C11	C10	C9	8.1(2)	C8	N1	C9	C10	−116.26(13)
C5	C4	C3	C2	4.1(2)	C17	O4	C14	C12	−165.24(12)
C10	C11	C12	O3	171.55(11)	C17	O4	C14	C15	12.7(2)

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for AB_AYA_SP02261BR_auto.				
Atom	*x*	*y*	*z*	U(eq)
H1	4181.26	9477.91	2365.04	38
H16	3617.34	5462.72	4934.12	23
H15	4062.82	6634.05	6483.26	24
H4	2520.99	7189.92	334.53	21
H6A	5738.36	6719.54	85.95	23
H6B	6002.04	6122.38	1457.35	23
H1A	6049.6	8462.43	274.93	24
H1B	6430.4	9139.05	1548.71	24
H3	2183.03	8586.15	-246.43	24
H13	6750.07	7703.11	2415.63	21
H9A	4959.33	5052.56	2508.5	25
H9B	3407.58	4831.81	2663.69	25
H2	4225.64	9411.15	-311.38	25
H8A	1814.58	5040.81	-816.6	37
H8B	1298.55	5169.31	571.48	37
H8C	2206.57	4325.39	399.47	37
H17A	4312.77	7931.95	7652.65	43
H17B	5524.57	8667.03	7954.68	43
H17C	5937.81	7666.39	7810.57	43

Experimental

Single crystals of $C_{17}H_{19}NO_4$ were block type. A suitable crystal was selected and mounted on a XtaLAB Synergy, Dualflex, HyPix3000 diffractometer. The crystal was kept at 100.01(15) K during data collection. Using Olex2 [1], the structure was solved with the SHELXT [2] structure solution program using SHELXT and refined with the SHELXL [2] refinement package using SHELXL minimisation.

1. Dolomanov, O.V., Bourhis, L.J., Gildea, R.J, Howard, J.A.K. & Puschmann, H. (**2009**), J. Appl. Cryst. 42, 339-341
2. George M. Sheldrick, ActaCryst. (**2015**). *C71*, 3–8.

Crystal structure determination of [AB_AYA_SP02261BR_auto]

Crystal Data for $C_{17}H_{19}NO_4$ (*M* =301.33 g/mol): monoclinic, space group $P2_1/n$ (no. 14), *a* = 9.7354(2) Å, *b* = 15.3138(2) Å, *c* = 9.9359(2) Å, *β* = 105.393(2)°, *V* = 1428.17(5) Å^3, *Z* = 4, *T* = 100.01(15) K, μ(Cu Kα) = 0.821 mm^{-1}, *Dcalc* = 1.401 g/cm^3, 20564 reflections measured (10.894° ≤ 2Θ ≤ 136.478°), 2597 unique (R_{int} = 0.0585, R_{sigma} = 0.0270) which were used in all calculations. The final R_1 was 0.0376 (I > 2σ(I)) and wR_2 was 0.1028 (all data).

Refinement model description

Number of restraints - 0, number of constraints - unknown.
Details:

```
1.a Ternary CH refined with riding coordinates:
 C13(H13), C2(H2)
1.b Secondary CH2 refined with riding coordinates:
 C6(H6A,H6B), C1(H1A,H1B), C9(H9A,H9B)
1.c Aromatic/amide H refined with riding coordinates:
 C16(H16), C15(H15), C4(H4), C3(H3)
1.d Idealised Me refined as rotating group:
 C8(H8A,H8B,H8C), C17(H17A,H17B,H17C)
1.e Idealised tetrahedral OH refined as rotating group:
 O1(H1)
```

checkCIF/PLATON report

Structure factors have been supplied for datablock(s) ab_aya_sp02261br_auto

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: ab_aya_sp02261br_auto

Bond precision: C-C = 0.0019 A Wavelength=1.54184

Cell: a=9.7354(2) b=15.3138(2) c=9.9359(2)
alpha=90 beta=105.393(2) gamma=90
Temperature: 100 K

	Calculated	Reported
Volume	1428.17(5)	1428.17(5)
Space group	P 21/n	P 1 21/n 1
Hall group	-P 2yn	-P 2yn
Moiety formula	C17 H19 N O4	C17 H19 N O4
Sum formula	C17 H19 N O4	C17 H19 N O4
Mr	301.33	301.33
Dx,g cm-3	1.401	1.401
Z	4	4
Mu (mm-1)	0.821	0.821
F000	640.0	640.0
F000'	642.05	
h,k,lmax	11,18,11	11,18,11
Nref	2620	2597
Tmin,Tmax	0.980,0.992	0.249,1.000
Tmin'	0.968	

