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Supporting Information for

Straight from the Bottle! Wines and Juices Dicarboxylic Acids as Templates for Supramolecular Cage Self-Assembly

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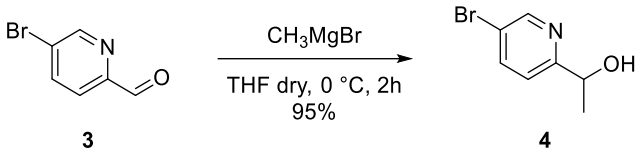
1 General Methods

NMR spectra were recorded at 301 K on Bruker Avance-300 MHz, Bruker 400 Avance III BBi-z grad 5 mm Bruker 600 Avance Neo spectrometer. All the ^{1}H-NMR spectra were referenced to residual isotopic impurity of $CDCl_3$ (7.26 ppm), DMSO-d_6 (2.50 ppm) or CD_3CN (1.98 ppm). ^{13}C-NMR spectra were referenced to the $CDCl_3$ peak (77.0 ppm) or CD_3CN peak (1.32 ppm).
The following abbreviations are used in reporting the multiplicity for NMR resonances; s=single, d=doublet, t= triplet, and m=multiplet. The NMR data were processed using Bruker Topspin 3.5 pl2 and MestReNova 12.0.0.
ESI-MS spectra have been acquired with an Agilent Technology LC/MSD Trap SL, interfaced to an Agilent 1100 binary pump. MS peak intensity for each analysis is reported as monoisotopic mass.
High resolution electrospray ionization mass spectrometry HRMS (ESI-TOF) analyses were performed in positive mode with Waters Xevo G2-S QTof. The analysis was performed with Fast Flow Injection: 10 ul of sample injected ACN at 30 ul/min. Capillary: 3000V, Sample cone: 30V, Source temperature: 80C, Desolvation temperature: 250 °C.
Chemicals were purchased from Sigma Aldrich, TCI, or Apollo Scientific and used without further purification.
ECD spectra were recorded with a Jasco J-1500 spectrometer and processed with OriginPro 2018 (64-bit) SR1 b9.5.1.195.
HPLC analysis were performed on a Shimadzu HPLC equipped with a Eurospher II 100-5 C18 (5 μm, 4.6 x 250 mm) column. The water, used for both solvent and diluent, was HPLC-grade. For buffering the mobile phase and adjusting the pH to 2.4, both monobasic potassium phosphate and phosphoric acid were used.

2 Synthesis and Characterization

2.1 Synthesis of 1-(5-bromopyridin-2-yl)ethan-1-ol (4)



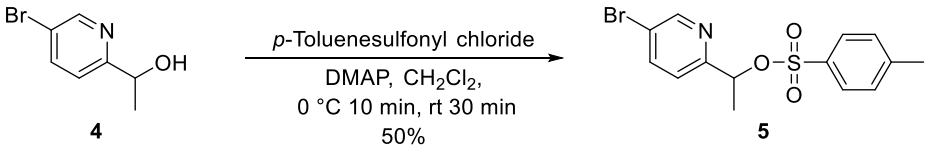
3 **4**

In a 250 mL double necked flask, 5-bromo-2-pyridinecarboxaldehyde **3** (10.00 g, 53.7 mmol) was dissolved in dry THF (180 mL) under N_2 and cooled to 0 °C. Methylmagnesium bromide (1.4 M in toluene/THF (3:1), 45.9 mL, 64.2 mmol) was added dropwise under stirring. After 2 hours, the reaction mixture was diluted with EtOAc, washed with potassium phosphate buffer (1 M, pH 7), dried over $MgSO_4$ and the solvent was removed under reduced pressure. The crude product **4** was obtained as a brownish oil and used in the next step without further purifications (10.26 g, 50.8 mmol, 95%).

^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 8.59 (d, *J* = 2.0 Hz, 1H), 7.80 (dd, *J* = 8.4, 2.3 Hz, 1H), 7.24 (d, *J* = 8.4 Hz, 1H), 4.86 (q, *J* = 6.4 Hz, 1H), 3.73 (s, 1H), 1.48 (d, *J* = 6.5 Hz, 2H).

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_7H_8BrNO+H]^+$, 202.00, found 201.93

2.2 Synthesis of 1-(5-bromopyridin-2-yl)ethyl 4-methylbenzenesulfonate (5)



4 **5**

In a 250 mL flask, to a stirred solution of alcohol **4** (9.17 g, 45.4 mmol) and DMAP (11.09 g, 90.8 mmol) in CH_2Cl_2 (180 mL) p-toluenesulfonyl chloride (10.33 g, 54.2 mmol) was added at 0 °C. The mixture was stirred for 10 min at the same temperature and then overnight at room temperature. After 12 hours, ice water was added to the reaction mixture and the mixture was extracted with CH_2Cl_2. The organic layer was washed with water and brine, dried over $MgSO_4$ and the solvent was removed under reduced pressure. The brownish oil was dissolved in CH_2Cl_2, and few milliliters of EtOH were added. The mixture was put in the fridge and after 24 h the pure product **5** was obtained as a pale brown crystalline solid that was washed with few milliliter of ice-cooled EtOH (8.10 g, 50 %).

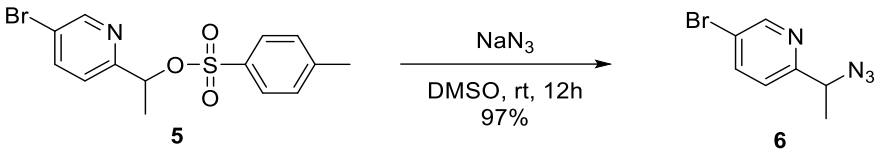
^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 8.50 (d, *J* = 2.4 Hz, 1H), 7.72 (dd, *J* = 8.3, 6.4 Hz, 4H), 7.29 – 7.20 (m, 4H), 5.55 (q, *J* = 6.6 Hz, 1H), 2.41 (s, 4H), 1.56 (d, *J* = 6.6, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 157.35, 150.21, 144.94, 139.53, 133.95, 129.87, 127.99, 122.12, 120.21, 80.13, 21.76.

FT-IR (KBr) ν (cm^{-1}): 2980, 2925, 1601, 1470, 1373, 1180, 1013.

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_{14}H_{14}BrNO_3S+H]^+$, 356.00 ; found 356.01.

2.3 Synthesis of 2-(1-azidoethyl)-5-bromopyridine (6)



In a 250 mL flask, a mixture of tosylate **5** (6.95 g, 19.5 mmol) and sodium azide (5.07 g, 78.0 mmol) was stirred in DMSO (100 mL) at room temperature overnight. After the reaction was complete the mixture was diluted with 150 mL of 30% EtOAc in hexane and washed with water and brine. The organic layer was dried over $MgSO_4$ and the solvent was removed under reduced pressure. The pure product **6** was obtained as a yellow oil (4.28 g, 97%).

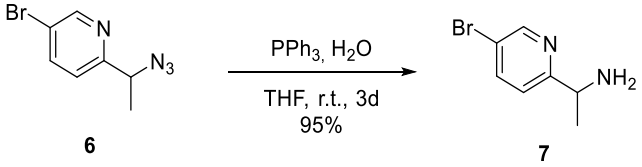
^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 8.62 (d, *J* = 2.4 Hz, 1H), 7.82 (dd, *J* = 8.3, 2.4 Hz, 1H), 7.32 – 7.14 (m, 1H), 4.62 (q, *J* = 6.9 Hz, 1H), 1.57 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 158.81, 150.62, 139.77, 122.06, 119.95, 61.10, 20.15.

FT-IR (CH_2Cl_2) ν (cm^{-1}): 2985, 2923, 2094, 1578, 1463.

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_7H_7BrN_4+H]^+$, 227.00, found 226.94.

2.4 Synthesis of 1-(5-bromopyridin-2-yl)ethan-1-amine (7)



In a 500 mL flask, a mixture of azide **6** (4.28g, 18.8 mmol), triphenylphosphine (9.89 g, 37.7 mmol), and water (0.68 mL, 37.7 mmol), was stirred in THF at room temperature for 48 hours. After that, water (0.68 mL, 37.7 mmol) was added and the reaction mixture was stirred for 24 hours. The mixture was condensed under reduced pressure and the residual brown oil was distilled using a Kügelrohr apparatus, yielding the pure product **7** as a pale yellow oil (3.6 g, 95%) (bp 130 °C/0.1 mm Hg).

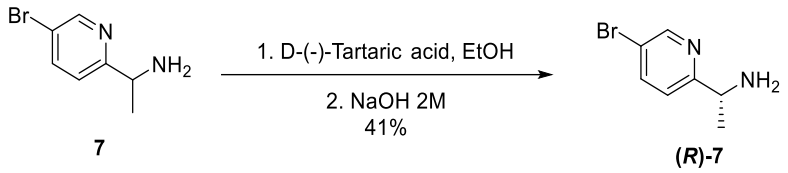
^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 8.59 (d, *J* = 2.4 Hz, 1H), 7.76 (dd, *J* = 8.2, 2.3 Hz, 1H), 7.23 (d, *J* = 8.4 Hz, 1H), 4.13 (q, *J* = 6.7 Hz, 1H), 1.88 (s, 3H), 1.40 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 164.41, 150.31, 139.28, 121.65, 118.70, 52.18, 24.53.

FT-IR (CH_2Cl_2) ν (cm^{-1}): 3350, 3591, 2976, 2931, 1587, 1463, 1365.

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_7H_9BrN_2+H]^+$, 201.00, found 200.95

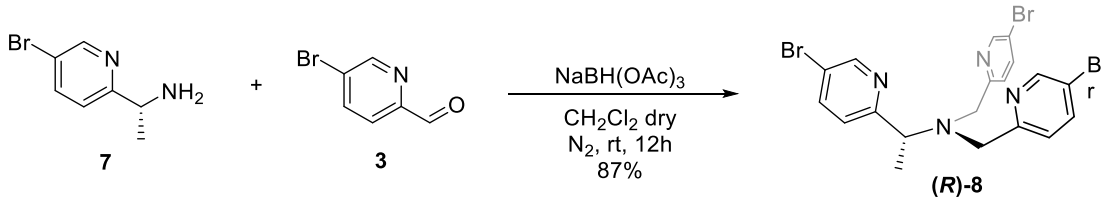
2.5 Synthesis of *R*-(+)-1-(5-bromopyridin-2-yl)ethan-1-amine ((*R*)-7)



In a Schlenk apparatus, racemic 1-(5-bromopyridin-2-yl)ethan-1-amine **7** (4.10 g, 12.6 mmol) and D-(−)-tartaric acid (3.50 g, 23.3 mmol) were dissolved in 2 mL of boiling water. Then 10 mL of boiling EtOH were added to the mixture. The solution was cooled to room temperature. After 24 hours, a white crystalline precipitate was observed. The supernatant was removed and the crystals washed with few milliliters of EtOH and Et_2O. Four recrystallizations of this precipitate from 8 mL of 95% EtOH gave the (−)-acid tartrate salt of *R*-(+)-amine (>99% e.e.). The salt was dissolved in 50 mL of 2 M NaOH and the solution was extracted with Et_2O. The organic layer was dried with $MgSO_4$ and concentrated under reduced pressure. The pure product (***R*)-7** was obtained as a pale yellow oil (0.85 g, 41%). The enantiomeric excess of (***R*)-7** has been reported via NMR using a reported procedure.[1]

$[\alpha]_D^{25}$ = +13.7° (c 0.02 g/mL, CH_2Cl_2)

2.6 Synthesis of *R*-(+)1-(5-bromopyridin-2-yl)-*N*,*N*-bis((5-bromopyridin-2-yl)methyl)ethan-1-amine ((*R*)-8)



In a Schlenk apparatus, **(*R*)-7** (0.40 g, 2.2 mmol) and 5-bromo-2-pyridinecarboxaldehyde **3** (0.41 g, 2.2 mol) were dissolved in 15 mL of dry CH_2Cl_2 under N_2, and left under stirring for 1 hour. Three aliquots of $NaBH(OAc)_3$ (0.15 g, 0.73 mmol) were added waiting 20 minutes between each addition. After that, 5-bromo-2-pyridinecarboxaldehyde **3** (0.41 g, 2.2 mol) was added and the mixture was left under stirring for 1 hour. Three aliquots of $NaBH(OAc)_3$ (0.15 g, 0.73 mmol) were added waiting 20 minutes between each addition. After the reaction mixture was stirred for 12 hours at room temperature. The solvent was removed under reduced pressure. The resulting brown oil was dissolved in EtOAc and the solution extracted with 0.1 M solution of KOH (3x25 mL). The organic phases were dried with $MgSO_4$ and the solvent was removed under reduced pressure. The crude product was chromatographed on neutral alumina (CH_2Cl_2/EtOAc = 9.5 : 0.5). The pure product (***R*)-8** was collected as a yellow oil (0.94 g, 87%).

$[\alpha]_D^{25}$ = +121.1° (c 0.02 g/mL, CH_2Cl_2)

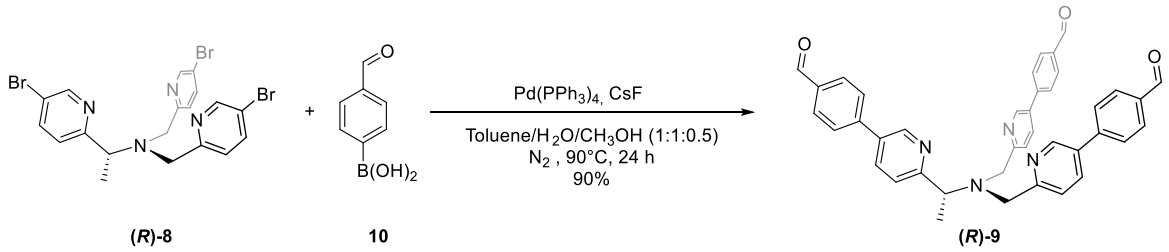
^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm): δ 8.65 (d, *J* = 2.4 Hz, 1H), 8.59 (d, *J* = 2.3 Hz, 2H), 7.80 (dd, *J* = 8.3, 2.4 Hz, 1H), 7.77 (dd, *J* = 8.3, 2.4 Hz, 2H), 4.02 (q, *J* = 6.8 Hz, 1H), 3.93 (d, *J* = 15.0 Hz, 2H), 3.72 (d, *J* = 15.0 Hz, 2H), 1.53 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 160.45, 158.93, 150.24, 139.20, 138.96, 124.36, 119,36, 119.11, 59.96, 56.23, 14.91.

FT-IR (KBr) ν (cm^{-1}): 2980, 2931, 2837 1573, 1468, 1362, 1084, 1007.

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_{19}H_{17}Br_3N_4+H]^+$, 538.90; found 538.93.

2.7 Synthesis of (*R*)-4,4'-((((1-(5-(4-formylphenyl)pyridin-2-yl)ethyl)azanediyl) bis(methylene))bis(pyridine-6,3-diyl))dibenzaldehyde ((*R*)-9)



(*R*)-8 10 (*R*)-9

In a Schlenk apparatus, a mixture of (***R*)-8** (0.465 g, 0.9 mmol), 4-formyphenylboronic acid **10** (1.030 g, 6.9 mmol), $Pd(PPh_3)_4$ (0.100 g, 0.086 mmol) and CsF (1.88 g, 12.3 mmol) was dissolved in 10 mL of H_2O/toluene/CH_3OH (1:1:0.5). The mixture was stirred under N_2 for 24 hours at 90 °C. The solvent was removed under reduced pressure. The resulting brown oil was dissolved in $CHCl_3$ and the solution washed with H_2O. the organic phases were dried over $MgSO_4$, filtered on Celite and the solvent was removed under reduced pressure. The resulting brown oil was precipitated by crystallization from THF/hexane to yield the product (***R*)-9** as pale yellow solid.

$[\alpha]_D^{25}$ = +95.2° (c 0.01 g/mL, CH_2Cl_2)

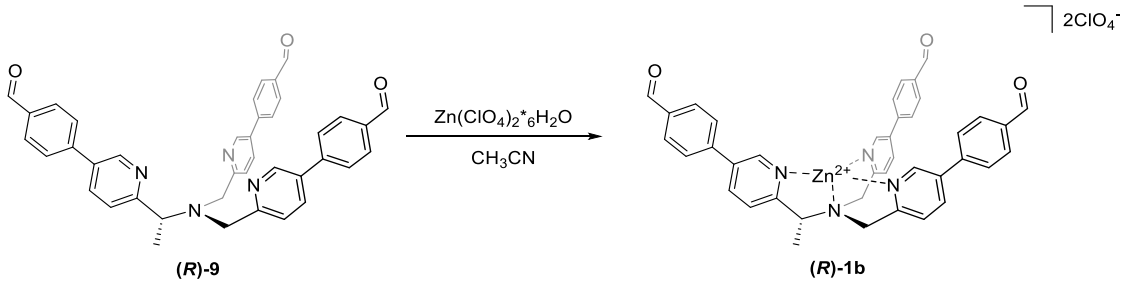
^{1}H NMR (600 MHz, $CDCl_3$) δ (ppm): 10.12-10.10 (m, 3H), 8.92 (d, *J* = 2.4 Hz, 1H), 8.83 (d, *J* = 2.3 Hz, 2H), 8.03-7.99 (m, 6H), 7.96 (dd, *J* = 8.1, 2.4 Hz, 1H), 7.93 (dd, *J* = 8.1, 2.4 Hz, 2H), 7.81 – 7.72 (m, 8H), 7.70 (d, *J* = 8.1 Hz, 1H), 4.26 (q, *J* = 6.8 Hz, 1H), 4.16 (d, *J* = 15.1 Hz, 2H), 3.96 (d, *J* = 15.1 Hz, 2H), 1.70 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 191.71, 161.97, 160.53, 147.60, 143.75, 135.81, 135.16, 134.92, 133.68, 130.54, 127.65, 123.08, 60.48, 56.71, 15.17.

FT-IR (KBr) ν (cm^{-1}): 2977, 2934, 2827, 1701, 1600, 1211, 1172, 821.

ESI-MS (m/z): $[M+H]^+$ calcd. for $[C_{40}H_{32}N_4O_3+H]^+$, 617.30; found 617.28.

2.8 Synthesis of complex (*R*)-1b



To a suspension of ligand (***R*)-9** (100 mg, 0.18 mmol) in CH_3CN (25 mL) zinc(II) perchlorate hexahydrate was added (67 mg, 0.18 mmol). The solution was stirred at room temperature for 1 hour and the reaction was followed by ^{1}H-NMR and ESI-MS. At the end of the reaction Et_2O (25mL) was added, obtaining quantitatively a crystalline solid then centrifugated and dried. Complex (***R*)-1b** resulted as pale yellow solid (154 mg, 95%).

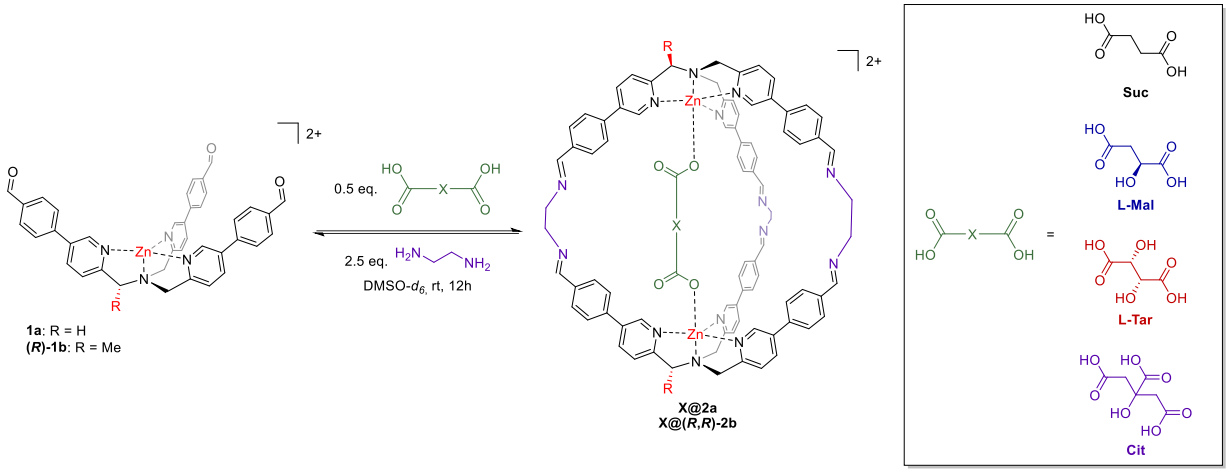
$[\alpha]_D^{25}$ = +181.9° (c 0.01 g/mL, CH_3CN)

^{1}H NMR (600 MHz, CD_3CN) δ (ppm): δ 10.13 (m, 3H, CHO), 9.05 (d, *J* = 2.2 Hz, 1H, PyrH), 9.03 (d, *J* = 2.1 Hz, 1H, PyrH), 9.02 (d, *J* = 2.1 Hz, 1H, PyrH), 8.55 (dd, *J* = 8.4, 2.2 Hz, 1H, PyrH), 8.48 (dd, *J* = 8.3, 2.2 Hz, 1H, PyrH), 8.46 (dd, *J* = 8.2, 2.2 Hz, 1H, PyrH), 8.12-8.11 (m, 6H, ArH), 8.02 – 7.95 (m, 6H, ArH), 7.93 (d, *J* = 8.4 Hz, 1H, PyrH), 7.80 (d, *J* = 8.3 Hz, 1H, PyrH), 7.75 (d, *J* = 8.3 Hz, 1H, PyrH), 4.71 (d, *J* = 17.1 Hz, 1H, CH), 4.42 (d, *J* = 16.8 Hz, 1H, CH), 4.29 (q, *J* = 6.7 Hz, 1H, CH), 4.11 (d, *J* = 17.1 Hz, 1H, CH), 4.05 (d, *J* = 16.8 Hz, 1H, CH), 1.86 (d, *J* = 6.8 Hz, 3H, CH_3).

^{13}C NMR (151 MHz, CD_3CN) δ (ppm) 193.21, 159.00, 156.02, 155.84, 147.92, 147.81, 141.85, 141.71, 141.49, 138.05, 138.01, 137.85, 137.80, 137.77, 131.35, 129.24, 129.19, 126.41, 126.25, 125.41, 60.16, 55.41, 53.00, 12.47.

ESI-MS (m/z): $[M+Cl]^+$ calcd. for $[C_{40}H_{32}N_4O_3Zn+Cl]^+$, 715.15; found 715.25.

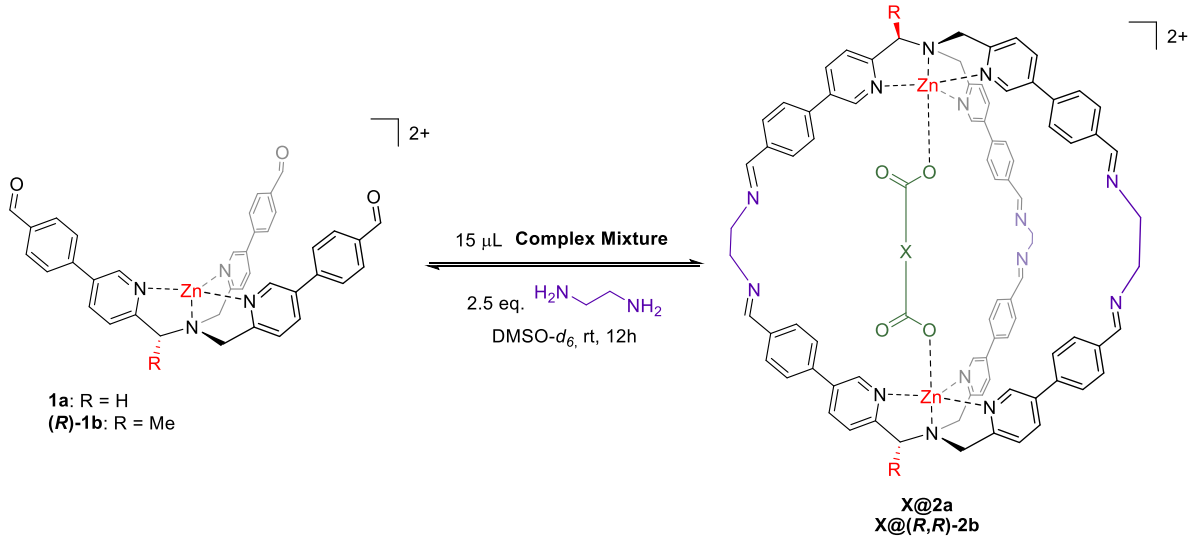
2.9 Synthesis of Cages X@2a and X@(*R*,*R*)-2b.