Correction method= # Reported T Limits: Tmin=0.249 Tmax=1.000
AbsCorr = MULTI-SCAN

Data completeness= 0.991 Theta(max)= 68.239

R(reflections)= 0.0376(2347) wR2(reflections)= 0.1028(2597)

S = 1.057 Npar= 202

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level C

PLAT911_ALERT_3_C Missing FCF Refl Between Thmin & STh/L= 0.600 2 Report
-8 13 4, -4 16 5,

Alert level G

PLAT007_ALERT_5_G Number of Unrefined Donor-H Atoms ..... 1 Report
H1
PLAT153_ALERT_1_G The s.u.'s on the Cell Axes are Equal ..(Note) 0.0002 Ang.
PLAT398_ALERT_2_G Deviating C-O-C Angle From 120 for O3 . 104.5 Degree
PLAT912_ALERT_4_G Missing # of FCF Reflections Above STh/L= 0.600 21 Note
PLAT969_ALERT_5_G The 'Henn et al.' R-Factor-gap value ..... 2.87 Note
Predicted wR2: Based on SigI**2 3.59 or SHELX Weight 10.12
PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density. 9 Info

0 **ALERT level A** = Most likely a serious problem - resolve or explain
0 **ALERT level B** = A potentially serious problem, consider carefully
1 **ALERT level C** = Check. Ensure it is not caused by an omission or oversight
6 **ALERT level G** = General information/check it is not something unexpected

1 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
2 ALERT type 2 Indicator that the structure model may be wrong or deficient
1 ALERT type 3 Indicator that the structure quality may be low
1 ALERT type 4 Improvement, methodology, query or suggestion
2 ALERT type 5 Informative message, check

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

Publication of your CIF in IUCr journals

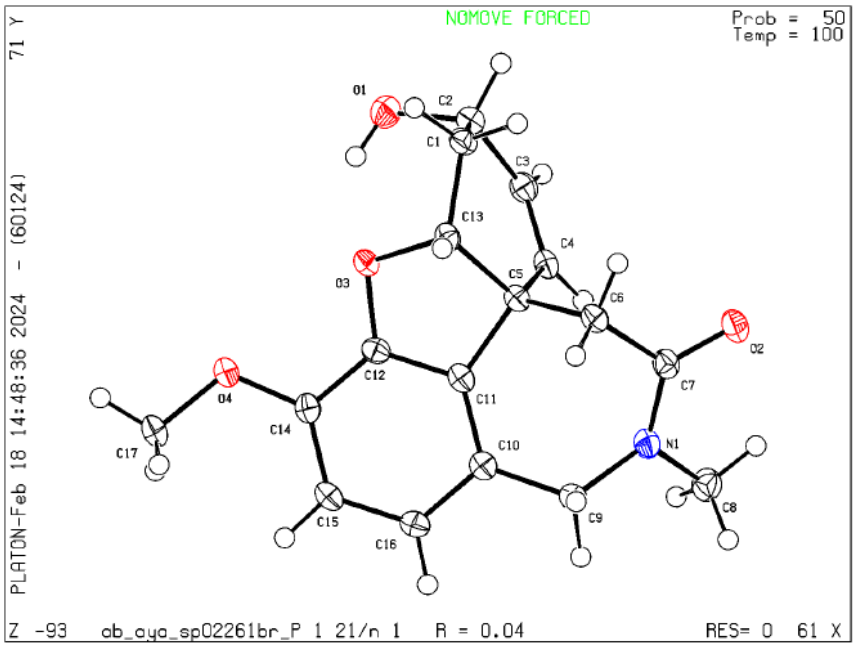
A basic structural check has been run on your CIF. These basic checks will be run on all CIFs submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit to *Acta Crystallographica Section C* or *E* or *IUCrData*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

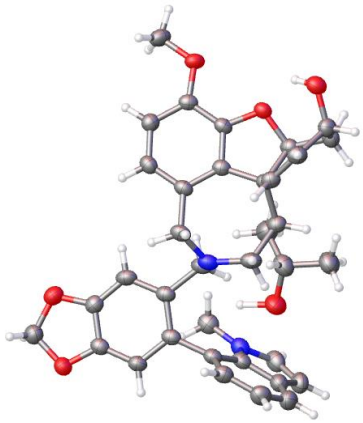
PLATON version of 06/01/2024; check.def file version of 05/01/2024