General procedure for the synthesis of molecular cages **X@2a** and **X@(*R*,*R*)-2b**. Perchlorate counterions are removed for clarity. Citric acid **Cit** has been employed as guest only in the presence of complex **1a**.

To 500 µl (1.0 µmol) of a solution 0.002 M of complex **1a** or **(*R*)-1b** in DMSO-*d6*, 50 µl (0.5 µmol, with 2 eq. of triethylamine) of a solution 0.01 M in DMSO-d_6 of a dicarboxylic acid **X** and 125 µl (2.5 µmol) of a solution 0.02 M in DMSO-*d6* of ethylenediamine were added in a NMR tube. The mixture was left for 12 hours at room temperature and checked *via* ^{1}H-NMR and ESI-MS. The yield for all the cages is >95% (Determined *via* ^{1}H-NMR based on internal standard *p*-xylene).

2.10 Synthesis of Cages in the presence of complex mixtures



General procedure for the synthesis of molecular cages **X@2a** and **X@(*R*,*R*)-2b**. Perchlorate counterions are removed for clarity.

To 500 µl (1.0 µmol) of a solution 0.002 M of complex **1a** or **(*R*)-1b** in DMSO-*d6*, 15 µL of Complex mixture without pre-treatment and 125 µl (2.5 µmol) of a solution 0.02 M in DMSO-*d6* of ethylenediamine were added in a NMR tube. The mixture was left for 12 hours at room temperature and checked *via* ^{1}H-NMR and ESI-MS. The concentration of **L-Tar@2a**, **L-Mal@2a**, and **L-Suc@2a** was determined *via* ^{1}H-NMR based on internal standard *p*-xylene, Table S1).

2.10.1 L-Tar@2a

^{1}H-NMR (600 MHz, DMSO-d_6) δ (ppm): 9.37 (s, 6H, PyrH), 8.23 (s, 6H, NH_{imm}), 8.16 (d, J = 7.5 Hz, 6H, PyrH), 7.85 (d, J = 7.8 Hz, 12H, ArH), 7.70 (d, J = 7.4 Hz, 12H, ArH), 7.50 – 7.48 (m, 6H, PyrH), 4.98 (d, J = 4.8 Hz, 2H, OH_{TAR}), 4.83 (d, J = 4.8 Hz, 2H, CH_{TAR}), 4.48 – 4.38 (m, 12H, CH_2-$_{TPMA}$), 3.98 – 3.85 (m, 12H, CH_2-$_{EDA}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{88}H_{76}N_{14}O_6Zn_2]^{2+}$,776.2322 ; found 776.2319.

2.10.2 L-Mal@2a

^{1}H-NMR (600 MHz, DMSO-d_6) δ (ppm): 9.39 – 9.30 (m, 6H, PyrH), 8.28 – 8.26 (m, 6H, NH_{imm}), 8.18 – 8.13 (m, 6H, PyrH), 7.85 (d, J = 7.8 Hz, 12H, ArH), 7.66 – 7.63 (m, 12H, ArH), 7.53 – 7.49 (m, 6H, PyrH), 4.92 – 4.90 (m, 2H, OH_{MAL} – CH_{MAL}), 4.46 – 4.43 (m, 12H, CH_2-$_{TPMA}$), 3.95 – 3.91 (m, 12H, CH_2-$_{EDA}$), 2.84 – 2.79 (m, 2H, $CH_{2\text{-}MAL}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{88}H_{76}N_{14}O_5Zn_2]^{2+}$, 768.2347; found 768.2348.

2.10.3 Suc@2a

^{1}H-NMR (600 MHz, DMSO-d_6) δ (ppm): 9.34 (s, 6H, PyrH), 8.29 (s, 6H, NH_{imm}), 8.16 (d, J = 8.1 Hz, 6H, PyrH), 7.85 (d, J = 8.4 Hz, 12H, ArH), 7.64 (d, 12H, J = 8.3 Hz, ArH), 7.51 (d, 6H, J = 8.2 Hz, PyrH), 4.45 (s, 12H, CH_2-$_{TPMA}$), 3.96 (s, 12H, CH_2-$_{EDA}$), 2.87 (s, 4H, $CH_{2\text{-}SUC}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{88}H_{76}N_{14}O_4Zn_2]^{2+}$, 760.2373; found 760.2349.

2.10.4 Cit@2a

^{1}H-NMR (600 MHz, DMSO-d_6) δ (ppm): 9.50 – 9.34 (m, 6H, PyrH), 8.31 – 8.23 (m, 12H, NH_{imm}+ PyrH), 7.82 – 7.71 (m, 26H, ArH+PyrH), 7.51 (s, 4H, PyrH), 4.46 (s, 12H, CH_2-$_{TPMA}$), 4.01 – 3.82 (m, 12H, CH_2-$_{EDA}$), ($CH_{2\text{-}CIT}$, 4H, hidden by solvent).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{78}N_{14}O_7Zn_2]^{2+}$, 797.2374; found 797.2391.

2.10.5 L-Tar@(*R*,*R*)-2b

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.59 – 9.17 (m, 6H, PyrH), 8.35 (d, J = 8.3 Hz, 2H, PyrH), 8.31 – 8.16 (m, 8H, NH_{imm}+PyrH), 8.01 – 7.99 (m, 4H, ArH+PyrH), 7.88 – 7.53 (m, 26H, ArH+PyrH), 7.09 (d, J = 8.2 Hz, 2H, PyrH), 5.03 (d, J = 4.6 Hz, 2H, OH_{TAR}), 4.99 – 4.92 (m, 2H, CH_{TPMA}), 4.90 (d, J = 4.6 Hz, 2H, CH_{TAR}), 4.62 – 4.58 (m, 2H, $CH_{2\text{-}TPMA}$), 4.52 – 4.47 (m, 2H, $CH_{2\text{-}TPMA}$), 4.24 – 4.13 (m, 4H, $CH_{2\text{-}TPMA}$), 3.96 – 3.87 (m, 4H, CH_2-$_{EDA}$), 3.68 – 3.64 (m, 8H, CH_2-$_{EDA}$), 1.84 (d, J = 6.6 Hz, 6H, CH_3-$_{TPMA}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{80}N_{14}O_6Zn_2]^{2+}$, 790.2479; found 790.2465.

2.10.6 D-Tar@(*R*,*R*)-2b

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.67 – 9.24 (m, 6H, PyrH), 8.29 – 8.19 (m, 12H, NH_{imm}+PyrH), 8.03 – 8.00 (m, 6H, NH_{imm}+PyrH), 7.85 – 7.80 (m, 8H, ArH+PyrH), 7.77 – 7.73 (m, 4H, ArH+PyrH), 7.64 – 7.54 (m, 10H, ArH+PyrH), 7.15 (d, J = 8.3 Hz, 2H), 4.94 – 4.92 (m, 4H, CH_{TPMA}+OH_{TAR}), 4.69 (d, J = 6.0 Hz, 2H, CH_{TAR}), 4.94 – 4.92 (m, 4H, $CH_{2\text{-}TPMA}$), 4.13 – 3.82 (m, 16H, $CH_{2\text{-}TPMA}$+CH_2-$_{EDA}$), 1.85 (d, J = 6.8 Hz, 6H, CH_3-$_{TPMA}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{80}N_{14}O_5Zn_2]^{2+}$, 790.2479; found 790.2465.

2.10.7 L-Mal@(*R*,*R*)-2b

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.72 – 9.11 (m, 6H, PyrH), 8.39 – 8.12 (m, 9H, NH_{imm}+PyrH), 8.07 – 7.96 (m, 5H, PyrH), 7.89 – 7.56 (m, 26H, ArH+PyrH), 7.20 – 7.12 (m, 2H, PyrH), 4.97 – 4.86 (m, 6H, CH_{MAL}+OH_{MAL}+ CH-$_{TPMA}$), 4.56 – 4.52 (m, 4H, CH_2-$_{TPMA}$), 4.16 – 4.14 (m, 2H, CH_2-$_{TPMA}$), 4.03 – 3.77 (m, 12H, CH_2-$_{EDA}$), , 1.87 – 1.84 (m, 6H, CH_3-$_{TPMA}$), ($CH_{2\text{-}MAL}$, 2H, hidden by solvent).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{80}N_{14}O_5Zn_2]^{2+}$, 782.2504; found 782.2457.

2.10.8 D-Mal@(*R*,*R*)-2b

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.73 – 9.07 (m, 6H, PyrH), 8.36 – 8.15 (m, 8H, NH_{imm}+PyrH), 8.06 – 7.54 (m, 32H, ArH+PyrH), 7.18 – 7.12 (m, 2H, PyrH), 4.96 – 4.84 (m, 5H, CH_{MAL}+OH_{MAL}+CH-$_{TPMA}$), 4.57 – 4.50 (m, 4H, CH_2-$_{TPMA}$), 4.18 – 4.16 (m, 2H, CH_2-$_{TPMA}$), 4.08 – 3.75 (m, 13H, CH_2-$_{TPMA}$+CH_2-$_{EDA}$), , 1.86 – 1.83 (m, 6H, CH_3-$_{TPMA}$), ($CH_{2\text{-}MAL}$, 2H, hidden by solvent).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{80}N_{14}O_6Zn_2]^{2+}$, 782.2504; found 782.2457.

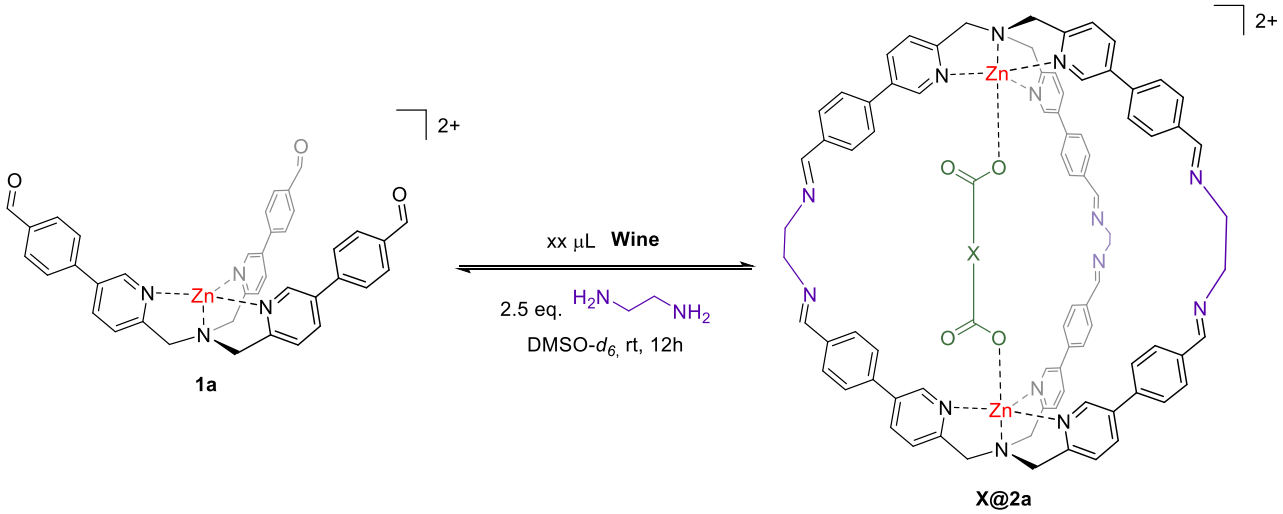
2.10.9 Suc@(*R*,*R*)-2b

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.53 – 9.15 (m, 6H, PyrH), 8.35 (s, 2H, NH_{imm}), 8.30 – 8.28 (m, 4H, NH_{imm}+PyrH), 8.24 (s, 2H, NH_{imm}), 8.19 – 8.17 (m, 2H, PyrH), 8.04 – 8.02 (m, 2H, PyrH), 7.97 (d, J = 8.3 Hz, 4H, ArH), 7.84 – 7.71 (m, 14H, ArH+PyrH), 7.62 – 7.58 (m, 8H, ArH+PyrH), 7.57 – 7.54 (m, 2H, PyrH), 7.20 (d, J = 8.3 Hz, 2H, PyrHf), 4.85 – 4.82 (m, 2H, CH-$_{TPMA}$), 4.53 (s, 4H, CH_2-$_{TPMA}$), 4.15 – 4.13 (m, 2H, CH_2-

$_{TPMA}$), 4.06 – 3.93 (m, 10H, CH_2-$_{TPMA}$+CH_2-$_{EDA}$), 3.84 – 3.83 (m, 4H, CH_2-$_{EDA}$), 2.34 (s, 4H, CH_2-$_{SUC}$), 1.85 (d, J = 6.7 Hz, 6H, CH_3-$_{TPMA}$).

HRMS (ESI-TOF) (*m/z*): [M^{2+}] calcd. for $[C_{90}H_{80}N_{14}O_4Zn_2]^{2+}$, 774.2529; found 774.2508.

3 Self Assembly with different amount of Wine



General procedure for the synthesis of molecular cage **X@2a** using different quantities of Valpolicella wine. Perchlorate counterions are removed for clarity.

To 500 µl (1.0 µmol) of a solution 0.002 M of complex **1** in DMSO-d_6 different amount of Valpolicella wine (15 µL, 30 µL, 50 µL, 75 µL, 100 µL, and 125 µL) without pre-treatment were added (triethylamine was added to correct the acidity of wine). In order to keep the concentration constant, DMSO-d_6 was added to reach the final volume of 625 µL. Then, 125 µl (2.5 µmol) of a solution 0.02 M in DMSO-*d6* of ethylenediamine were added slowly under stirring. The mixture was left for 12 hours at room temperature and checked *via* ^{1}H-NMR using p-xylene as internal standard.

3.1 Addition of 15 µL of wine

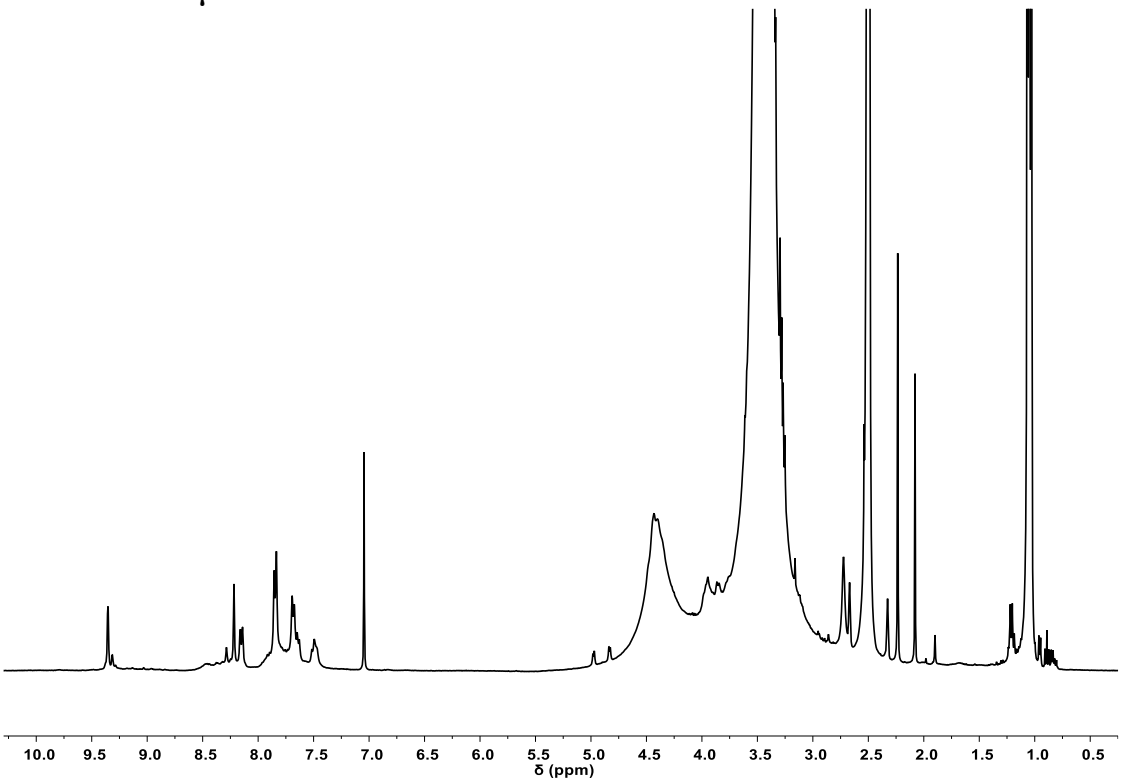


Figure S1 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 15 µL of wine (yield 43% based on p-xylene).

3.2 Addition of 30 µL of wine

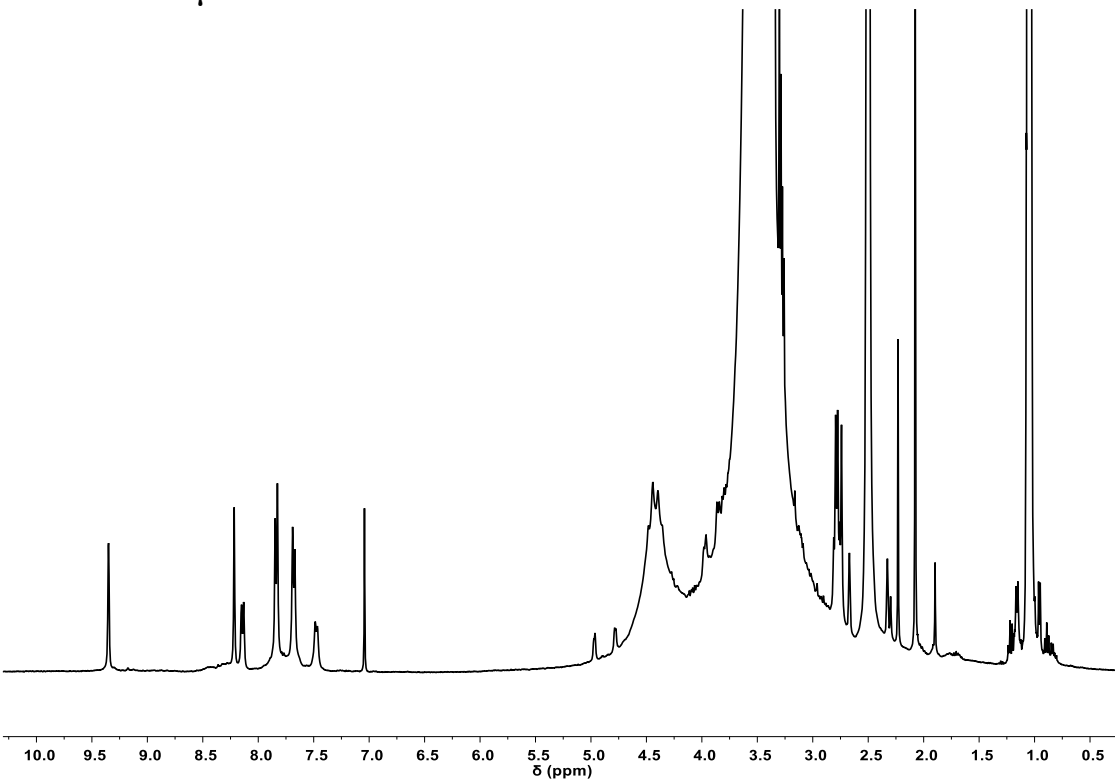


Figure S2 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 30 µL of wine (yield 94% based on p-xylene).

3.3 Addition of 50 µL of wine

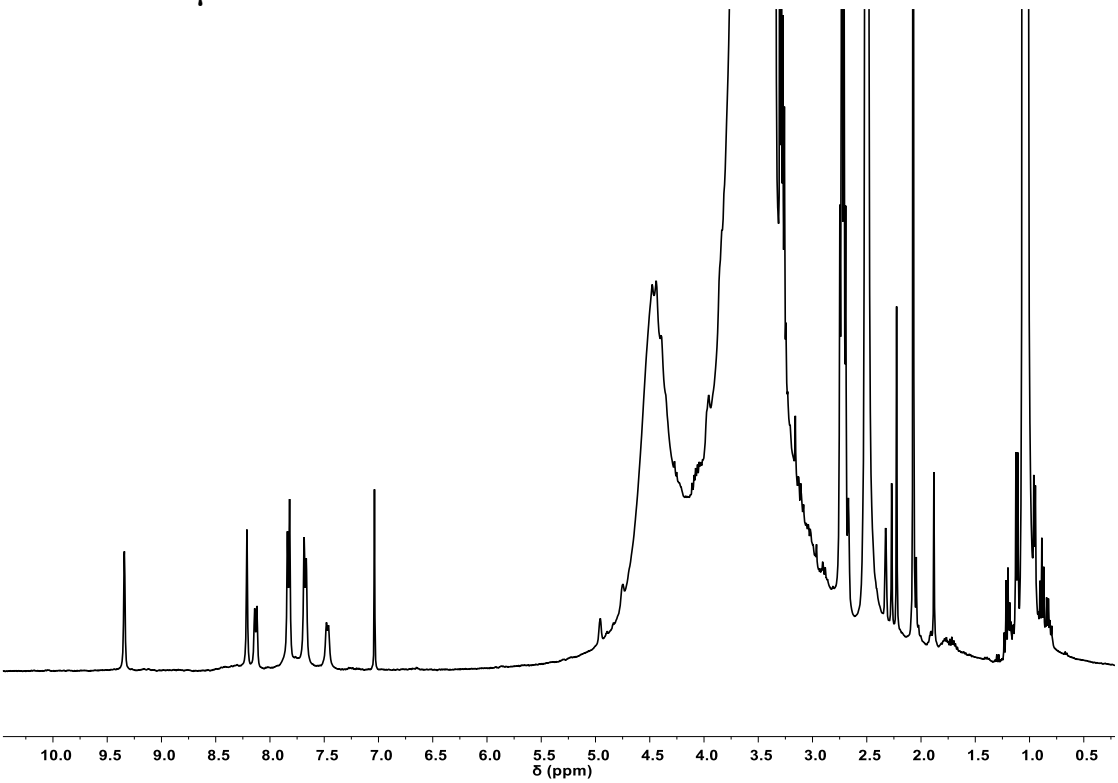


Figure S3 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 50 µL of wine (yield 72% based on p-xylene).

3.4 Addition of 75 µL of wine

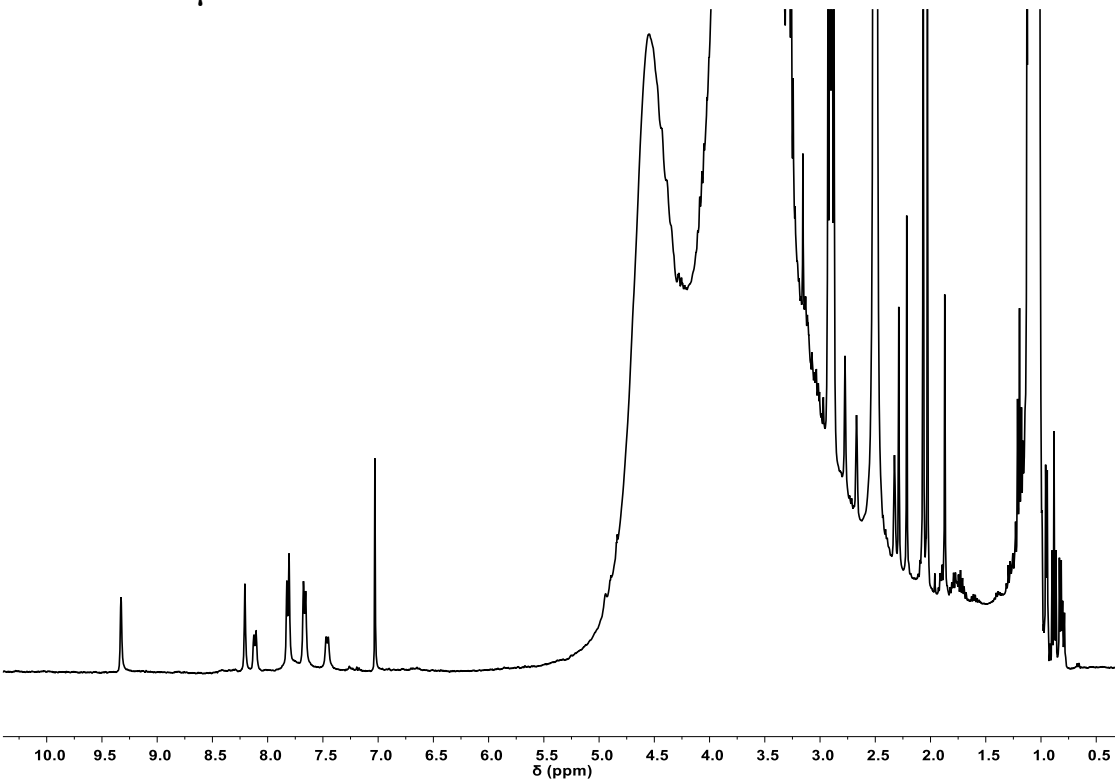


Figure S4 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 75 µL of wine (yield 33% based on p-xylene).