Datablock ab_aya_sp02261br_auto - ellipsoid plot



SCXRD Data of dehydro-narcipavline (26b)

Crystal Data and Structure Refinement of (±)-**26b** (**CCDC 2363948**):



AB_SP_DHNPV_auto

Table 8 Crystal data and structure refinement for AB_SP_DHNPV_auto.	
Identification code	2363948
Empirical formula	$C_{36}H_{40}N_2O_6$
Formula weight	596.70
Temperature/K	100.15
Crystal system	monoclinic
Space group	$P2_1/c$
a/Å	11.5497(2)
b/Å	13.3748(3)
c/Å	19.9348(3)
α/°	90
β/°	101.134(2)
γ/°	90
Volume/Å^3	3021.47(10)
Z	4
ρ_{calc}g/cm^3	1.312
μ/mm^{-1}	0.719
F(000)	1272.0
Crystal size/mm^3	0.4 × 0.4 × 0.4
Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	7.802 to 140.658
Index ranges	-13 ≤ h ≤ 13, -15 ≤ k ≤ 16, -20 ≤ l ≤ 24
Reflections collected	43284
Independent reflections	5477 [R_{int} = 0.0549, R_{sigma} = 0.0275]
Data/restraints/parameters	5477/0/405
Goodness-of-fit on F^2	1.046

Final R indexes [I>=2σ (I)]	R_1 = 0.0535, wR_2 = 0.1481
Final R indexes [all data]	R_1 = 0.0662, wR_2 = 0.1595
Largest diff. peak/hole / e $Å^{-3}$	0.55/-0.31

checkCIF/PLATON report

Structure factors have been supplied for datablock(s) ab_sp_dhnpv_auto

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: ab_sp_dhnpv_auto

```
Bond precision:   C-C = 0.0031 A          Wavelength=1.54184

Cell:             a=11.5497(2)     b=13.3748(3)         c=19.9348(3)
                  alpha=90         beta=101.134(2)      gamma=90
Temperature:      100 K

                  Calculated                Reported
Volume            3021.47(10)               3021.47(10)
Space group       P 21/c                    P 1 21/c 1
Hall group        -P 2ybc                   -P 2ybc
Moiety formula    C33 H32 N2 O5, C3 H8 O    C33 H32 N2 O5, C3 H8 O
Sum formula       C36 H40 N2 O6             C36 H40 N2 O6
Mr                596.70                    596.70
Dx,g cm-3         1.312                     1.312
Z                 4                         4
Mu (mm-1)         0.719                     0.719
F000              1272.0                    1272.0
F000'             1275.86
h,k,lmax          14,16,24                  13,16,24
Nref              5770                      5477
Tmin,Tmax         0.788,0.750               0.528,1.000
Tmin'             0.714

Correction method= # Reported T Limits: Tmin=0.528 Tmax=1.000
AbsCorr = ?

Data completeness= 0.949           Theta(max)= 70.329

R(reflections)= 0.0535( 4506)                wR2(reflections)=
                                             0.1595( 5477)
S = 1.046                  Npar= 405
```

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level A

```
PLAT355_ALERT_3_A Long   O-H (X0.82,N0.98A)  O008     - H008     .       1.17 Ang.
```

Alert level C

```
PLAT052_ALERT_1_C Info on Absorption Correction Method   Not Given     Please Do !
PLAT906_ALERT_3_C Large K Value in the Analysis of Variance ......      4.844 Check
PLAT911_ALERT_3_C Missing FCF Refl Between Thmin & STh/L=    0.600         15 Report
             -12   8   5, -11   9   8, -11   9   9, -10 10 10, -13   3 11, -10   9 11,
              -9   9 14,   -8 10 14,   -7 10 14,   -2 13 14,   -9   8 15,   -8   9 15,
              -8   8 16,    0 11 17,   -5   7 21,
```