3.5 Addition of 100 µL of wine

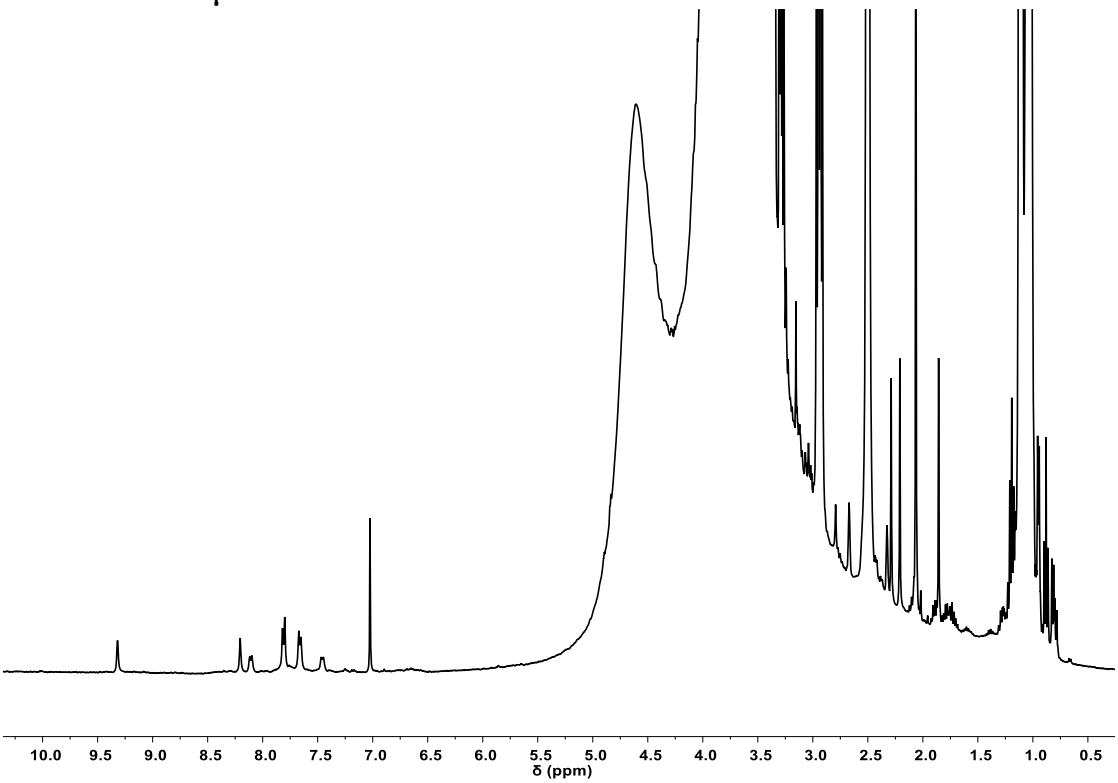


Figure S5 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 100 µL of wine (yield 22% based on p-xylene)..

3.6 Addition of 125 µL of wine

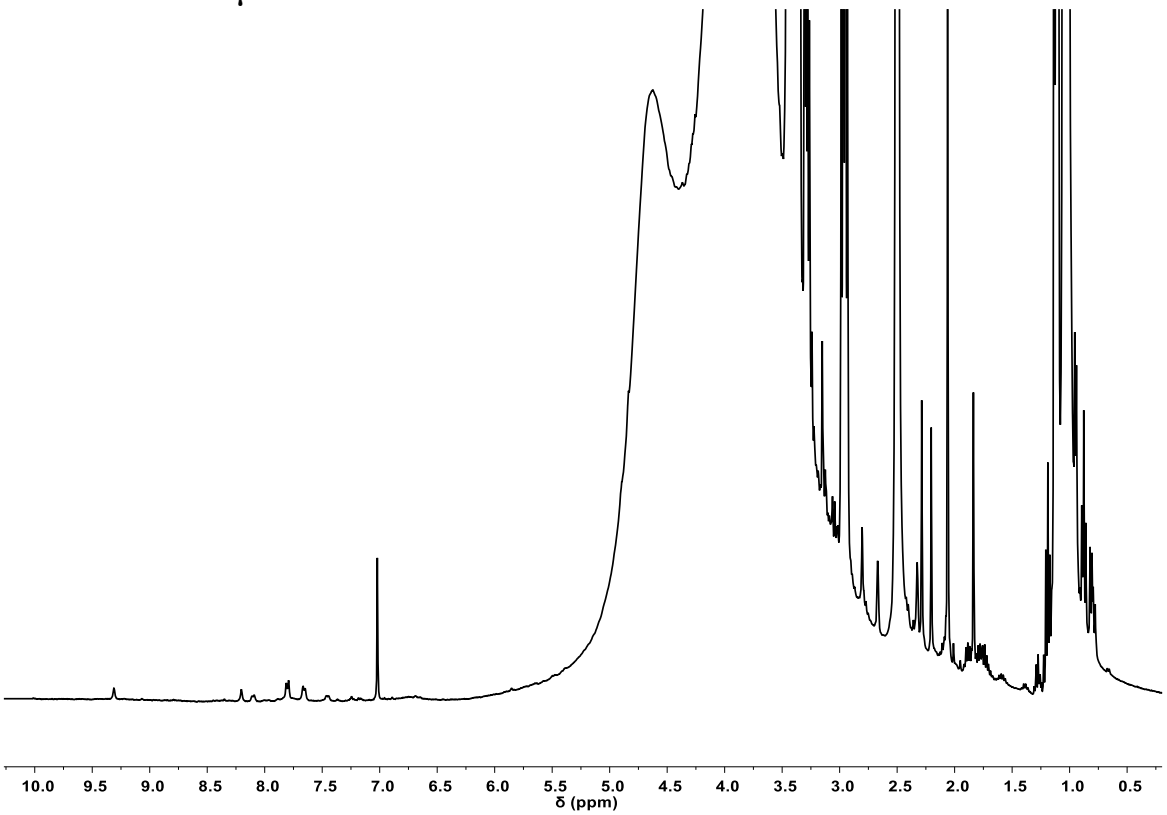


Figure S6 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the mixture obtained using 125 µL of wine (yield 8% based on p-xylene)..

4 ECD measurement

ECD measurement was performed diluting complex **(*R*)-1b** with CH_3CN to obtain a final concentration equal to $1.0 \cdot 10^{-5}$M (0.1 cm cuvette). The CD spectrum was measured in millidegrees and reported in G value.

4.1 CD spectrum of complex (*R*)-1b

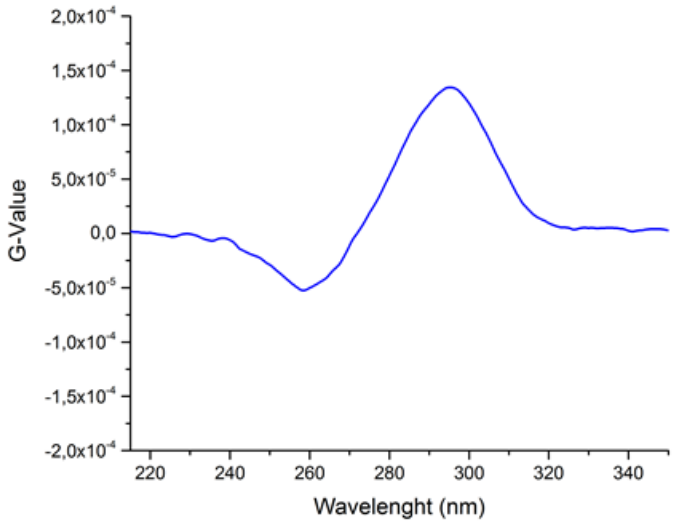
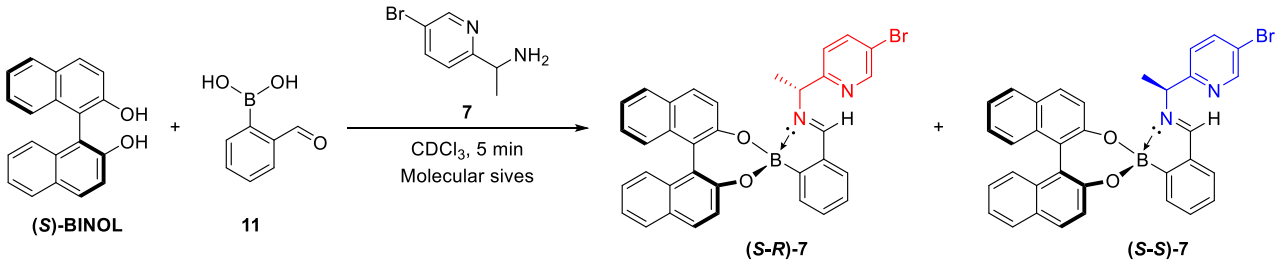


Figure S7 ECD spectrum of complex **(*R*)-1b**.

5 Determination of the enantiomeric excess of (*R*)-7

The enantiomeric excess of the chiral amine ***R*-7** has been determined using a procedure reported by Bull *et al.*[1] To obtain the derivatization, 1.0 equiv. of boronic acid **11**, 1.1 equiv. of **(*S*)-BINOL** and 1.0 equiv. of the racemic amine **7** was dissolved in $CDCl_3$ in the presence of 4 Å molecular sieves and the ^{1}H-NMR was acquired after 5 minutes. The reaction led to the formation of rigid diastereoisomeric imino-boronate esters **(*S*-*R*)- 7** and **(*S*-*S*)-7**



The ^{1}H-NMR spectrum of racemic **7** showed a good separation of the doublet of the methyl group, the quartet of the benzylic proton, and the imine proton due to the significantly different anisotropic effects experienced by the amine fragments in the presence of more than one aryl substituent. As expected, the racemic mixture presented the doubling of the signal in a 1:1 ratio, making this method suitable for the determination of the enantiomeric excess of the crystallized amines (Figure S8).

As shown in Figure S9, the ^{1}H-NMR of ***R*-27**, after four crystallizations, showed the presence of only one diastereomer in solution, with the disappearance of the signals of the second specie, indicating the complete resolution of the enantiomer. The absolute configuration of the enantiomer has been attributed from the work of Bull taking α-phenylethylamine as reference.

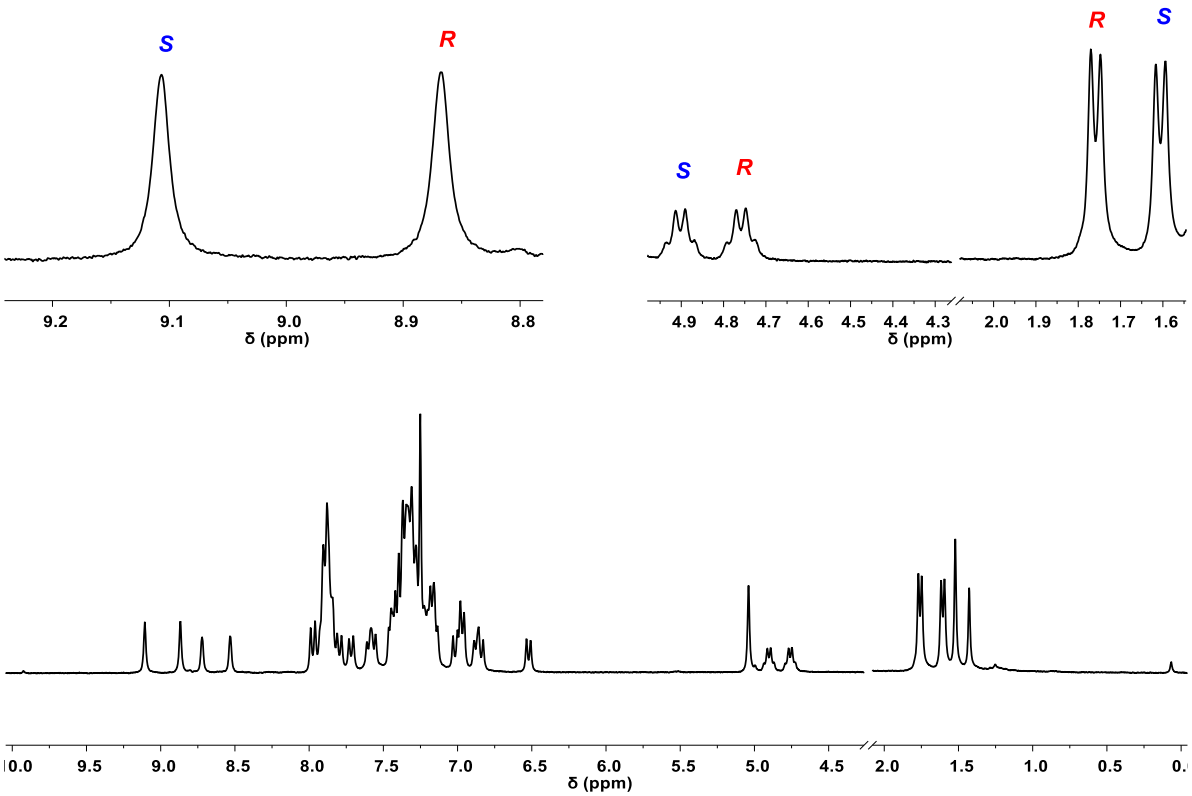


Figure S8 ^{1}H-NMR ($CDCl_3$, 300 MHz) spectrum of racemic mixture **(*S*-*R*)-7** and **(*S*-*S*)-7**

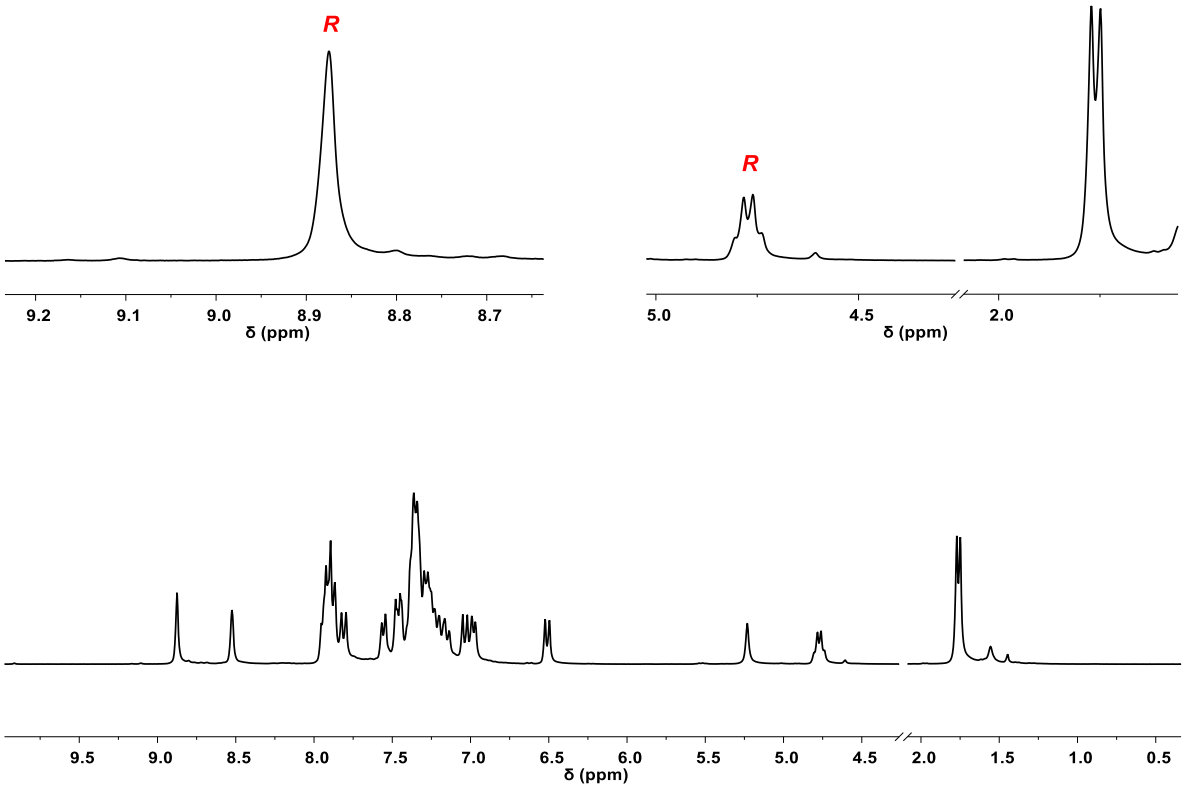
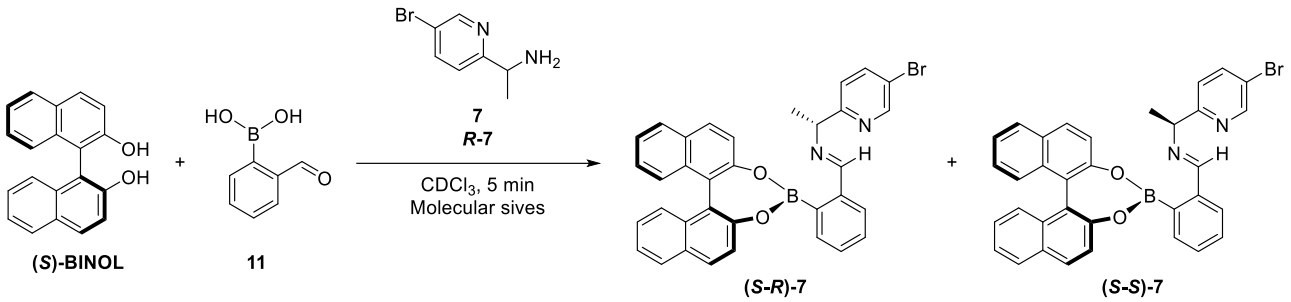


Figure S9 ^{1}H-NMR ($CDCl_3$, 300 MHz) spectrum of **(*S*-*R*)-7**

5.1 Procedure for the enantiomeric excess determination of 1-(5-bromopyridin-2-yl)ethan-1-amine (7)



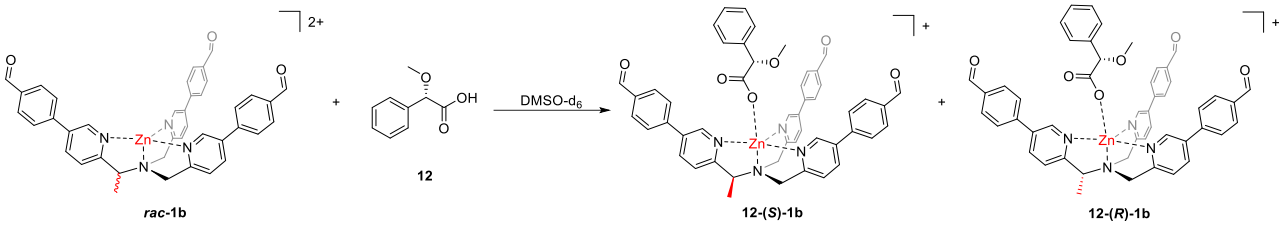
In a vial, 1.1 equiv. of (*S*)-(−)-1,1'-Bi(2-naphthol) **(*S*)-BINOL**, 1.0 equiv. of 2-formylphenylboronic acid **8** and 1.0 equiv. of 1-(5-bromopyridin-2-yl)ethan-1-amine **7** or (***R*)-7** were dissolved in 2 mL of $CDCl_3$ in the presence of 4 Å molecular sieves. The ^{1}H-NMR spectrum of an aliquot was acquired after 5 minutes.

6 Determination of the enantiomeric excess of zinc complex (*R*)-1b

Since it was not possible to find a method for the quantification of enantiomeric excess of the ligand (***R*)-9** using neither chiral chromatography nor chiral derivatization, the attention was focused on the zinc complex (***R*)-1b**.

The capability of the zinc complex to bind chiral carboxylic acid was exploited to determine its enantiomeric excess using NMR technique.

To analyze the optical purity of the both zinc complexes (***R*)-1b** using NMR analysis, (*S*)-(+)-2-methoxy-2-phenylacetic acid **12** was employed as CSR



Adding chiral acid **12** to a solution of the racemic complex ***rac*-1b** in DMSO-d_6 allowed to observe a doubling of the signals in the region of the α pyridine protons between 8.90 ppm and 9.30. From the relative ratio of the areas of the signals it was possible to estimate directly the enantiomeric excess of the complex, considering the experimental error of the NMR technique. As shown in Figure S10, the racemic complex presented two doubling peaks with the same areas.

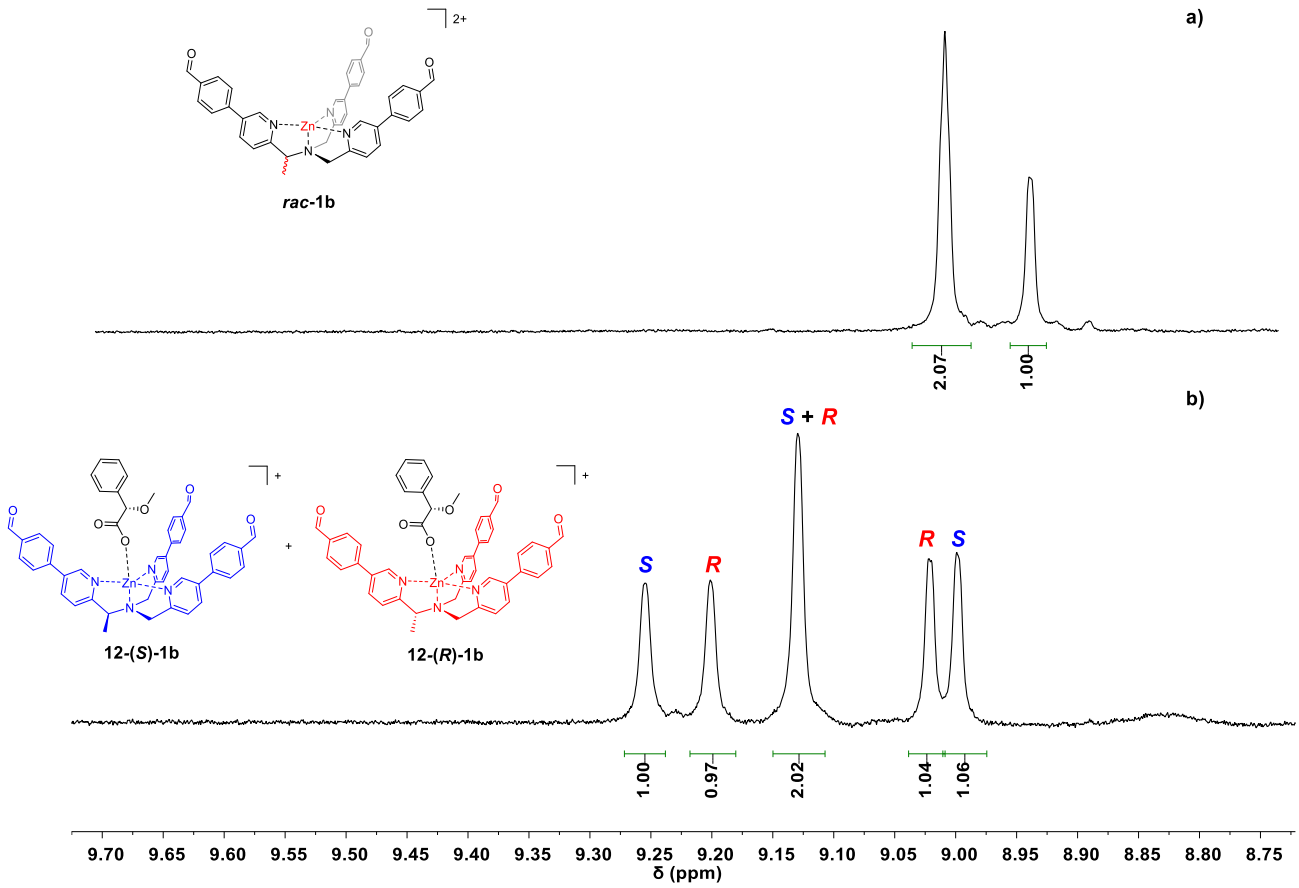


Figure S10 ^{1}H-NMR (DMSO-d_6, 600 MHz) spectrum of a) ***rac*-1b** complex, b) ***rac*-1b** complex after the addition of (*S*)-(+)-2-methoxy-2-phenylacetic acid **12**. From the relative ratio of the areas it was possible to estimate the enantiomeric excess.

The enantiomeric excess of zinc complex (***R*)-1b,** has been reported in Figure S11.

From the relative ratio of the areas of the obtained signals, more than 90% of enantiomeric excess was estimated.

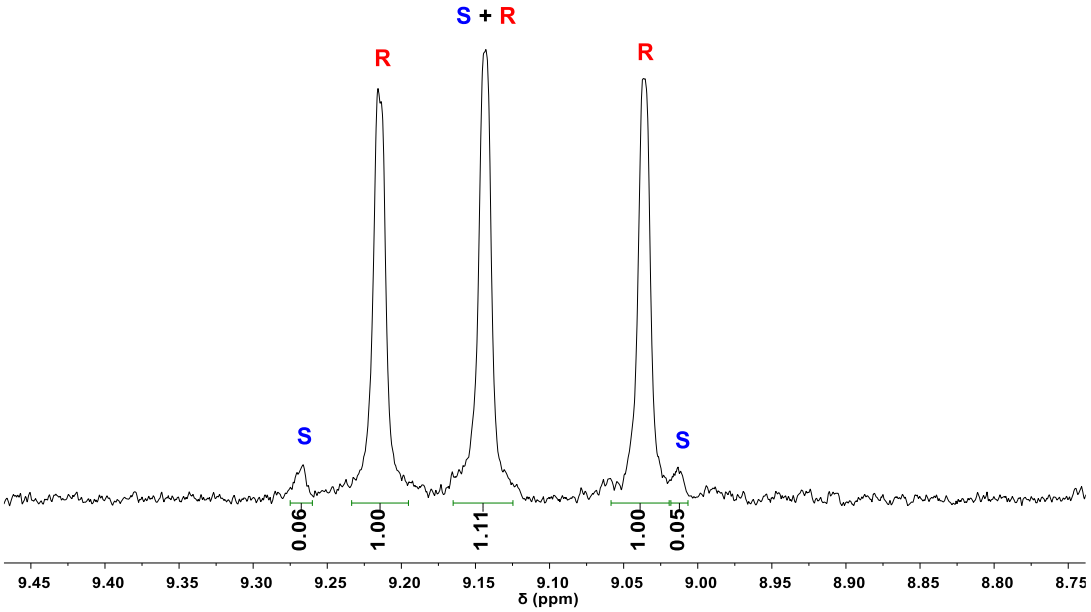
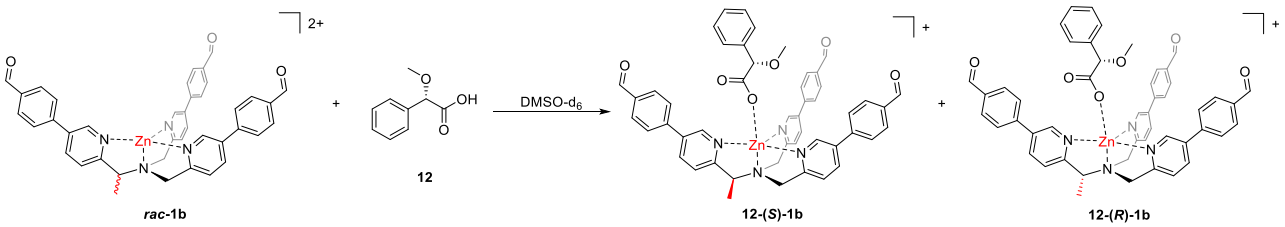


Figure S11 ^{1}H-NMR (DMSO-d_6, 600 MHz) spectrum (***R*)-1b** complex after the addition of (S)-(+)-2-methoxy-2-phenylacetic acid **12**. From the relative ratio of the areas it was possible to estimate an enantiomeric excess of more than 90%.

6.1 General procedure for the enantiomeric excess determination of the complex.



To 400 µL (1.0 µmol) of a 0.002 M solution of complex (***R*)-1b** in DMSO-d_6, 122 µL (1.0 µmol) of a 0.01 M solution of (*S*)-(+)-2-methoxy-2-phenylacetic acid **12** in DMSO-d_6 of were added in a NMR tube. The mixture was checked *via* ^{1}H-NMR.

7 Stereochemical considerations on the possible cages present in solution

Due to presence of a stereocenter in one arm of the **TPMA** complexes, during the cage formation more than one assembly could be obtained. In particular, three different structures could be formed using (***R***)**-1b** complex. The resulting structures are all diastereoisomers since there is not any symmetry operation that could interconvert them to each other (Figure S12).

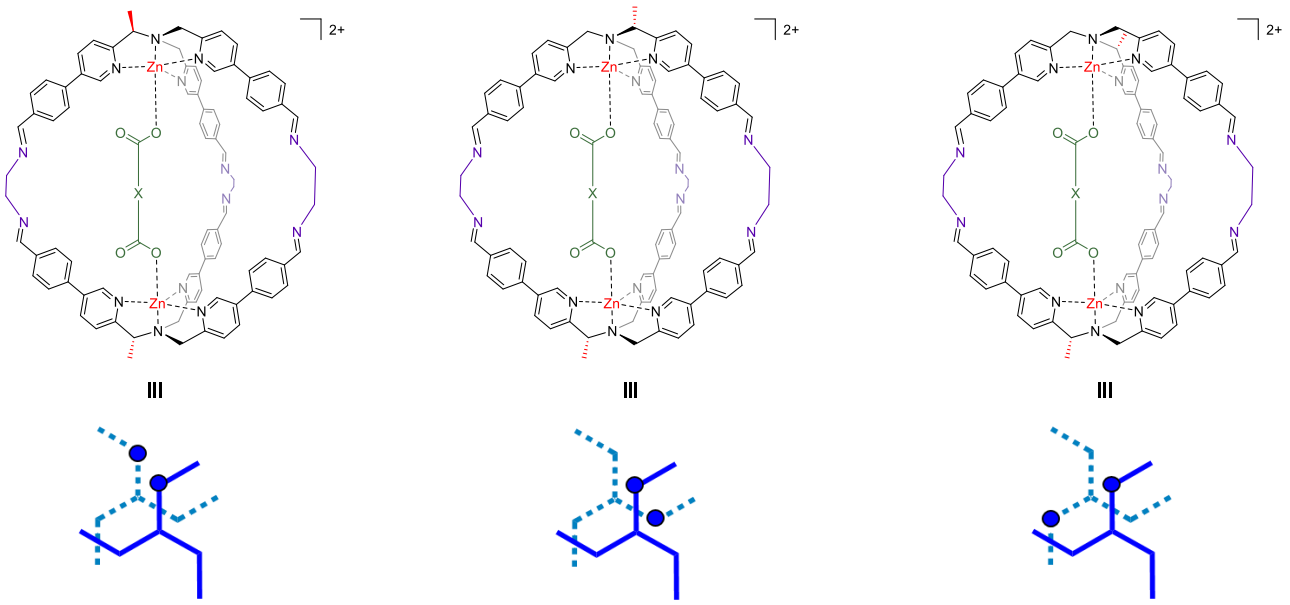


Figure S12 Different diastereoisomers of cages **X@(*R*,*R*)-2b** formed in solution using enantiopure complex (***R***)**-1b**.

8 Addition of D-tar to Wine@(*R*,*R*)-2b

In order test cage capability to sense unnatural enantiomers in the complex matrix, increasing amounts of unnatural **D-Tar** have been added to Valpolicella wine and used as templating agents for cage formation. After determination of L-Tartaric acid content in Valpolicella wine using ^{1}H-NMR (2.3 g/L, Figure S49) different amount of **D-Tar** acid has been added to obtain different enantiomeric excesses. Since cage **X@(*R*,*R*)-2b** is chiral, **DL-Tar** (0.2 eq.) was added to a solution of complex **(*R*)-1b** and ethylenediamine in order to understand if there was no preference in binding for one of the two chiral dicarboxylic acids. As shown in Figure S13 no preference was observed.

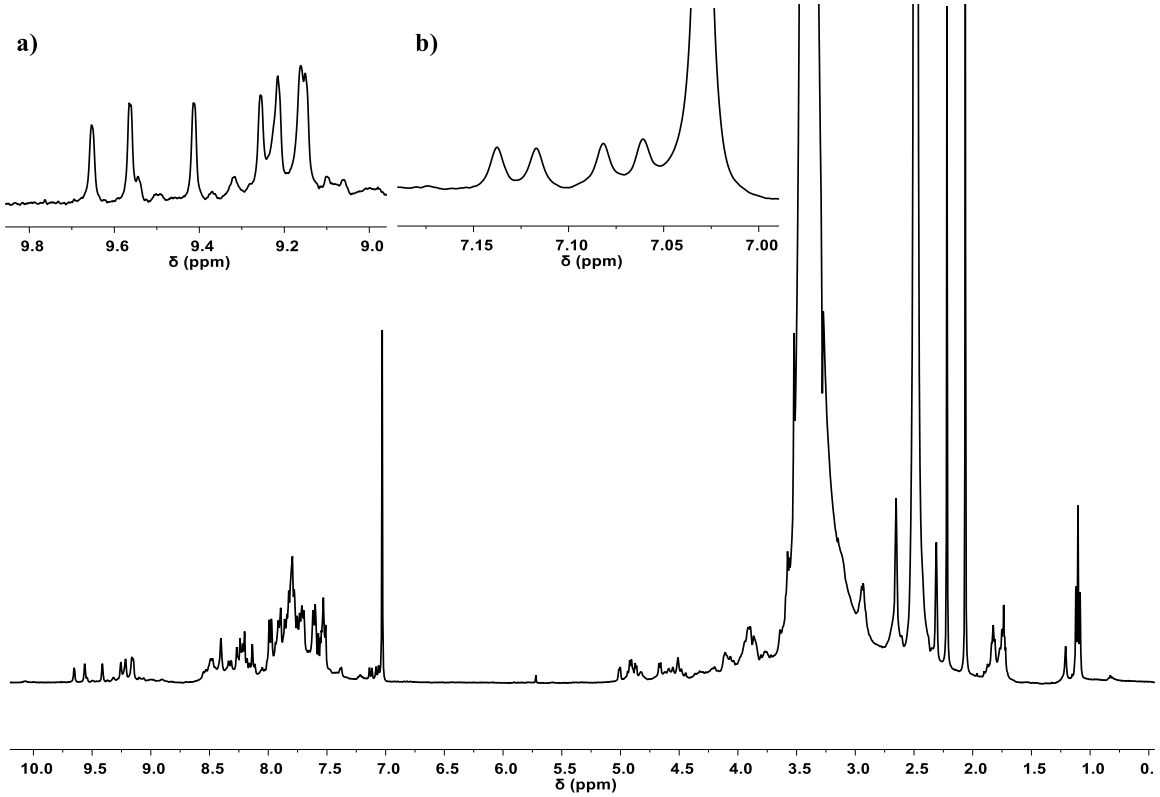


Figure S13 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **DL-Tar@(*R*,*R*)-2b**, a) α-pyridine protons region, and b) pyridine proton region.

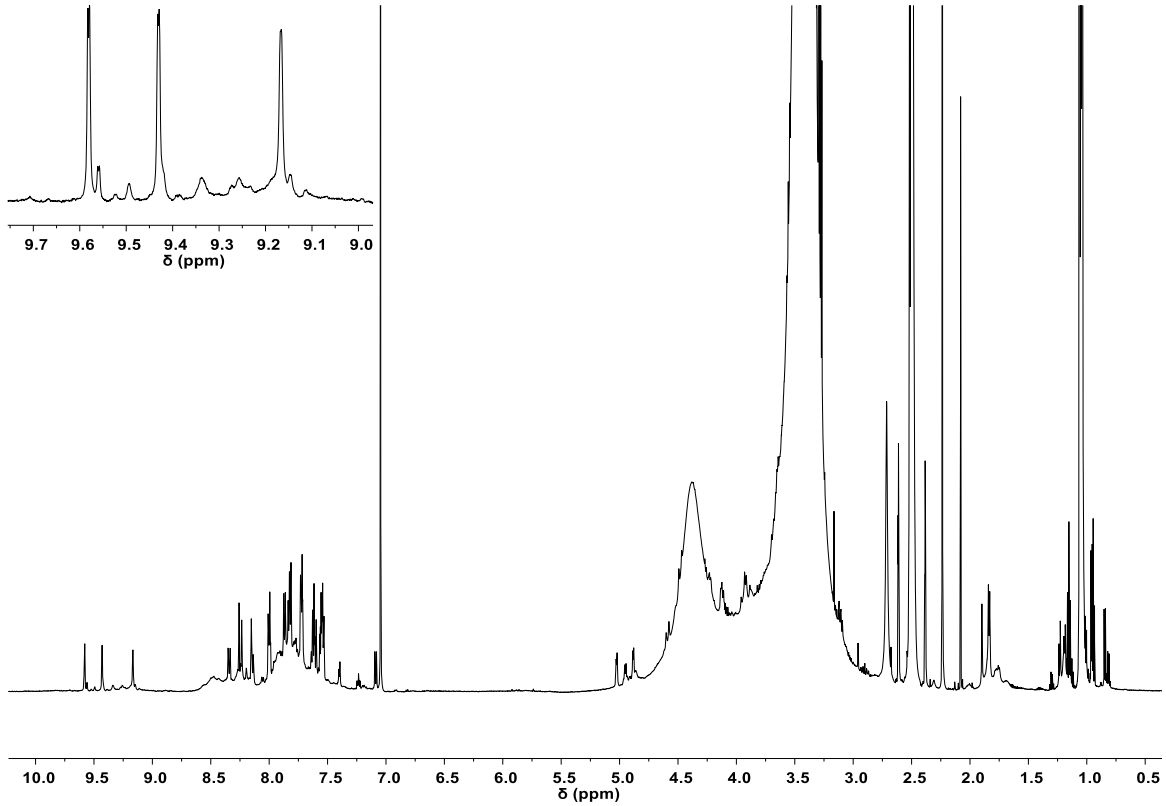


Figure S14 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Wine@(*R*,*R*)-2b** with **D-Tar** in order to obtain an enantiomeric excess equal to 98%.

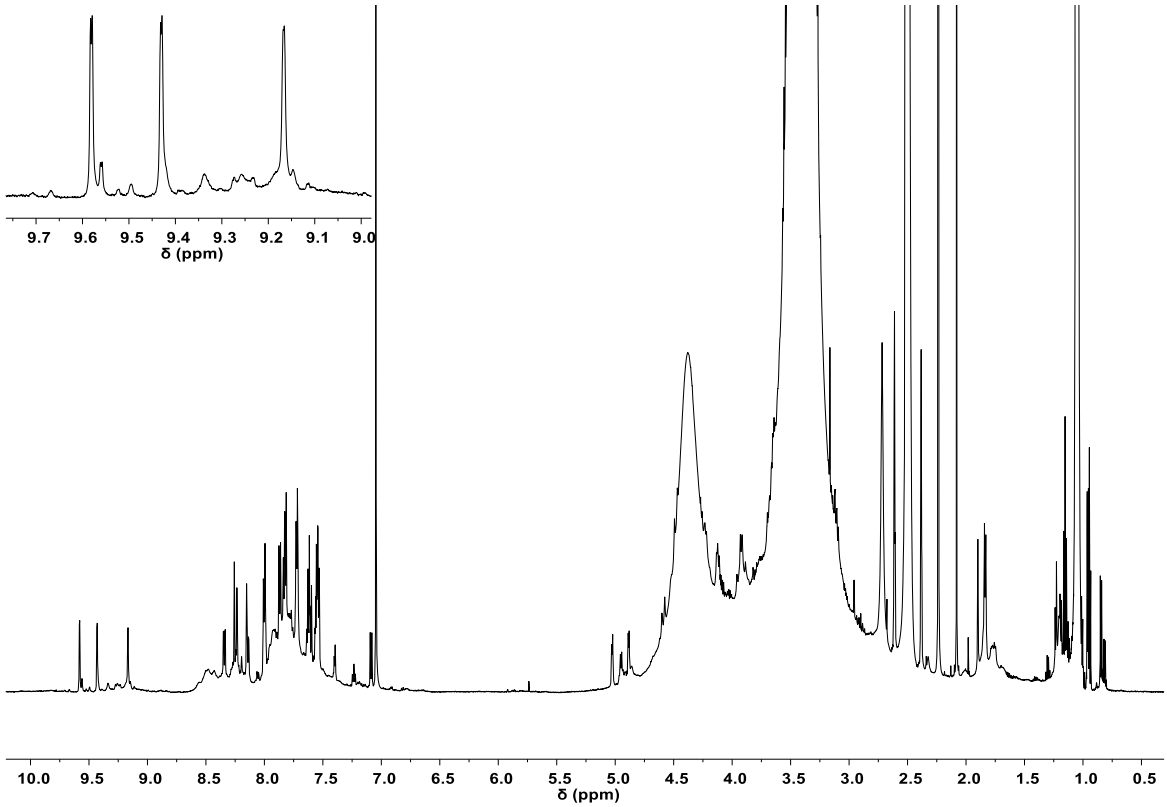


Figure S15 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Wine@(*R*,*R*)-2b** with **D-Tar** in order to obtain an enantiomeric excess equal to 94%.

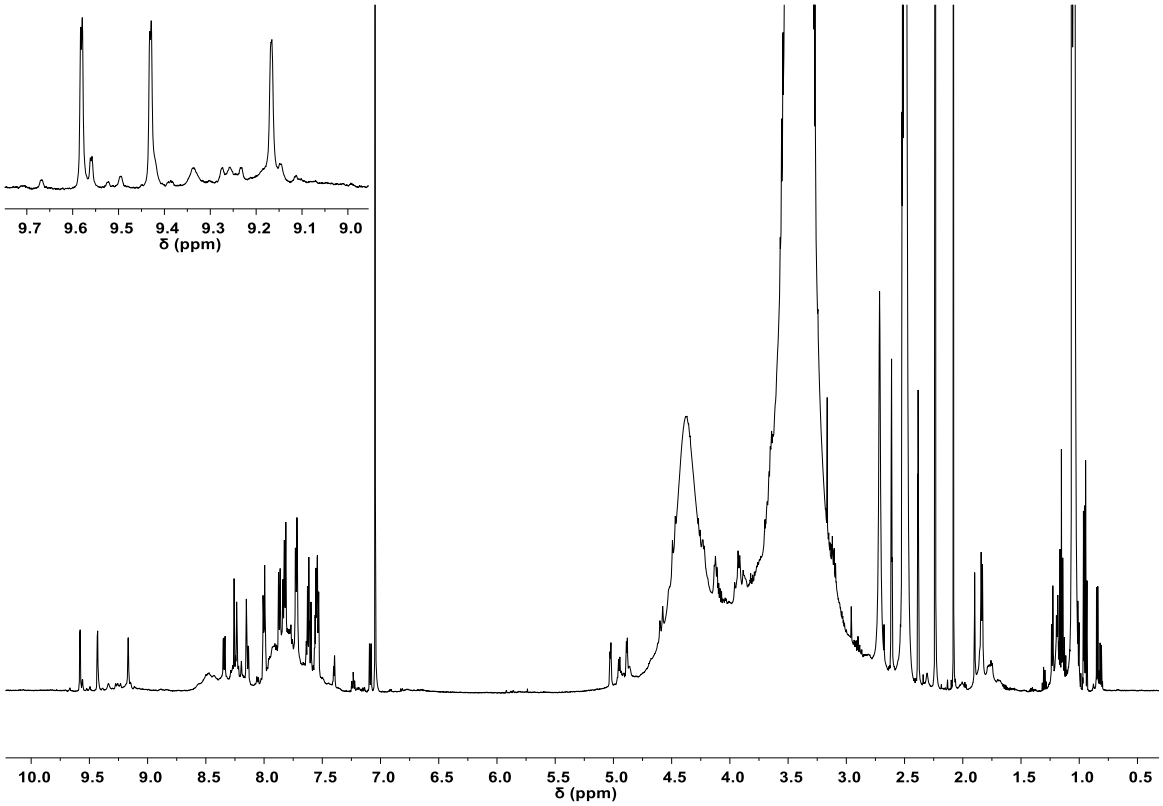


Figure S16 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Wine@(*R*,*R*)-2b** with **D-Tar** in order to obtain an enantiomeric excess equal to 90%.

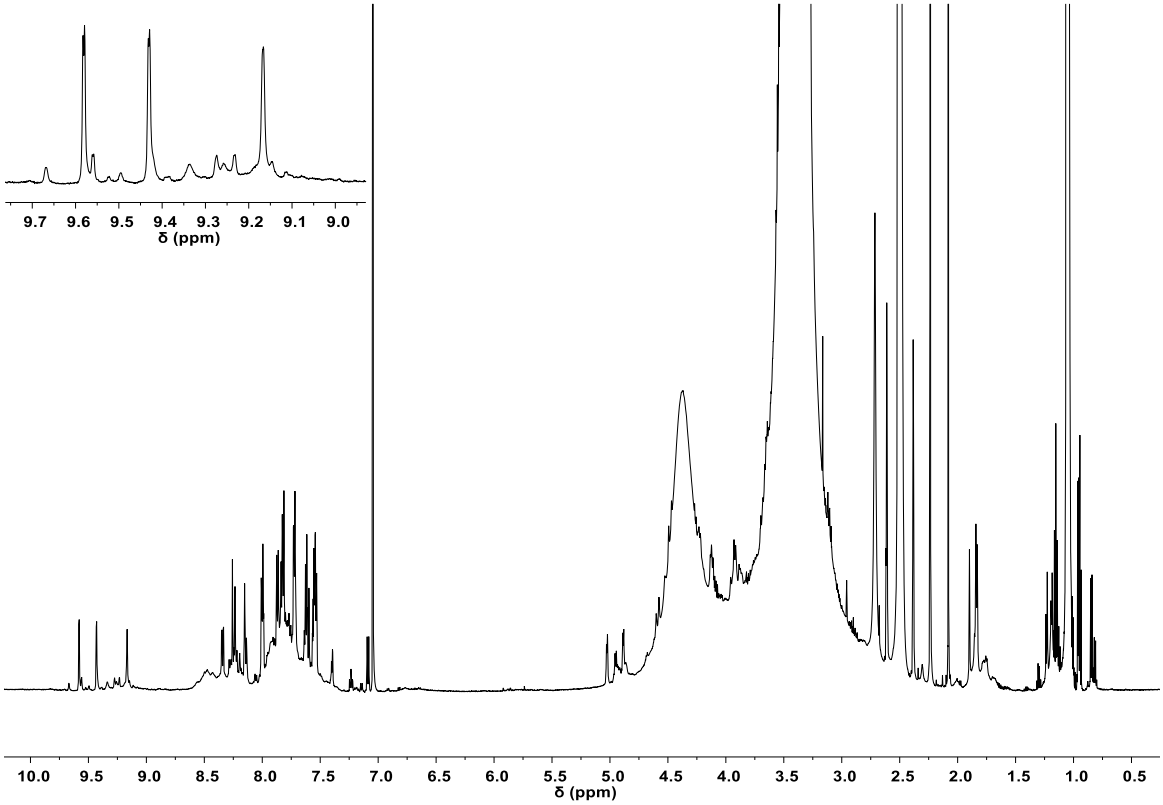


Figure S17^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Wine@(*R*,*R*)-2b** with **D-Tar** in order to obtain an enantiomeric excess equal to 84%.