Alert level G

```
PLAT007_ALERT_5_G Number of Unrefined Donor-H Atoms ..............          1 Report
             H004
PLAT398_ALERT_2_G Deviating  C-O-C   Angle From 120 for O001     .      104.4 Degree
PLAT398_ALERT_2_G Deviating  C-O-C   Angle From 120 for O003     .      105.8 Degree
PLAT398_ALERT_2_G Deviating  C-O-C   Angle From 120 for O005     .      106.2 Degree
PLAT432_ALERT_2_G Short Inter X...Y Contact  O005     ..C011     .       2.95 Ang.
                                       1-x,-1/2+y,1/2-z  =      2_645 Check
PLAT720_ALERT_4_G Number of Unusual/Non-Standard Labels ..........         84 Note
             O001    O002    O003    O004    H004    O005    N006    N007
             O008    H008    C009    C00A    H00A    C00B    C00C    C00D
             C00E    C00F    C00G    C00H    C00I    C00J    C00K    H00K
             C00L    C00M    H00M    C00N    H00N    C00O    H00O    C00P
             H00P    C00Q    H00B    H00C    C00R    H00R    C00S    H00S
             C00T    H00D    H00E    C00U    H00F    H00G    C00V    H00H
             H00I    C00W    H00J    H00L    C00X    C00Y    H00Y    C00Z
             H00Z    C010    H010    C011    H01A    H01B    H01C    C012
             H01D    H01E    H01F    C013    H013    C014    H014    C015
             H01G    H01H    C016    H016    C017    H01I    H01J    H01K
             C018    H01L    H01M    H01N
PLAT793_ALERT_4_G Model has Chirality at C00C        (Centro SpGr)          R Verify
PLAT793_ALERT_4_G Model has Chirality at C00M        (Centro SpGr)          R Verify
PLAT793_ALERT_4_G Model has Chirality at C00Y        (Centro SpGr)          S Verify
PLAT883_ALERT_1_G No Info/Value for _atom_sites_solution_primary .     Please Do !
PLAT912_ALERT_4_G Missing # of FCF Reflections Above STh/L=  0.600        269 Note
PLAT969_ALERT_5_G The 'Henn et al.' R-Factor-gap value ...........      4.720 Note
             Predicted wR2: Based on SigI**2  3.38 or SHELX Weight 15.24
PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density.          7 Info
```

---

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```

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Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

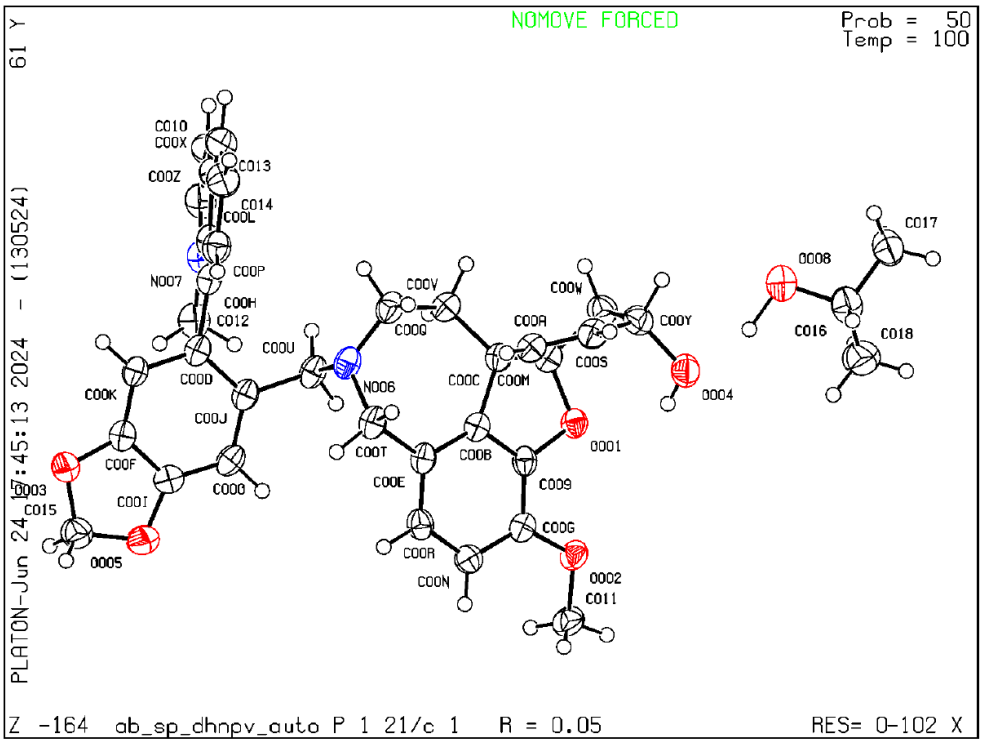
Validation response form

Please find below a validation response form (VRF) that can be filled in and pasted into your CIF.

```
# start Validation Reply Form
_vrf_PLAT355_ab_sp_dhnpv_auto
;
PROBLEM: Long   O-H (X0.82,N0.98A)  O008     - H008     .       1.17 Ang.
RESPONSE: ...
;
# end Validation Reply Form
```