9 NMR characterization

9.1 1-(5-bromopyridin-2-yl)ethan-1-ol (4)

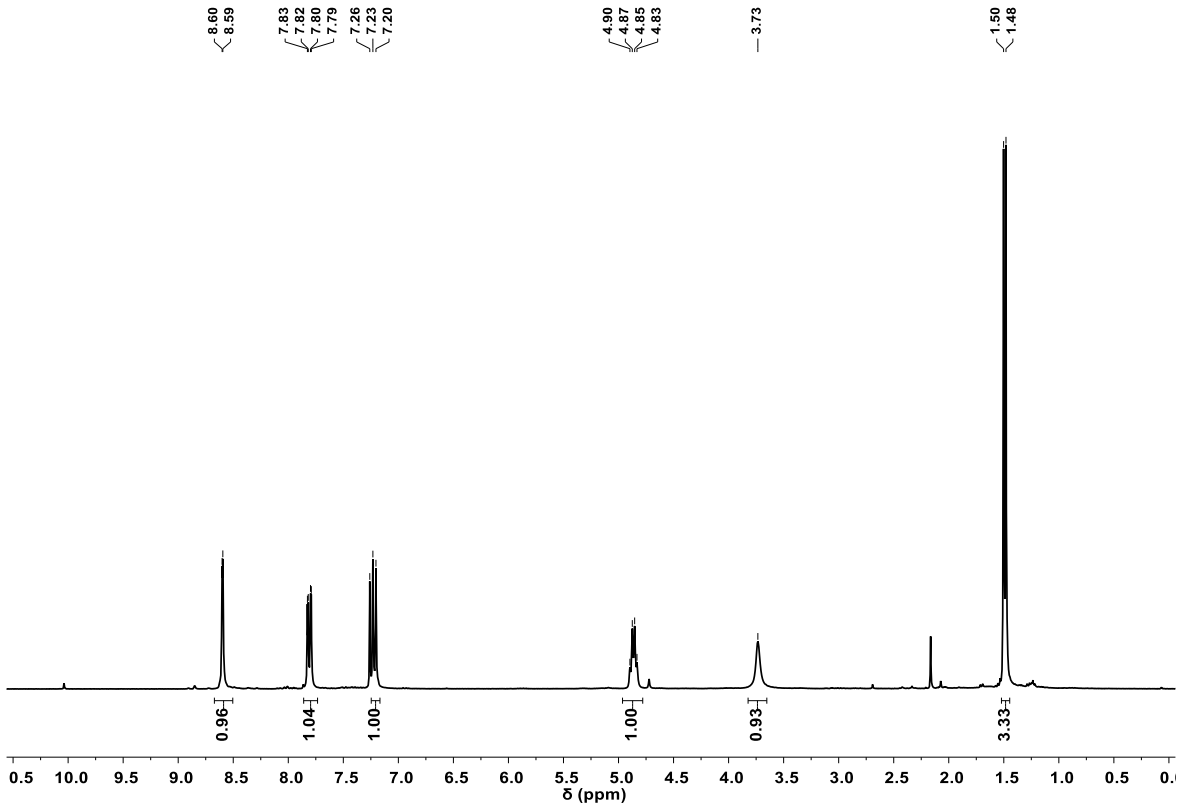


Figure S18 ^{1}H-NMR spectrum (300 MHz, 301 K, $CDCl_3$) of **4**.

9.2 1-(5-bromopyridin-2-yl)ethyl 4-methylbenzenesulfonate (5)

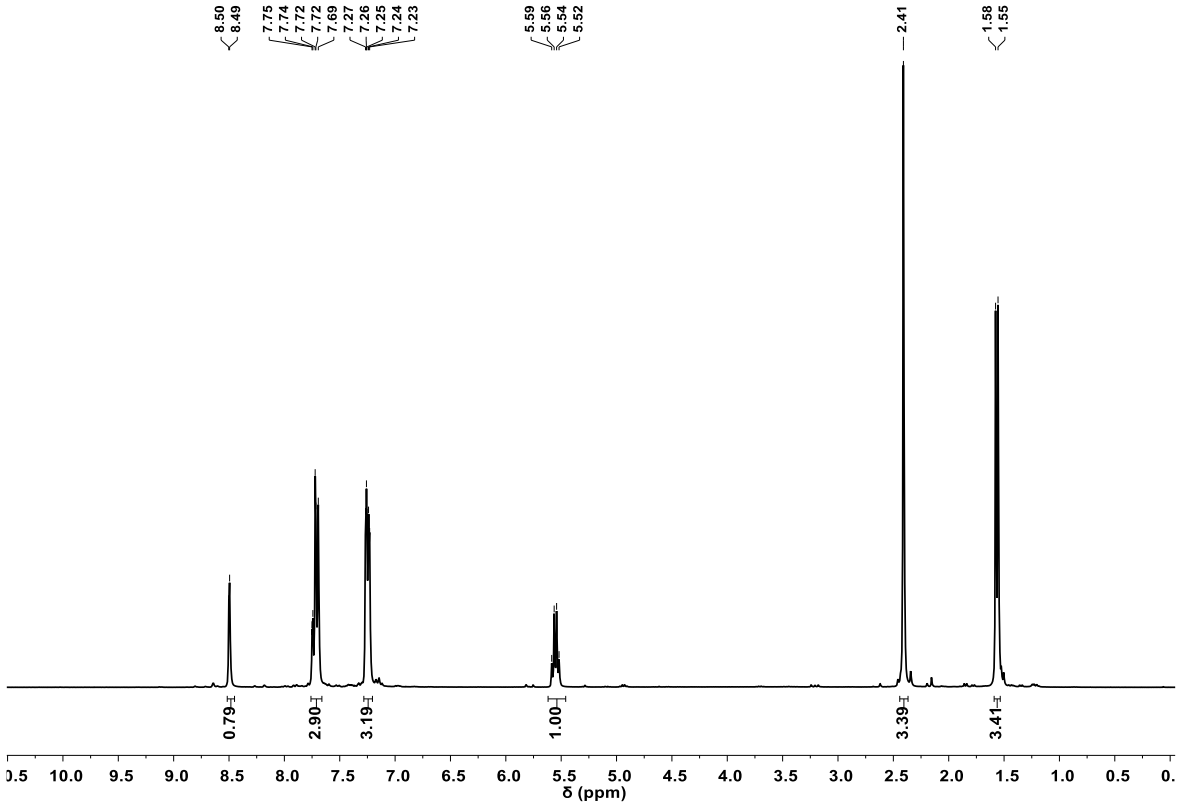


Figure S19 ^{1}H-NMR spectrum (300 MHz, 301 K, $CDCl_3$) of **5**.

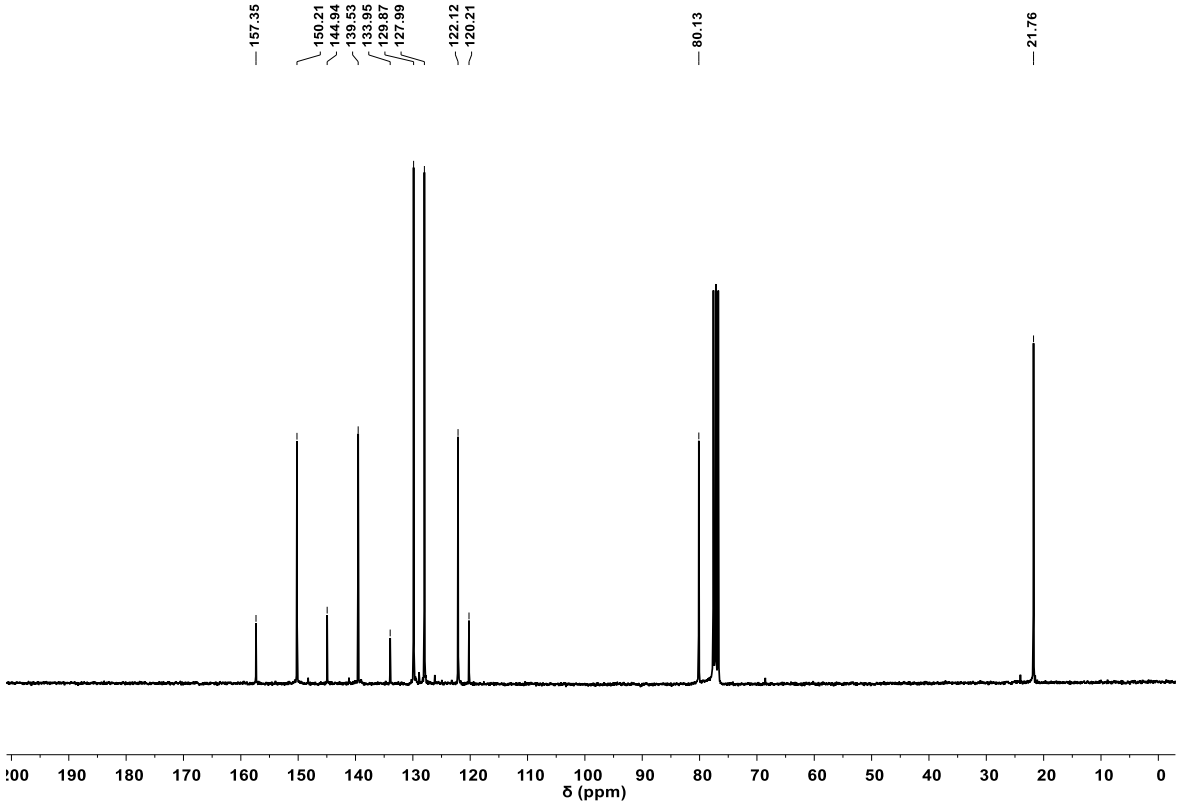


Figure S20 ^{13}C-NMR spectrum (75 MHz, 301 K, $CDCl_3$) of **5**.

9.3 2-(1-azidoethyl)-5-bromopyridine (6)

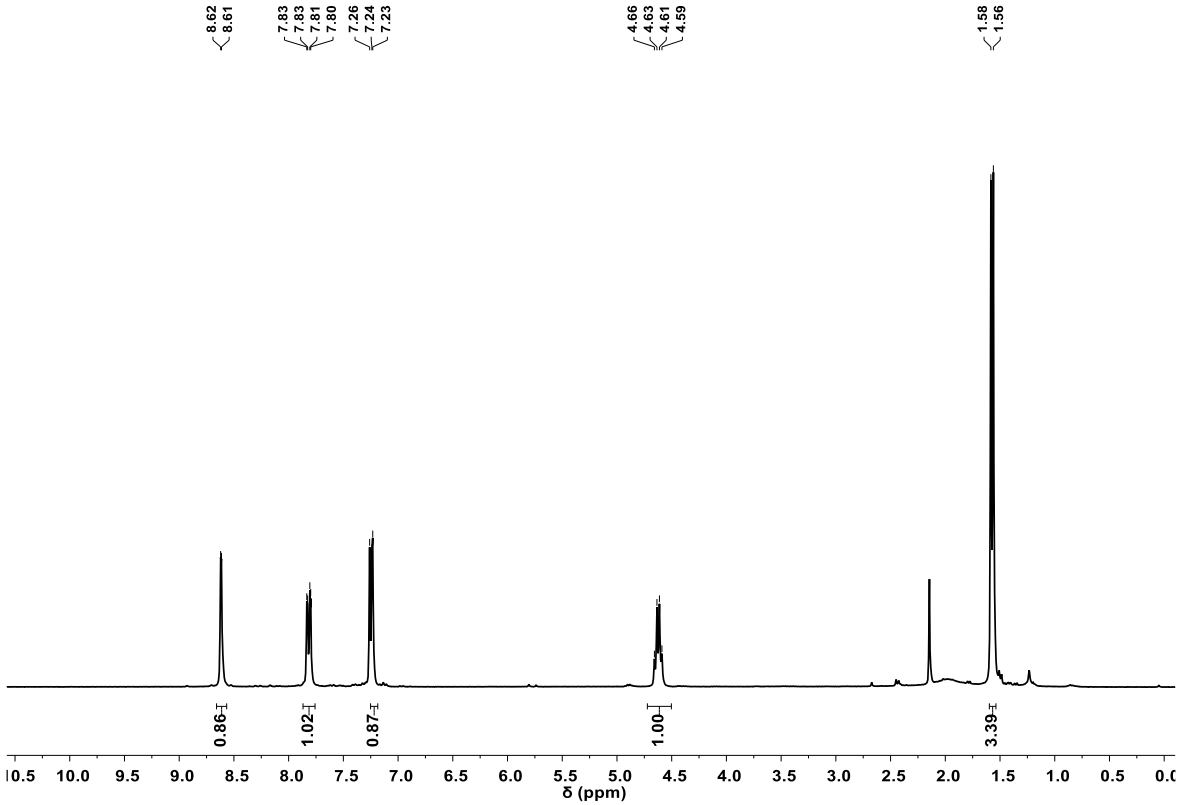


Figure S21 ^{1}H-NMR spectrum (300 MHz, 301 K, $CDCl_3$) of **6**.

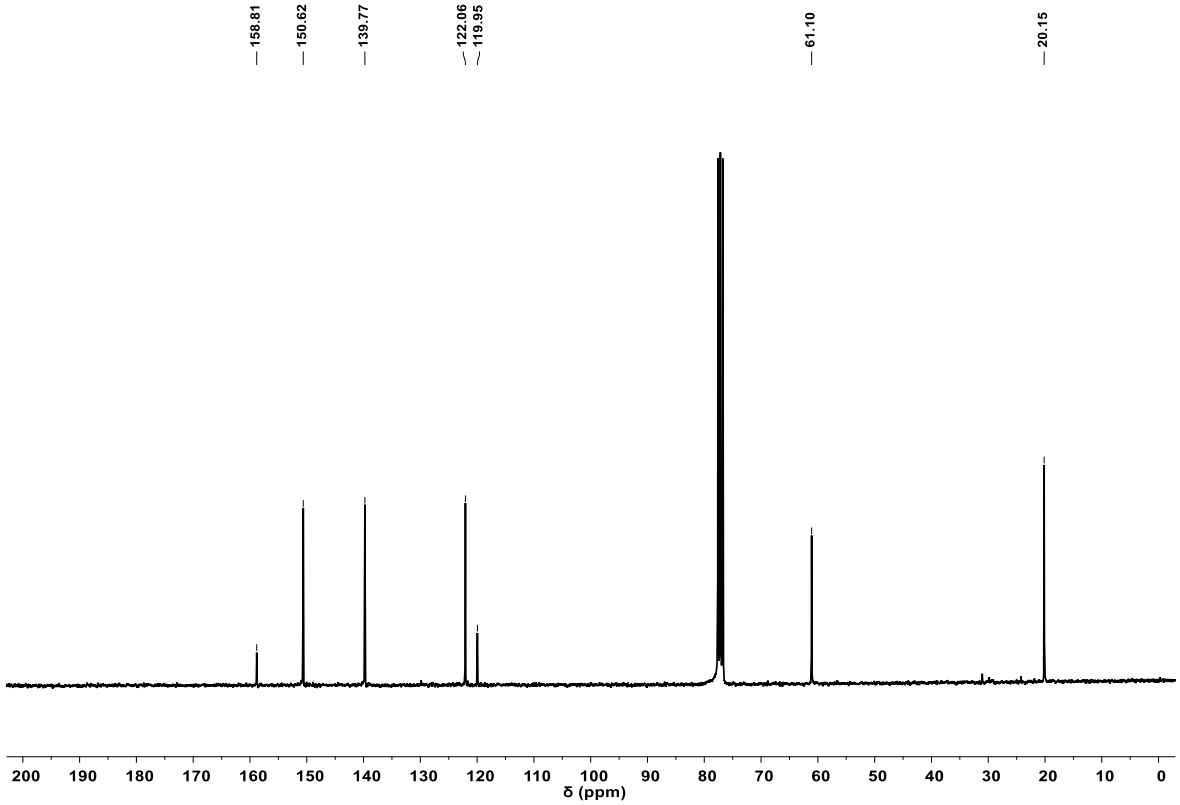


Figure S22 ^{13}C-NMR spectrum (75 MHz, 301 K, $CDCl_3$) of **6**.

9.4 1-(5-bromopyridin-2-yl)ethan-1-amine (7)

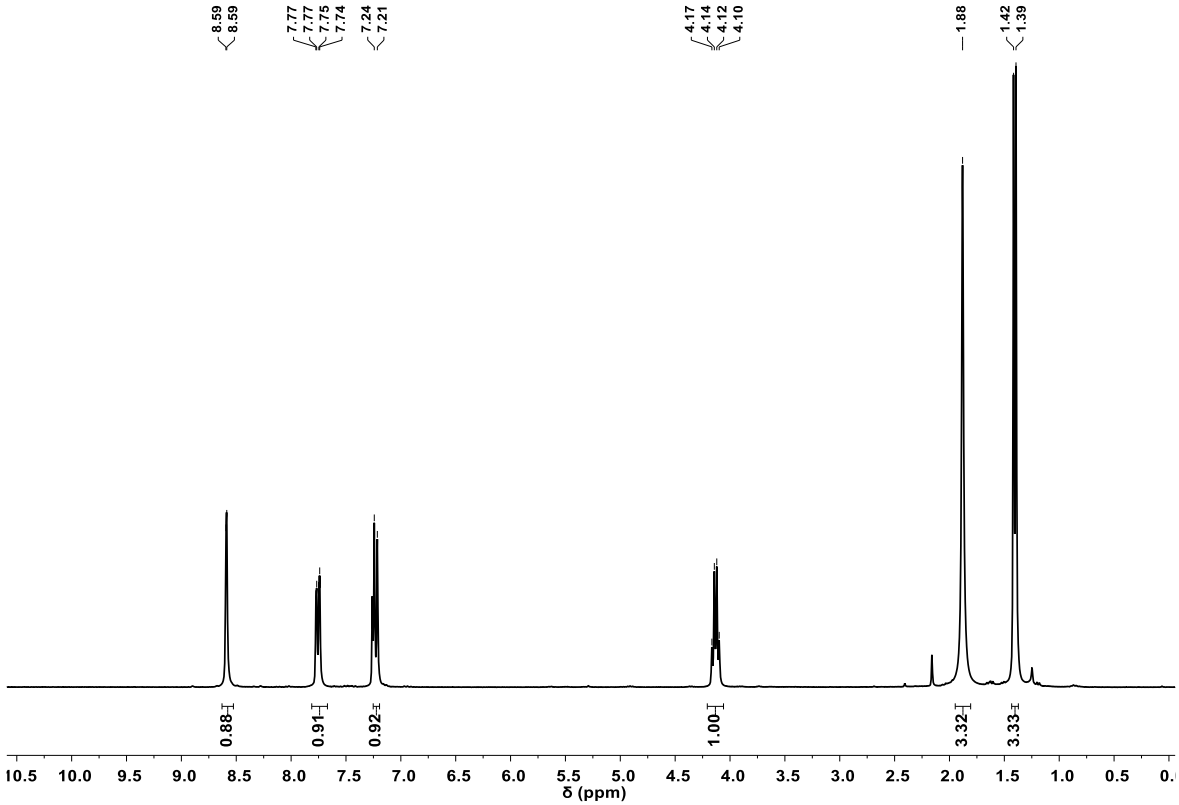


Figure S23 ^{1}H-NMR spectrum (300 MHz, 301 K, $CDCl_3$) of **7**.

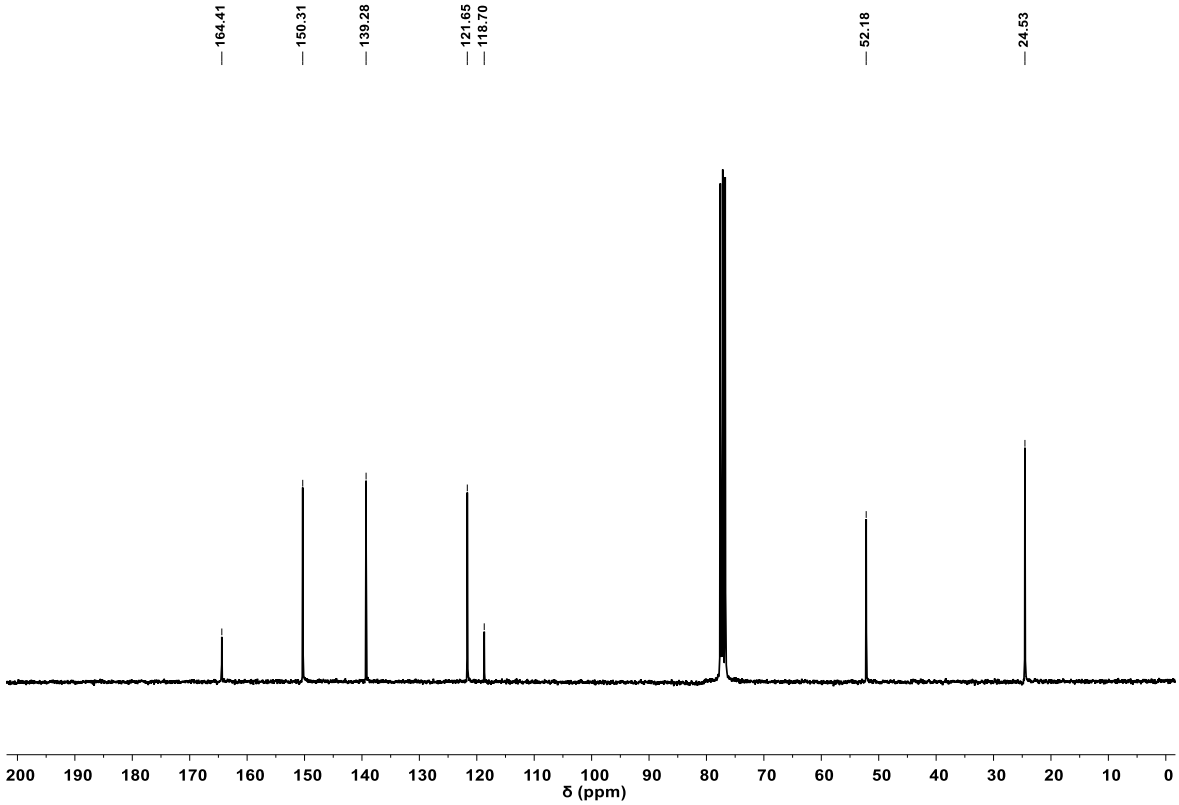


Figure S24 ^{13}C-NMR spectrum (75 MHz, 301 K, $CDCl_3$) of **7**.