PLATON version of 13/05/2024; check.def file version of 04/05/2024

Datablock ab_sp_dhnpv_auto - ellipsoid plot



SCXRD Data of (–)-14

Crystal Data and Structure Refinement of (–)-**14** (**CCDC 2384521**):

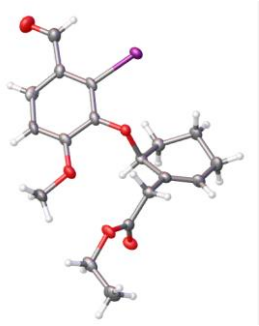


Table 1 Crystal data and structure refinement for (–)-14	
CCDC	2384521
Empirical formula	$C_{18}H_{21}IO_5$
Formula weight	444.25
Temperature/K	99.98(11)
Crystal system	monoclinic
Space group	$P2_1$
a/Å	13.1948(3)
b/Å	4.76050(10)
c/Å	14.5444(4)
α/°	90
β/°	102.504(3)
γ/°	90
Volume/Å^3	891.92(4)
Z	2
ρ_{calc}g/cm^3	1.654
μ/mm^{-1}	14.318
F(000)	444.0
Crystal size/mm^3	0.54 × 0.08 × 0.04
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	6.224 to 136.044
Index ranges	$-15 \leq h \leq 15$, $-4 \leq k \leq 5$, $-17 \leq l \leq 17$
Reflections collected	9822
Independent reflections	2723 [R_{int} = 0.0499, R_{sigma} = 0.0439]
Data/restraints/parameters	2723/1/219
Goodness-of-fit on F^2	1.079
Final R indexes [I>=2σ (I)]	R_1 = 0.0309, wR_2 = 0.0764
Final R indexes [all data]	R_1 = 0.0323, wR_2 = 0.0774
Largest diff. peak/hole / e Å^{-3}	0.94/-1.05
Flack parameter	-0.028(6)

Table 2 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 2384521. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
I1	3839.1(2)	5176.0(13)	4943.9(2)	25.13(14)
O3	3107(3)	4289(10)	6815(3)	22.9(11)
O2	1452(4)	-150(20)	2898(3)	47.8(19)
C11	5001(4)	5070(30)	8839(4)	27.3(14)
C4	973(4)	-342(16)	5653(4)	27(2)
C1	2590(5)	2757(16)	5213(5)	23.9(15)
C2	1927(5)	1252(15)	4498(4)	24.7(16)
C15	3132(5)	5943(14)	8747(4)	25(2)
C8	2021(5)	1169(17)	3510(5)	35(2)
C6	2467(5)	2751(15)	6141(5)	23.9(15)
C13	5598(5)	3130(18)	7453(5)	29.0(17)
C9	3734(5)	2603(15)	7598(4)	21.4(15)
C14	4650(5)	1202(15)	7298(5)	24.7(16)
C5	1618(5)	1248(15)	6347(5)	24.3(16)
C7	681(4)	-90(30)	7516(5)	36(2)
C10	4015(5)	4567(15)	8417(4)	24.3(19)
O1	1494(3)	1493(11)	7249(3)	30.5(12)
C12	5914(5)	3929(19)	8490(5)	34.2(19)
C3	1143(5)	-297(17)	4751(5)	27(2)
C16	2575(5)	4080(16)	9312(4)	23.3(15)
O5	1658(3)	5246(18)	9385(3)	28.7(9)
C17	1100(5)	3700(19)	9988(5)	31.9(18)
C18	1454(5)	4620(20)	11003(5)	44(3)
O4	2894(3)	1911(11)	9678(3)	26.7(11)

Table 3 Anisotropic Displacement Parameters (Å^2×10^3) for 2384521. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
I1	21.91(19)	27.6(3)	28.75(19)	3.5(3)	11.72(13)	1.3(3)
O3	19(2)	27(3)	23(2)	0.4(19)	5.8(16)	-1.7(19)
O2	49(3)	60(6)	33(2)	-16(4)	5(2)	-12(4)
C11	26(3)	32(4)	27(3)	-5(5)	13(2)	-1(5)
C4	16(3)	27(7)	40(3)	4(3)	7(2)	-5(3)
C1	15(3)	24(4)	36(4)	4(3)	12(3)	3(3)
C2	17(3)	25(4)	31(3)	-3(3)	3(3)	3(3)
C15	22(3)	27(6)	27(3)	3(3)	8(2)	3(3)
C8	27(3)	43(6)	35(4)	-4(3)	8(3)	-4(3)
C6	17(3)	22(4)	34(4)	0(3)	7(3)	0(3)