9.5 *R*-(+)1-(5-bromopyridin-2-yl)-*N*,*N*-bis((5-bromopyridin-2-yl)methyl)ethan-1-amine ((*R*)-8)

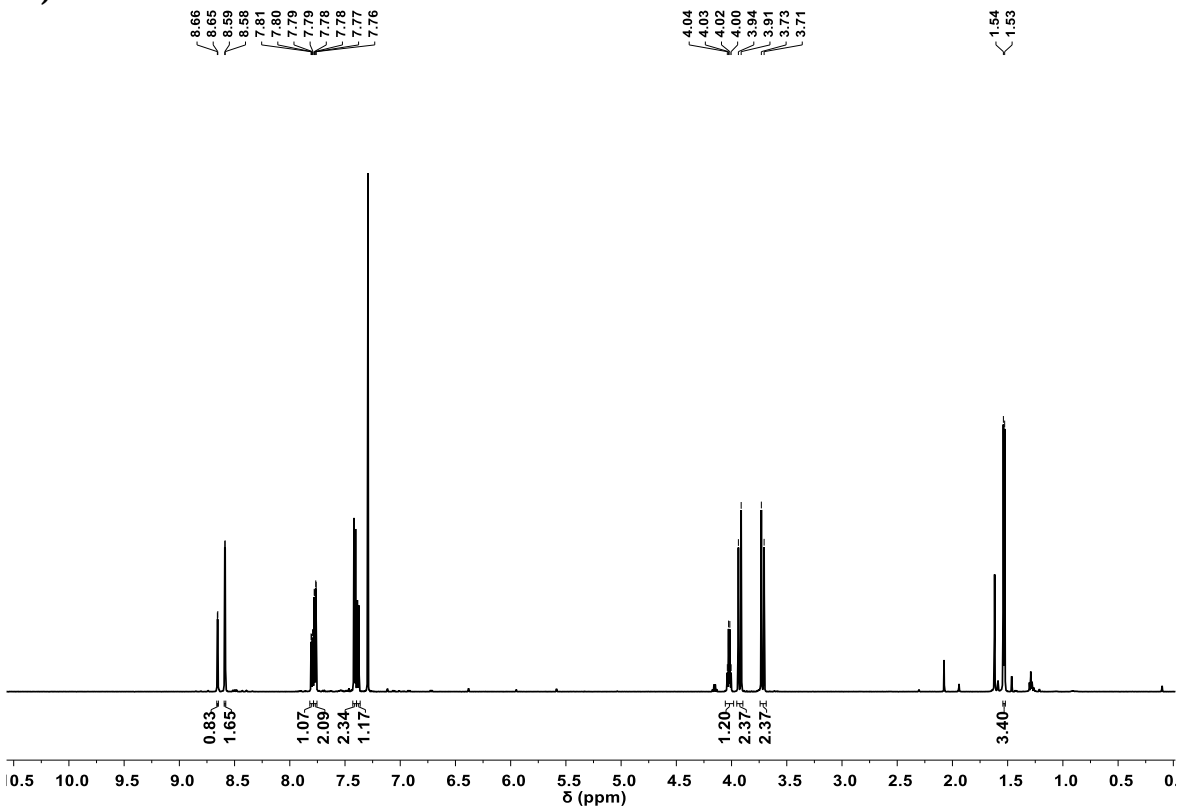


Figure S25 ^{1}H-NMR spectrum (600 MHz, 301 K, $CDCl_3$) of **(*R*)-8**.

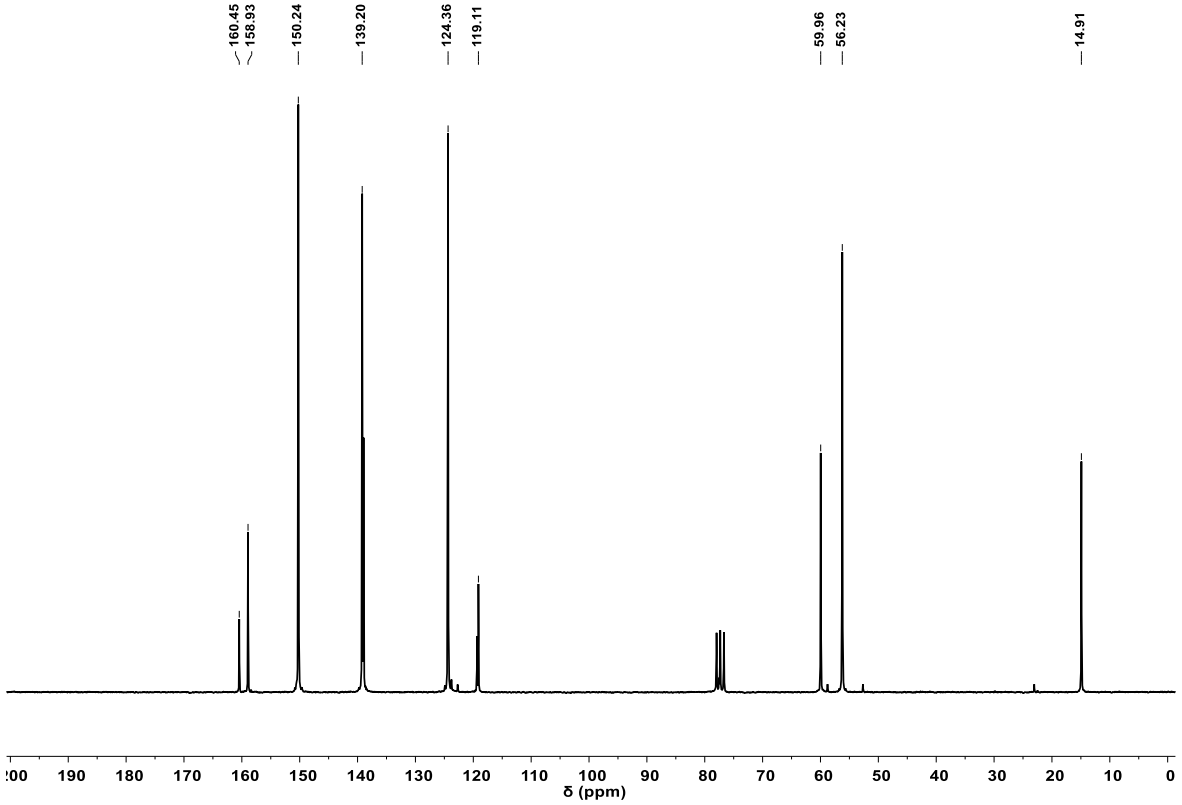


Figure S26 ^{13}C-NMR spectrum (75 MHz, 301 K, $CDCl_3$) of **(*R*)-8**.

9.6 (*R*)-4,4'-((((1-(5-(4-formylphenyl)pyridin-2-yl)ethyl)azanediyl) bis(methylene)) bis(pyridine-6,3-diyl))dibenzaldehyde ((*R*)-9)

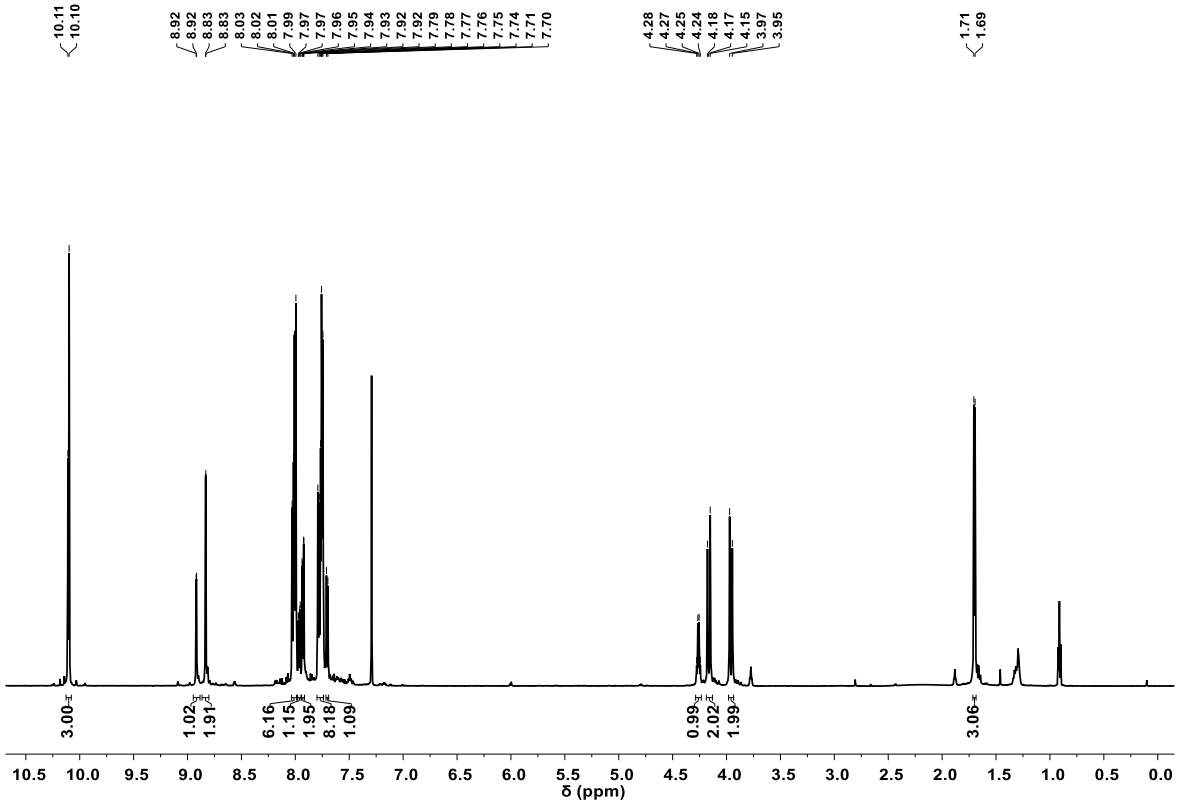


Figure S27 ^{1}H-NMR spectrum (600 MHz, 301 K, $CDCl_3$) of **(*R*)-9**.

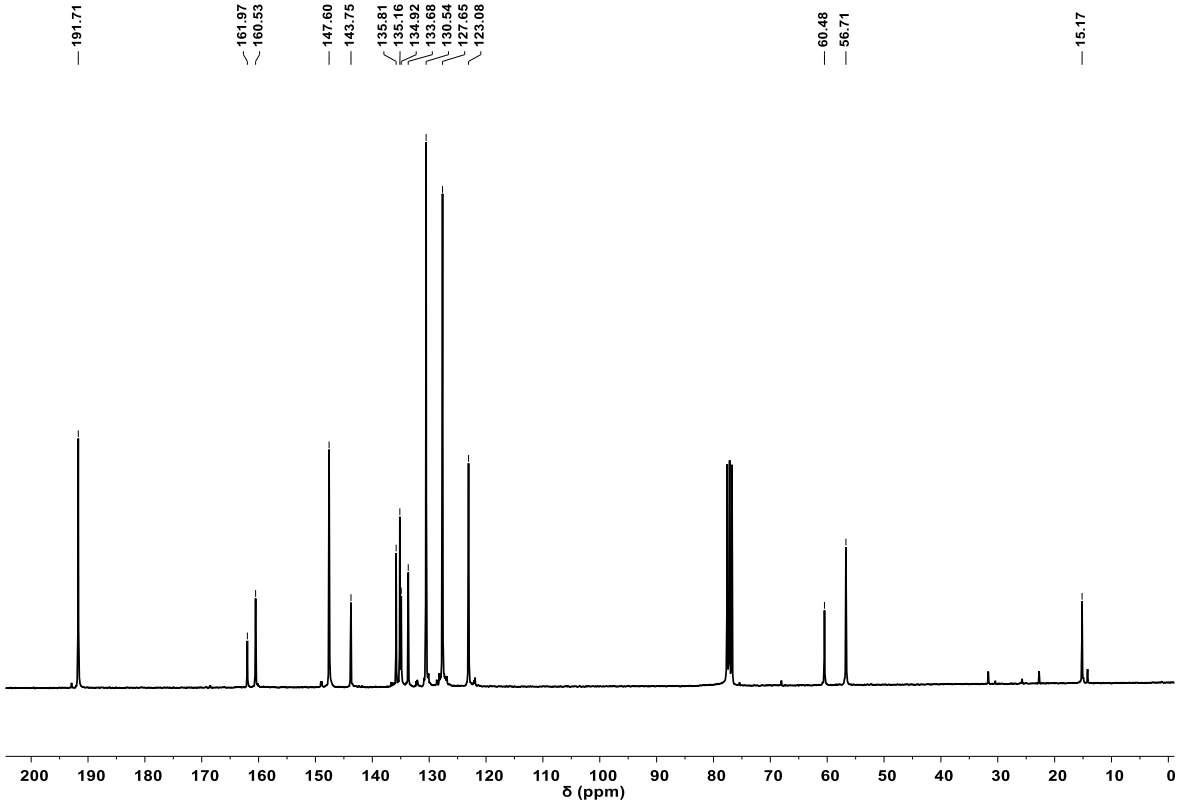


Figure S28 ^{13}C-NMR spectrum (75 MHz, 301 K, $CDCl_3$) of **(*R*)-9**.

9.7 Complex (*R*)-1b

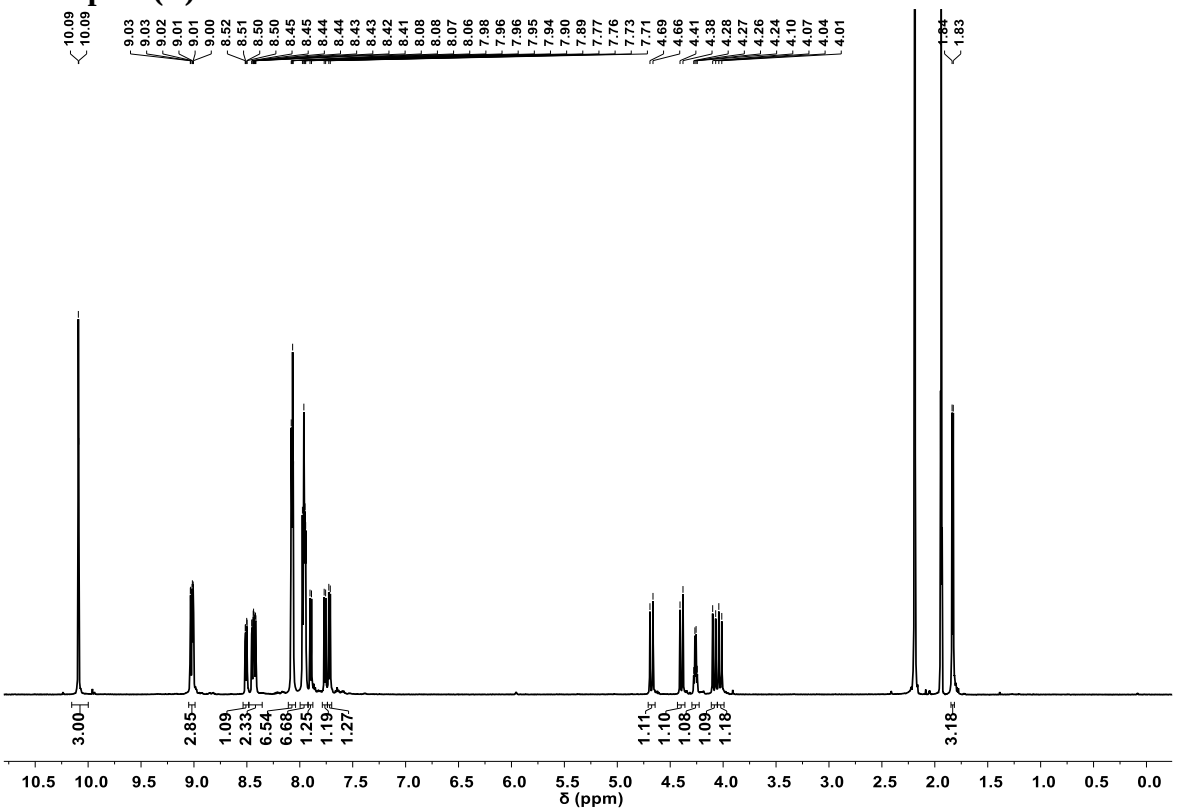


Figure S29 ^{1}H-NMR spectrum (600 MHz, 301 K, CD_3CN) of complex **(*R*)-1b**.

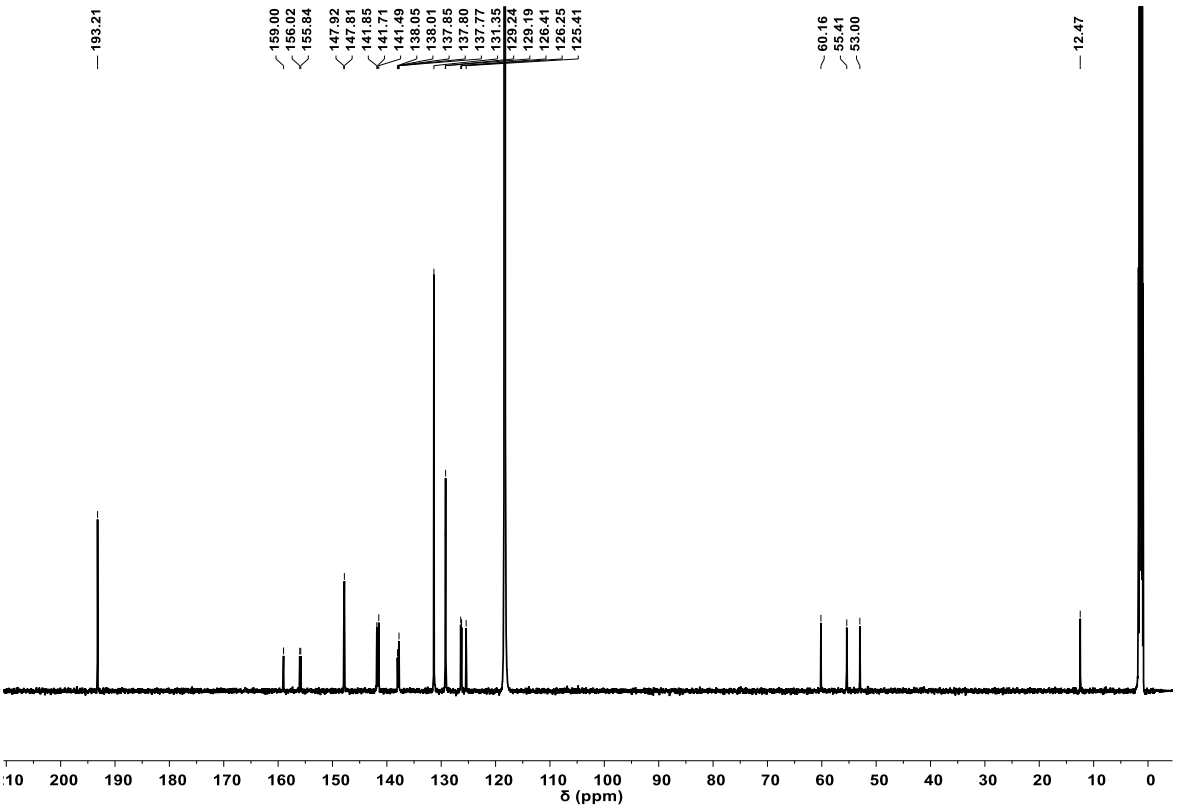


Figure S30 ^{13}C-NMR spectrum (151 MHz, 301 K, CD_3CN) of complex **(*R*)-1b**.

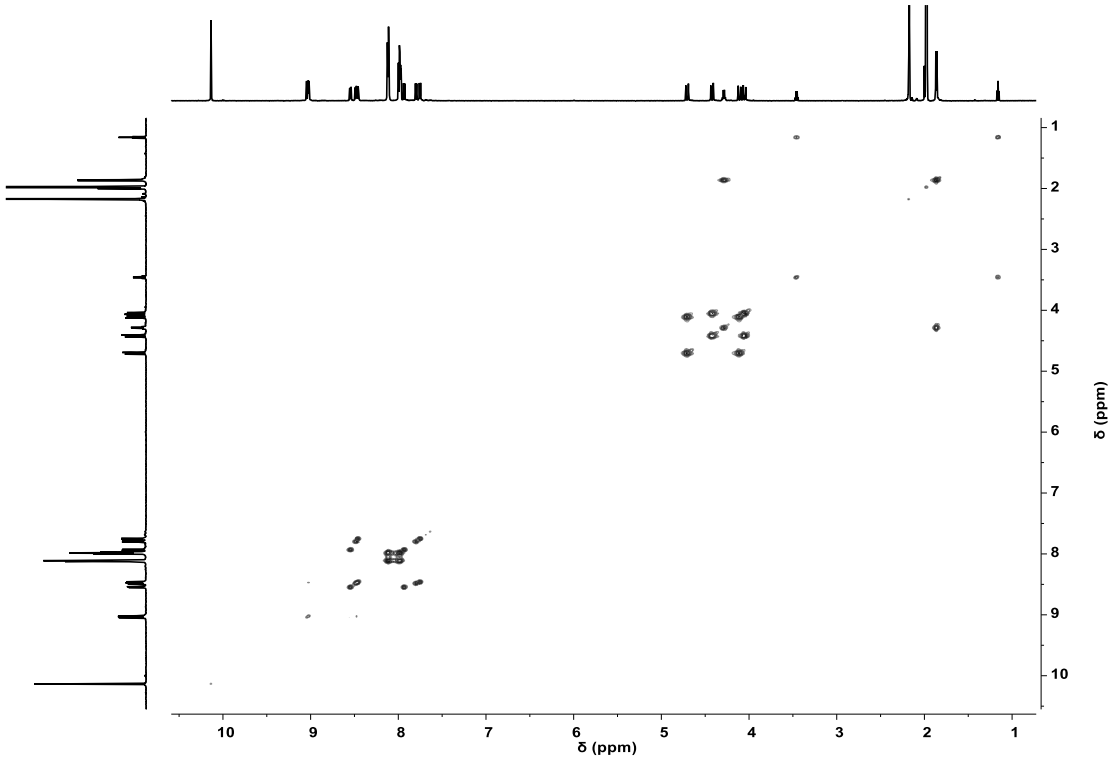


Figure S31 ^{1}H-^{1}H COSY spectrum (600 MHz, 301 K, CD_3CN)) of complex **(*R*)-1b**.

9.8 L-Tar@2a

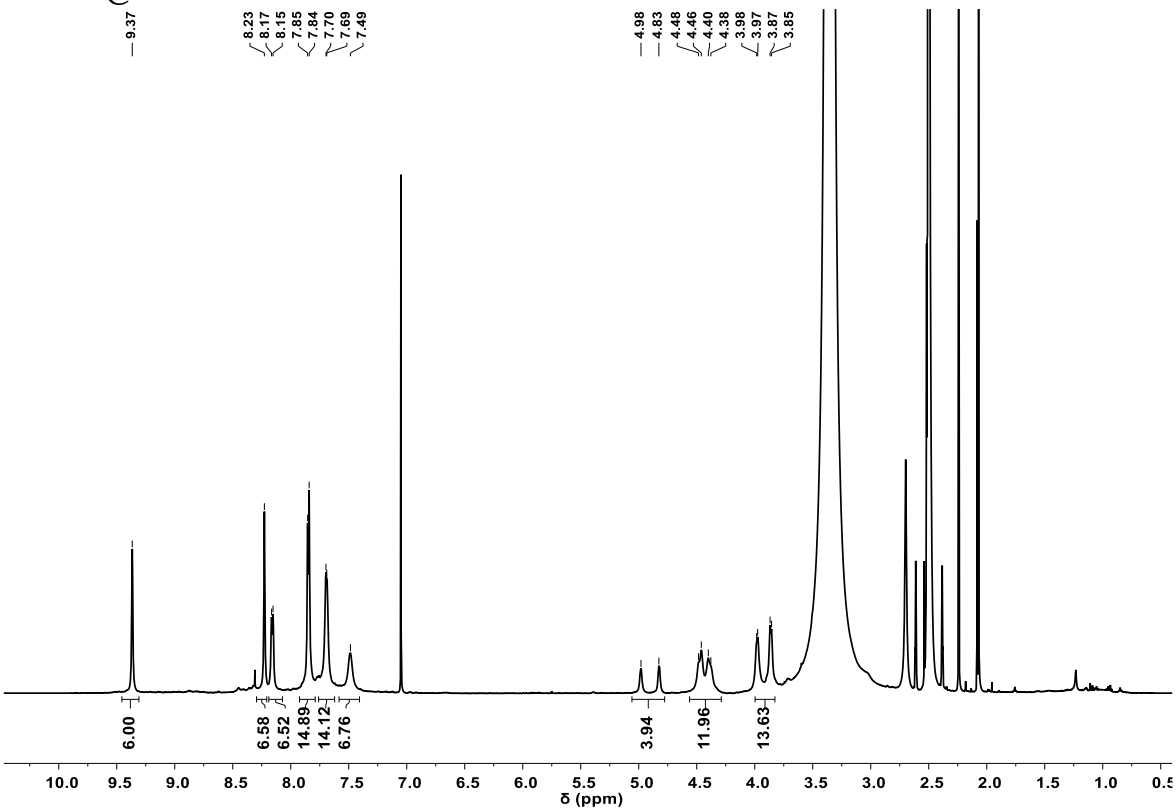


Figure S32 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **L-Tar@2a**.

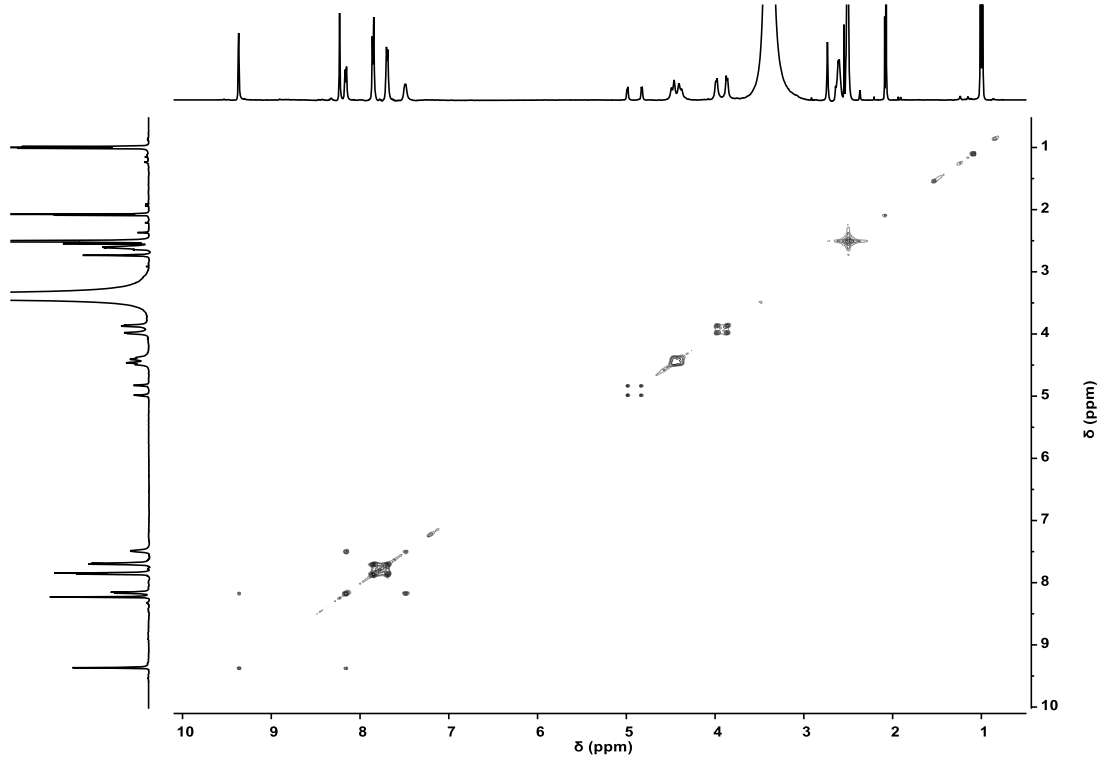


Figure S33 ^{1}H-^{1}H COSY spectrum (400 MHz, 301 K, DMSO-d_6) of cage **L-Tar@2a**.

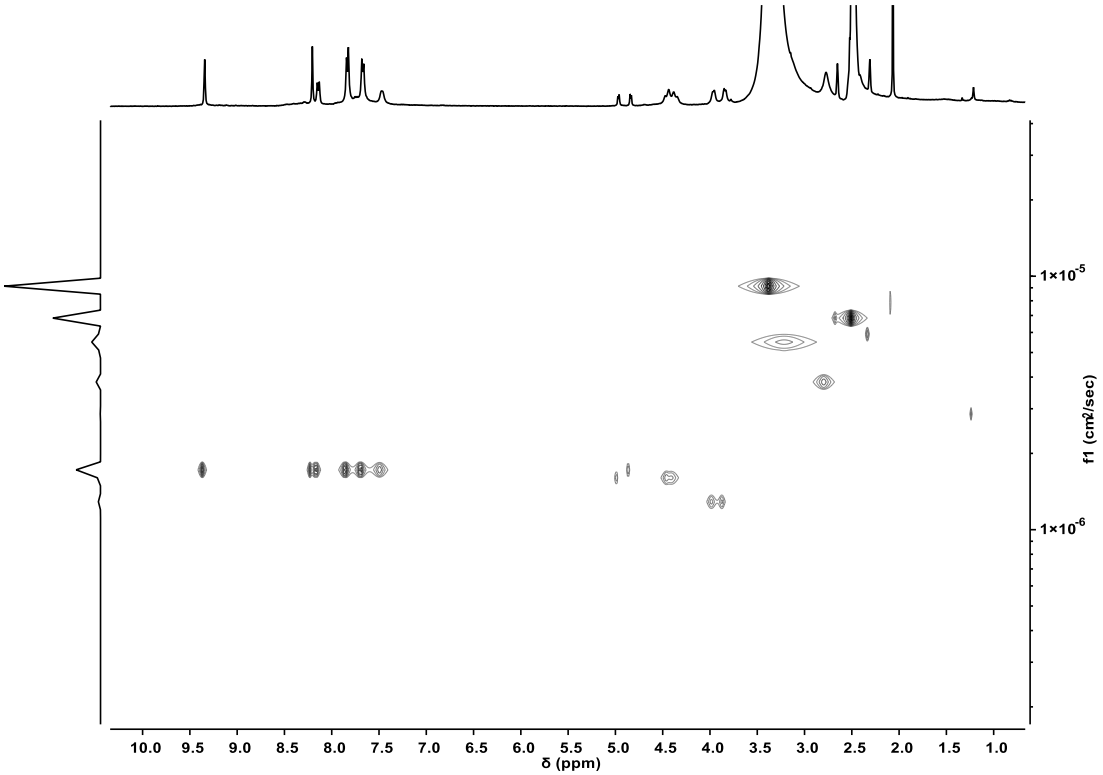


Figure S34 DOSY spectrum (400 MHz, 301 K, DMSO-d_6) of cage **L-Tar@2a**. The diffusion coefficient for the molecular cage **L-Tar@2a** was calculated to be 1.63 x 10^{-10} m^2 s^{-1}, corresponding to a hydrodynamic radius (r_H) of 6.8 Å. The hydrodynamic radius was calculated using Stokes-Einstein equation.[2,3]

9.9 L-Mal@2a

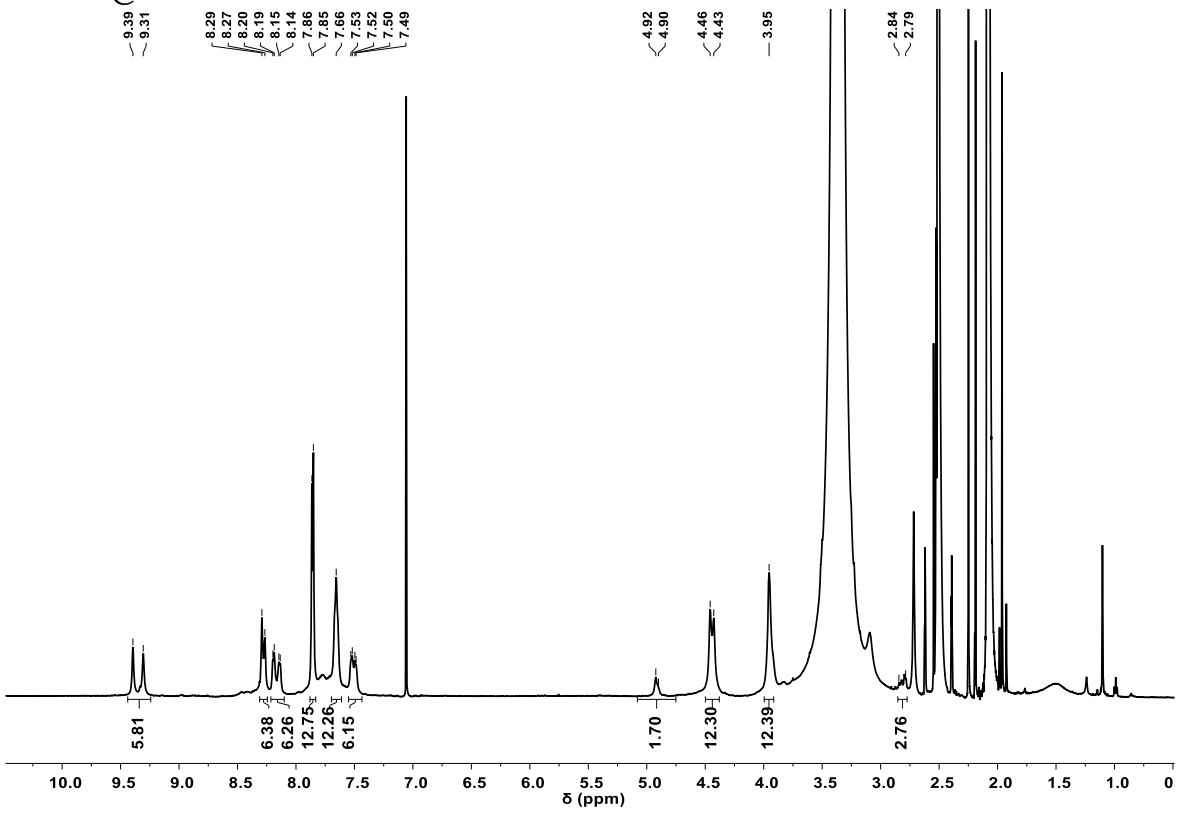


Figure S35 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **L-Mal@2a**.

9.10 Suc@2a

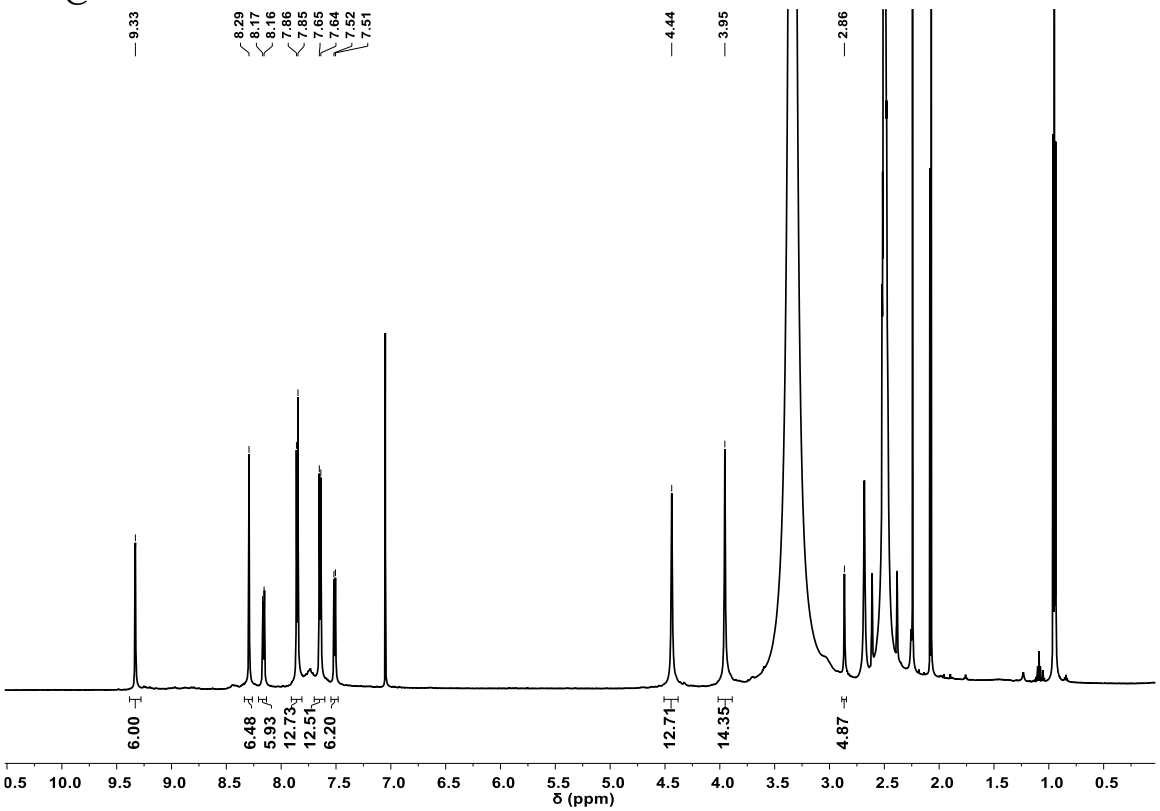


Figure S36 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Suc@2a**.

9.11 Cit@2a

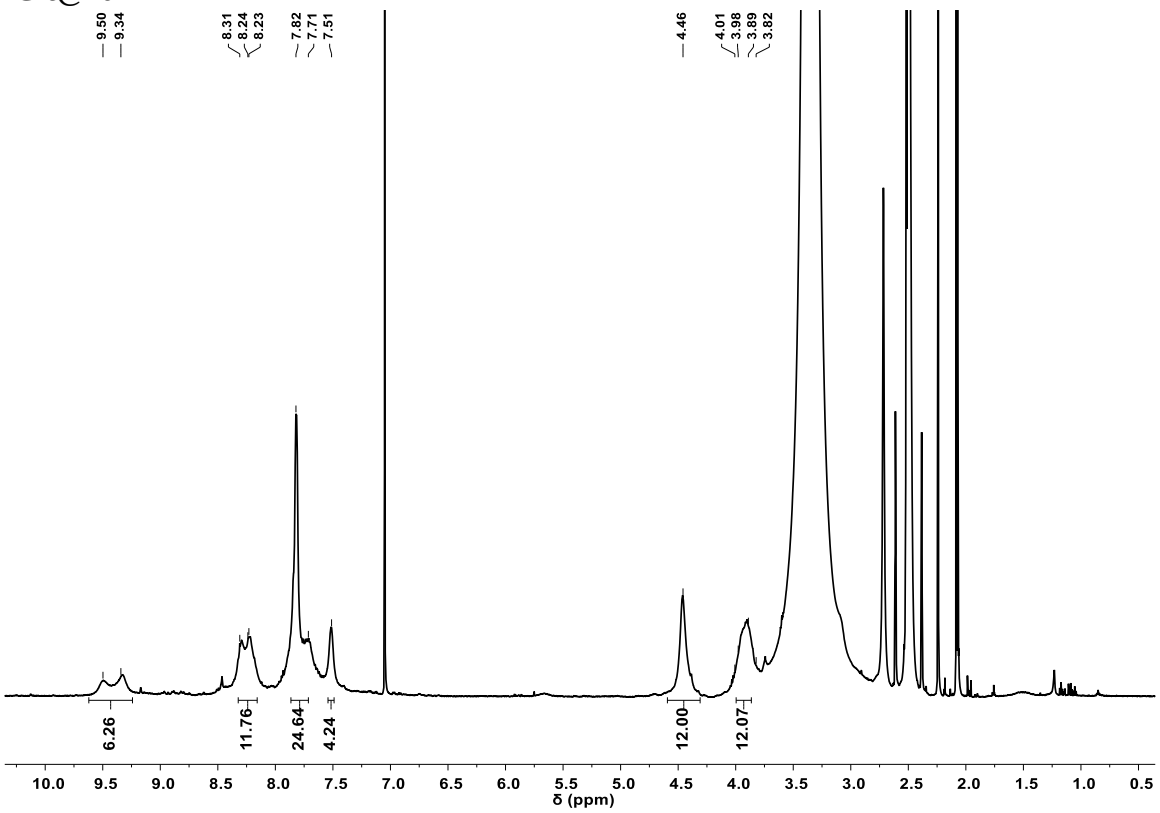


Figure S37 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Cit@2a**.

9.12 L-Tar@(*R*,*R*)-2b

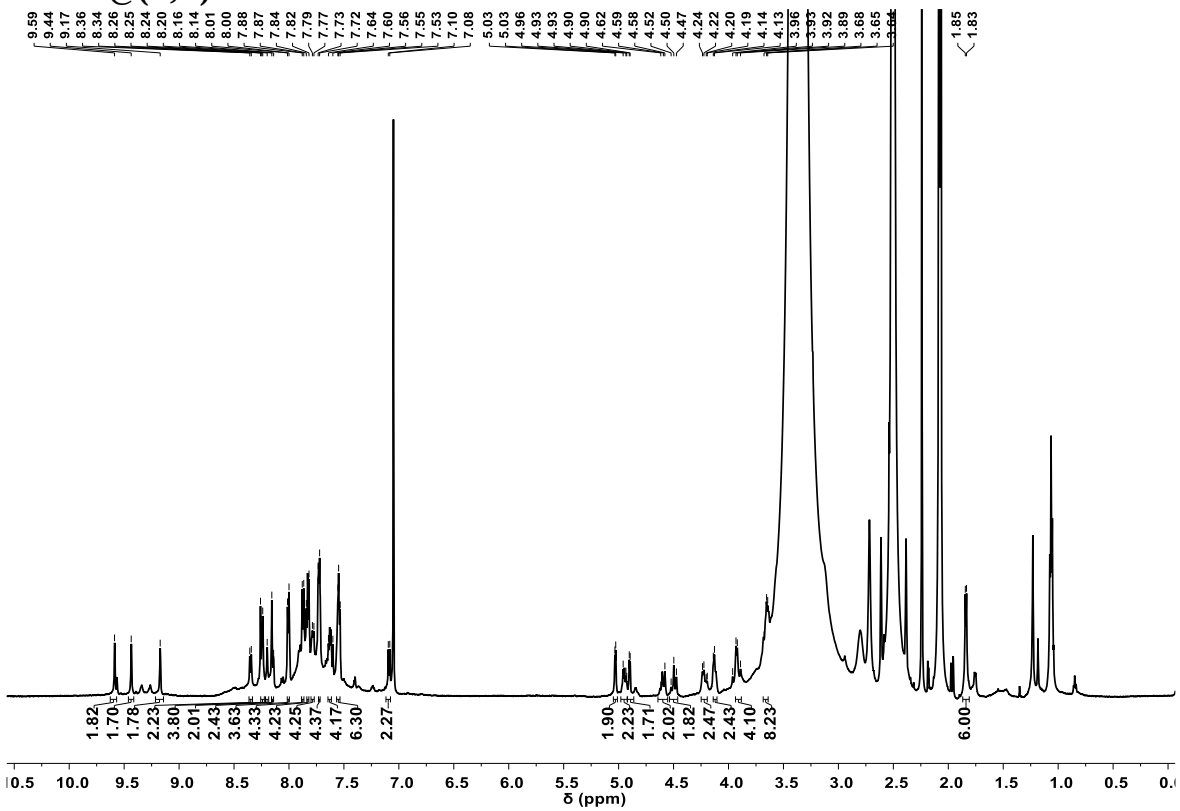


Figure S38 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **L-Tar@(*R*,*R*)-2b**.

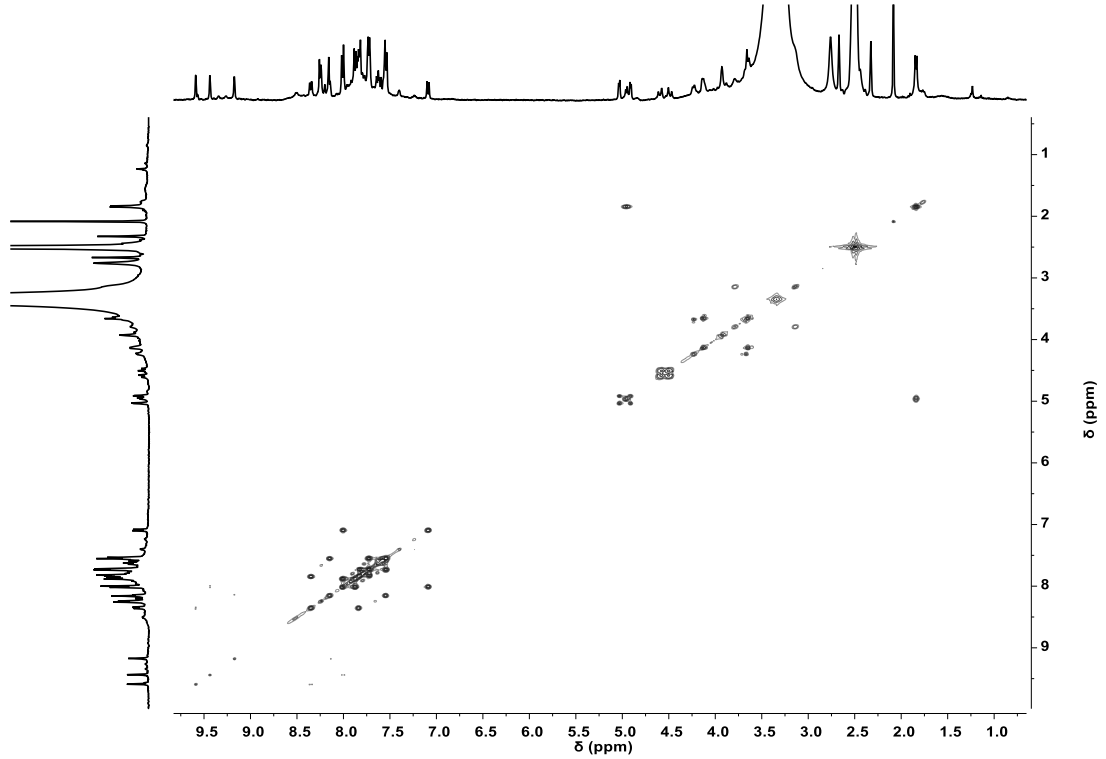


Figure S39 ^{1}H-^{1}H COSY spectrum (400 MHz, 301 K, DMSO-d_6) of cage **L-Tar@(*R*,*R*)-2b**.