Table 3 Anisotropic Displacement Parameters ($Å^2×10^3$) for 2384521. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
C13	20(3)	38(5)	31(3)	-2(3)	12(3)	0(3)
C9	21(3)	19(4)	25(3)	6(3)	5(3)	1(3)
C14	23(3)	22(4)	30(3)	0(3)	8(3)	5(3)
C5	19(3)	24(4)	34(3)	2(3)	13(3)	4(3)
C7	22(3)	50(7)	38(3)	10(5)	11(2)	-8(5)
C10	22(3)	28(6)	25(3)	4(3)	10(2)	3(3)
O1	23(2)	37(3)	34(2)	1(2)	12.8(19)	-5(2)
C12	19(3)	53(6)	33(3)	-6(4)	9(3)	-1(3)
C3	31(3)	14(7)	34(3)	-5(3)	2(2)	5(3)
C16	22(3)	26(4)	23(3)	-4(3)	6(2)	-1(3)
O5	19.9(18)	32(3)	39(2)	6(4)	16.1(15)	4(4)
C17	25(4)	27(5)	49(4)	5(3)	19(3)	5(3)
C18	31(3)	59(9)	48(4)	5(4)	23(3)	5(4)
O4	29(3)	21(3)	34(2)	4(2)	14(2)	5(2)

Table 4 Bond Lengths for 2384521.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
I1	C1	2.116(7)	C15	C16	1.504(9)
O3	C6	1.361(8)	C6	C5	1.415(9)
O3	C9	1.490(7)	C13	C14	1.528(10)
O2	C8	1.209(9)	C13	C12	1.524(9)
C11	C10	1.334(8)	C9	C14	1.524(9)
C11	C12	1.507(9)	C9	C10	1.496(9)
C4	C5	1.395(9)	C5	O1	1.362(8)
C4	C3	1.379(9)	C7	O1	1.432(9)
C1	C2	1.402(9)	C16	O5	1.356(8)
C1	C6	1.394(9)	C16	O4	1.195(8)
C2	C8	1.469(9)	O5	C17	1.460(9)
C2	C3	1.384(10)	C17	C18	1.514(10)
C15	C10	1.504(9)			

Table 5 Bond Angles for 2384521.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C6	O3	C9	114.6(5)	C10	C9	C14	115.2(5)
C10	C11	C12	123.4(7)	C9	C14	C13	111.7(6)
C3	C4	C5	118.7(6)	C4	C5	C6	120.6(6)
C2	C1	I1	121.8(5)	O1	C5	C4	124.2(6)
C6	C1	I1	116.0(5)	O1	C5	C6	115.2(6)
C6	C1	C2	122.2(6)	C11	C10	C15	121.3(6)
C1	C2	C8	124.7(6)	C11	C10	C9	121.8(7)
C3	C2	C1	117.2(6)	C9	C10	C15	116.8(5)

Table 5 Bond Angles for 2384521.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C3	C2	C8	118.2(6)	C5	O1	C7	118.0(6)
C10	C15	C16	114.9(6)	C11	C12	C13	110.9(5)
O2	C8	C2	124.4(7)	C4	C3	C2	123.2(6)
O3	C6	C1	120.8(6)	O5	C16	C15	110.5(6)
O3	C6	C5	121.1(6)	O4	C16	C15	125.9(6)
C1	C6	C5	118.0(6)	O4	C16	O5	123.5(7)
C12	C13	C14	109.6(6)	C16	O5	C17	114.5(7)
O3	C9	C14	111.1(5)	O5	C17	C18	110.5(7)
O3	C9	C10	105.8(5)				

Table 6 Torsion Angles for 2384521.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
I1	C1	C2	C8	0.3(10)	C6	C5	O1	C7	-176.9(7)
I1	C1	C2	C3	179.1(5)	C9	O3	C6	C1	-118.0(6)
I1	C1	C6	O3	1.7(8)	C9	O3	C6	C5	66.2(8)
I1	C1	C6	C5	177.6(5)	C14	C13	C12	C11	-51.9(9)
O3	C6	C5	C4	-179.4(6)	C14	C9	C10	C11	0.9(10)
O3	C6	C5	O1	0.6(10)	C14	C9	C10	C15	-178.7(6)
O3	C9	C14	C13	87.2(6)	C5	C4	C3	C2	0.1(11)
O3	C9	C10	C11	-122.3(8)	C10	C11	C12	C13	21.0(13)
O3	C9	C10	C15	58.1(7)	C10	C15	C16	O5	-165.4(5)
C4	C5	O1	C7	3.1(10)	C10	C15	C16	O4	16.8(9)
C1	C2	C8	O2	179.4(8)	C10	C9	C14	C13	-33.2(8)
C1	C2	C3	C4	2.1(11)	C12	C11	C10	C15	-175.0(7)
C1	C6	C5	C4	4.7(10)	C12	C11	C10	C9	5.4(13)
C1	C6	C5	O1	-175.3(6)	C12	C13	C14	C9	58.9(8)
C2	C1	C6	O3	-178.3(6)	C3	C4	C5	C6	-3.6(10)
C2	C1	C6	C5	-2.4(10)	C3	C4	C5	O1	176.4(6)
C15	C16	O5	C17	-175.2(5)	C3	C2	C8	O2	0.6(12)
C8	C2	C3	C4	-179.0(7)	C16	C15	C10	C11	-103.2(8)
C6	O3	C9	C14	77.4(7)	C16	C15	C10	C9	76.4(7)
C6	O3	C9	C10	-156.8(5)	C16	O5	C17	C18	87.1(8)
C6	C1	C2	C8	-179.7(7)	O4	C16	O5	C17	2.7(9)
C6	C1	C2	C3	-0.9(10)					

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for 2384521.

Atom	*x*	*y*	*z*	U(eq)
H11	5133.5	6203.51	9389.71	33
H4	426.17	-1436.44	5799.17	33
H15A	2622.67	6632.06	8190.14	30
H15B	3404.25	7597.45	9135.29	30

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for 2384521.

Atom	*x*	*y*	*z*	U(eq)
H8	2565.12	2221.16	3341.44	41
H13A	6180.39	2156.31	7257.21	35
H13B	5431.76	4845.36	7064.44	35
H9	3279.62	1094.48	7767.31	26
H14A	4447.14	691.3	6623.42	30
H14B	4832.69	-548.46	7663.96	30
H7A	6.65	690.59	7204.04	54
H7B	755.34	11.16	8200.52	54
H7C	723.71	-2054.02	7326.55	54
H12A	6192.84	2254.68	8864.17	41
H12B	6469.38	5364.44	8575.37	41
H3	700.53	-1380.58	4280.2	32
H17A	1227.28	1661.51	9937.83	38
H17B	345.65	4037.14	9775.42	38
H18A	1353.21	6651.32	11048.64	66
H18B	2191.1	4169.66	11226.35	66
H18C	1046.74	3636.71	11392.69	66

checkCIF/PLATON report

Structure factors have been supplied for datablock(s) ab_aya_sp02336r_souvik

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: ab_aya_sp02336r_souvik

```
Bond precision:   C-C = 0.0096 A          Wavelength=1.54184

Cell:             a=13.1948(3)     b=4.7605(1)          c=14.5444(4)
                  alpha=90         beta=102.504(3)      gamma=90
Temperature:      100 K

                 Calculated                Reported
Volume           891.92(4)                 891.92(4)
Space group      P 21                      P 1 21 1
Hall group       P 2yb                     P 2yb
Moiety formula   C18 H21 I O5              C18 H21 I O5
Sum formula      C18 H21 I O5              C18 H21 I O5
Mr               444.25                    444.25
Dx,g cm-3        1.654                     1.654
Z                2                         2
Mu (mm-1)        14.318                    14.318
F000             444.0                     444.0
F000'            444.69
h,k,lmax         15,5,17                   15,5,17
Nref             3255[ 1840]               2723
Tmin,Tmax        0.291,0.564               0.189,1.000
Tmin'            0.000

Correction method= # Reported T Limits: Tmin=0.189 Tmax=1.000
AbsCorr = MULTI-SCAN

Data completeness= 1.48/0.84        Theta(max)= 68.022

R(reflections)= 0.0309( 2575)                wR2(reflections)=
                                             0.0774( 2723)
S = 1.079                 Npar= 219
```

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level C

PLAT342_ALERT_3_C Low Bond Precision on C-C Bonds ..... 0.00956 Ang.
PLAT911_ALERT_3_C Missing FCF Refl Between Thmin & STh/L= 0.600 6 Report
6 5 0, -11 4 5, 4 5 6, -8 2 10, -7 3 14, -6 3 14,
PLAT915_ALERT_3_C No Flack x Check Done: Low Friedel Pair Coverage 63 %

Alert level G

PLAT791_ALERT_4_G Model has Chirality at C9 (Sohncke SpGr) S Verify
PLAT909_ALERT_3_G Percentage of I>2sig(I) Data at Theta(Max) Still 88% Note
PLAT912_ALERT_4_G Missing # of FCF Reflections Above STh/L= 0.600 3 Note
PLAT969_ALERT_5_G The 'Henn et al.' R-Factor-gap value ..... 1.839 Note
Predicted wR2: Based on SigI**2 4.21 or SHELX Weight 7.17
PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density. 0 Info

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0 **ALERT level A** = Most likely a serious problem - resolve or explain
0 **ALERT level B** = A potentially serious problem, consider carefully
3 **ALERT level C** = Check. Ensure it is not caused by an omission or oversight
5 **ALERT level G** = General information/check it is not something unexpected

0 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
1 ALERT type 2 Indicator that the structure model may be wrong or deficient
4 ALERT type 3 Indicator that the structure quality may be low
2 ALERT type 4 Improvement, methodology, query or suggestion
1 ALERT type 5 Informative message, check

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

Publication of your CIF in IUCr journals

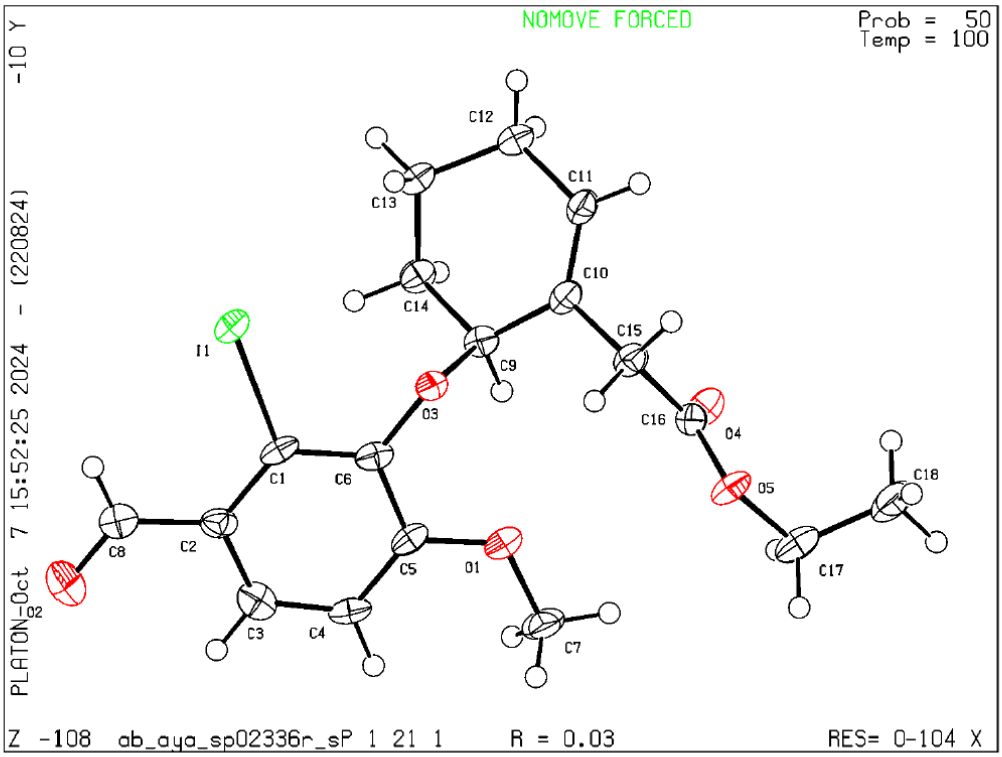
A basic structural check has been run on your CIF. These basic checks will be run on all CIFs submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit to *Acta Crystallographica Section C* or *E* or *IUCrData*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

PLATON version of 22/08/2024; check.def file version of 21/08/2024

Datablock ab_aya_sp02336r_souvlk - ellipsoid plot



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