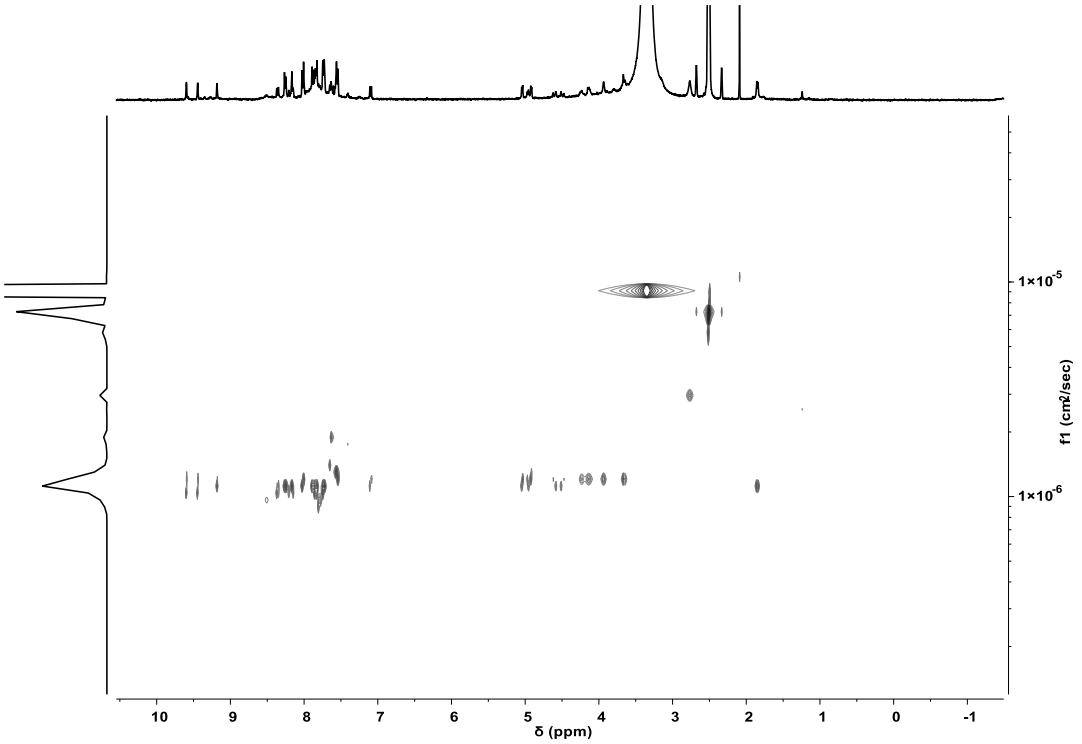


Figure S40 DOSY spectrum (400 MHz, 301 K, DMSO-d_6) of cage **L-Tar@(*R*,*R*)-2b**. The diffusion coefficient for the molecular cage **L-Tar@(*R*,*R*)-2b** was calculated to be 1.22 x 10^{-10} m^2 s^{-1}, corresponding to a hydrodynamic radius (r_H) of 9.08 Å. The hydrodynamic radius was calculated using Stokes-Einstein equation.[2,3]

9.13 D-Tar@(*R*,*R*)-2b

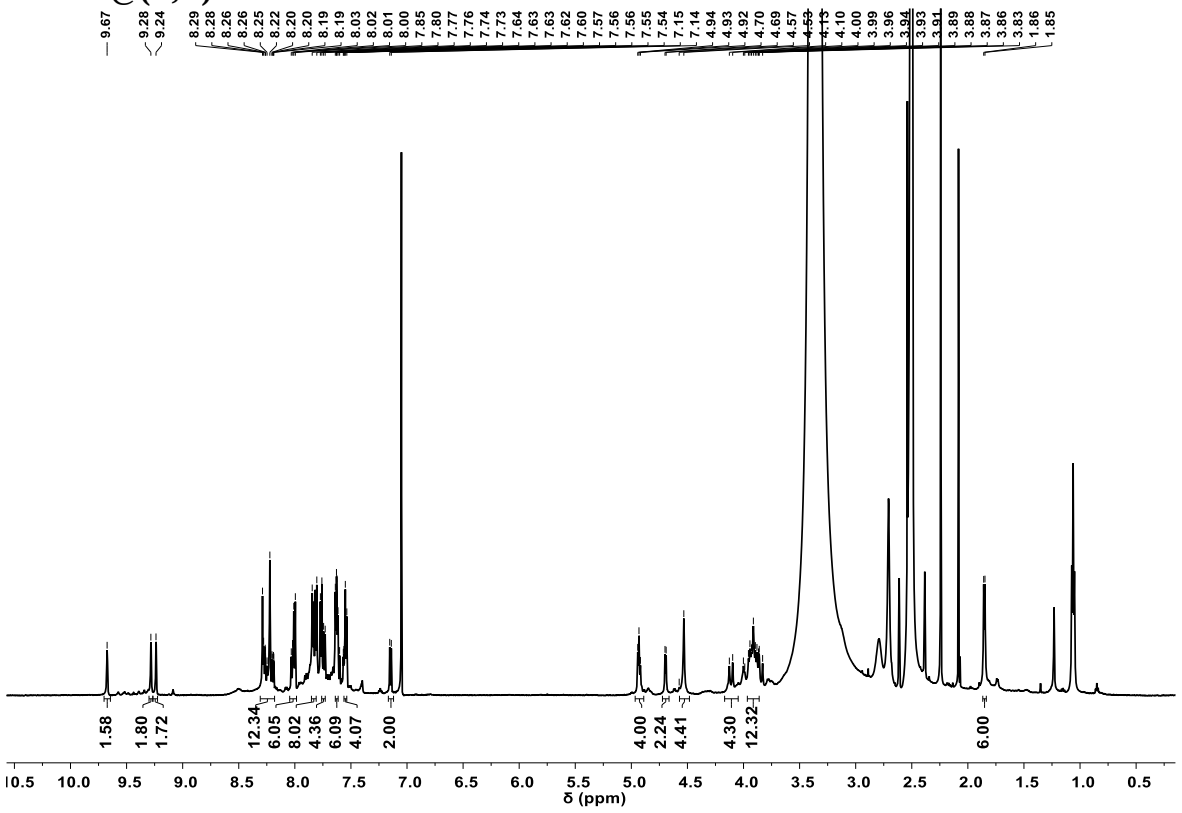


Figure S41 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **D-Tar@(*R*,*R*)-2b**.

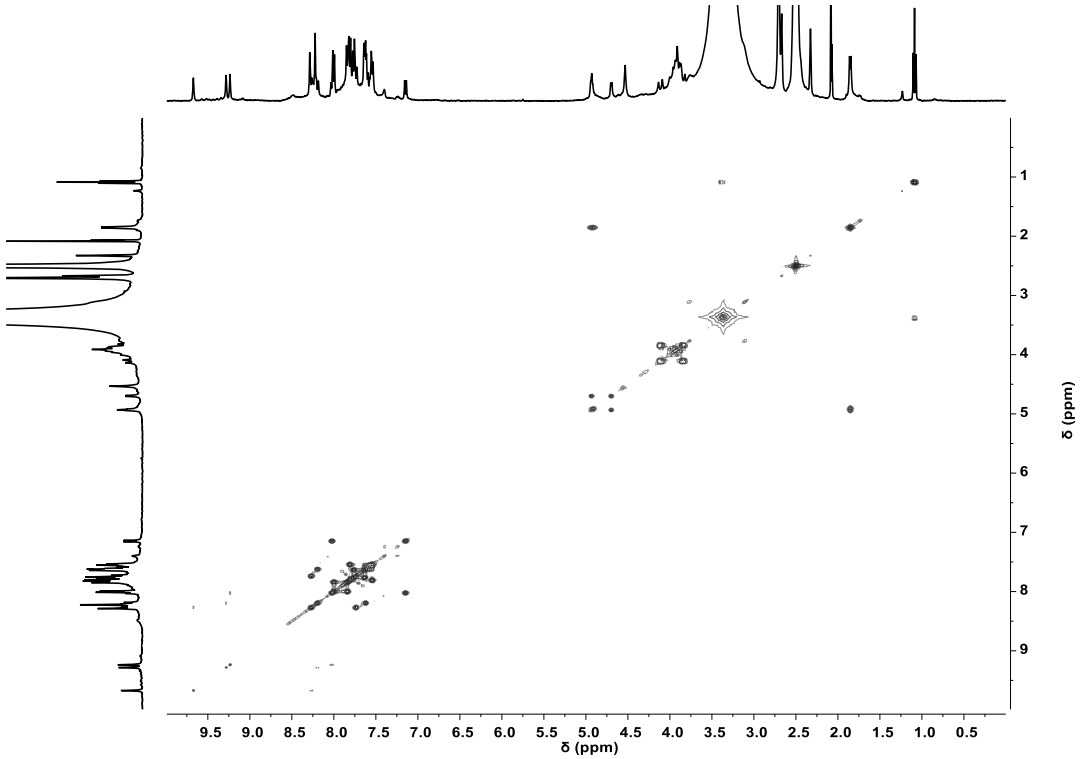


Figure S42 ^{1}H-^{1}H COSY spectrum (400 MHz, 301 K, DMSO-d_6) of cage **D-Tar@(*R*,*R*)-2b**.

9.14 L-Mal@(*R*,*R*)-2b

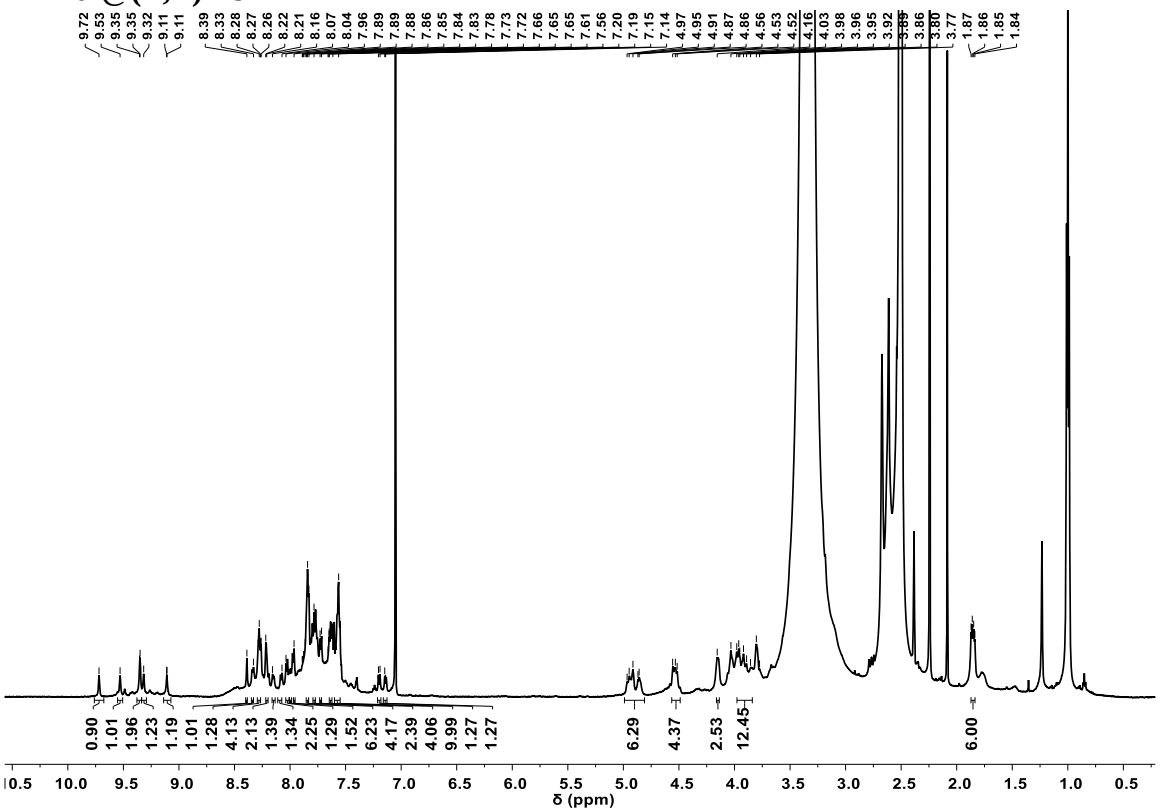


Figure S43 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **L-Mal@(*R*,*R*)-2b**.

9.15 D-Mal@(*R*,*R*)-2b

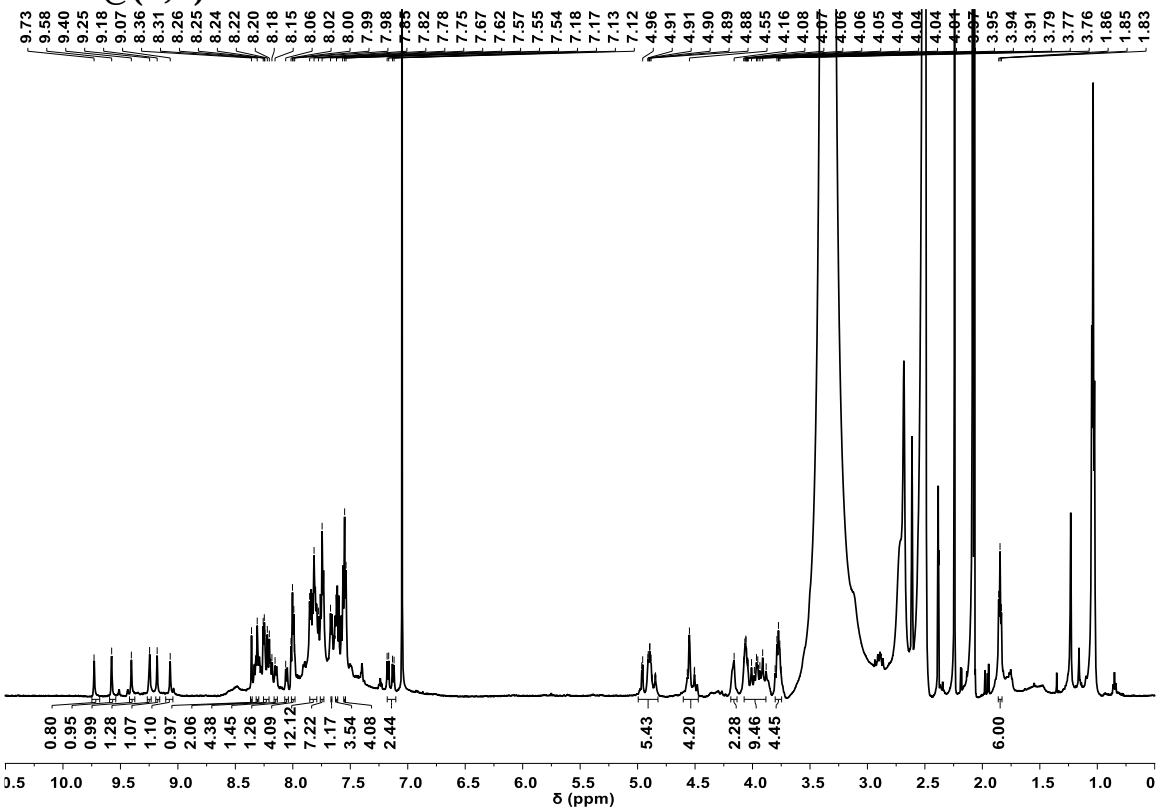


Figure S44 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **D-Mal@(*R*,*R*)-2b**.

9.16 Suc@(*R*,*R*)-2b

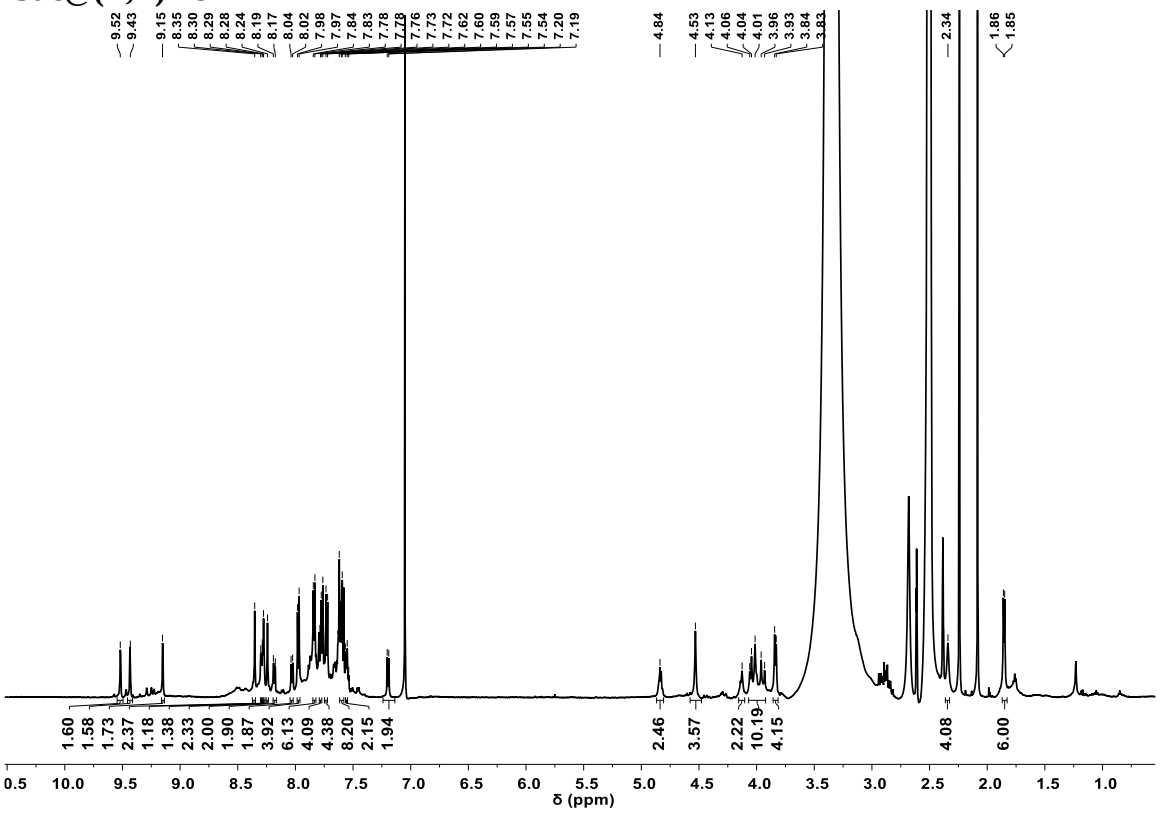


Figure S45 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of cage **Suc@(*R*,*R*)-2b**.

9.17 Prosecco@2a

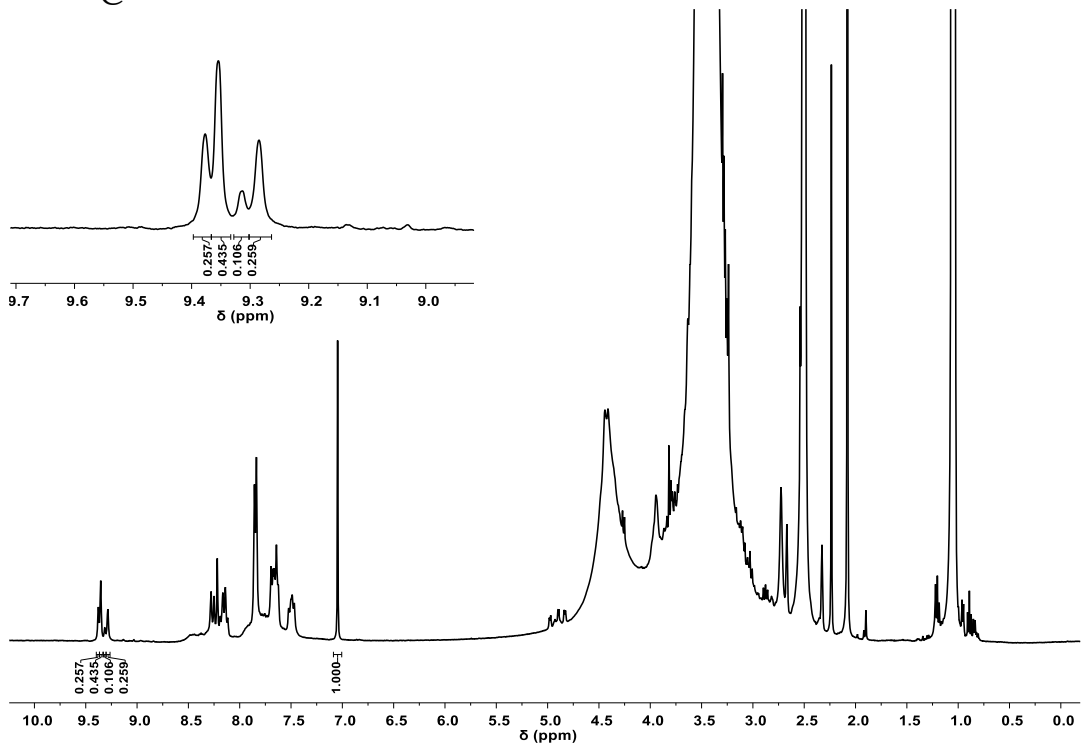


Figure S46 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Prosecco wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.18 Chianti@2a

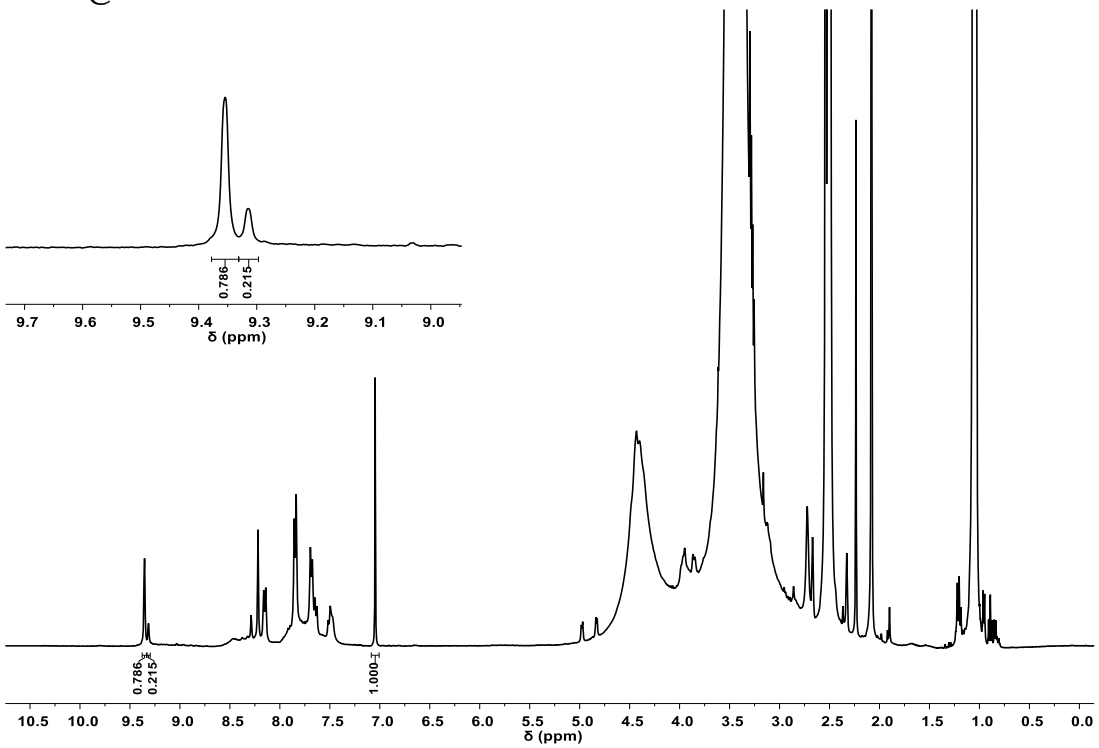


Figure S47 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Chianti wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.19 Chardonnay@2a

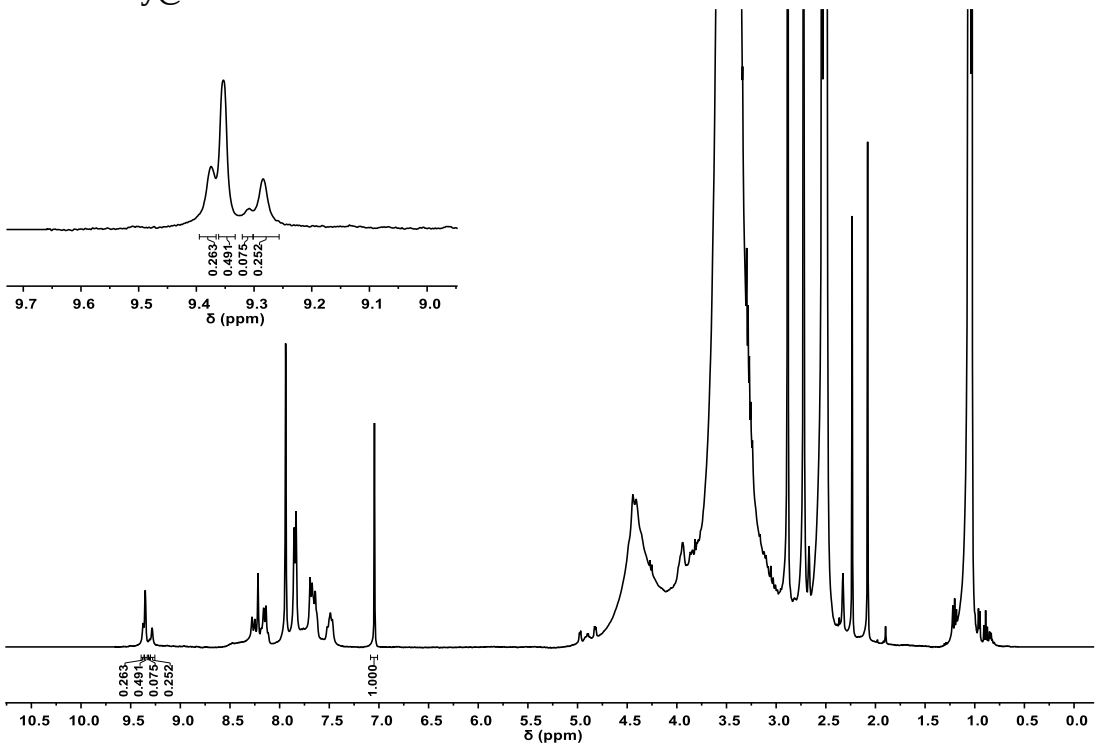


Figure S48 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Chardonnay wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.20 Valpolicella@2a

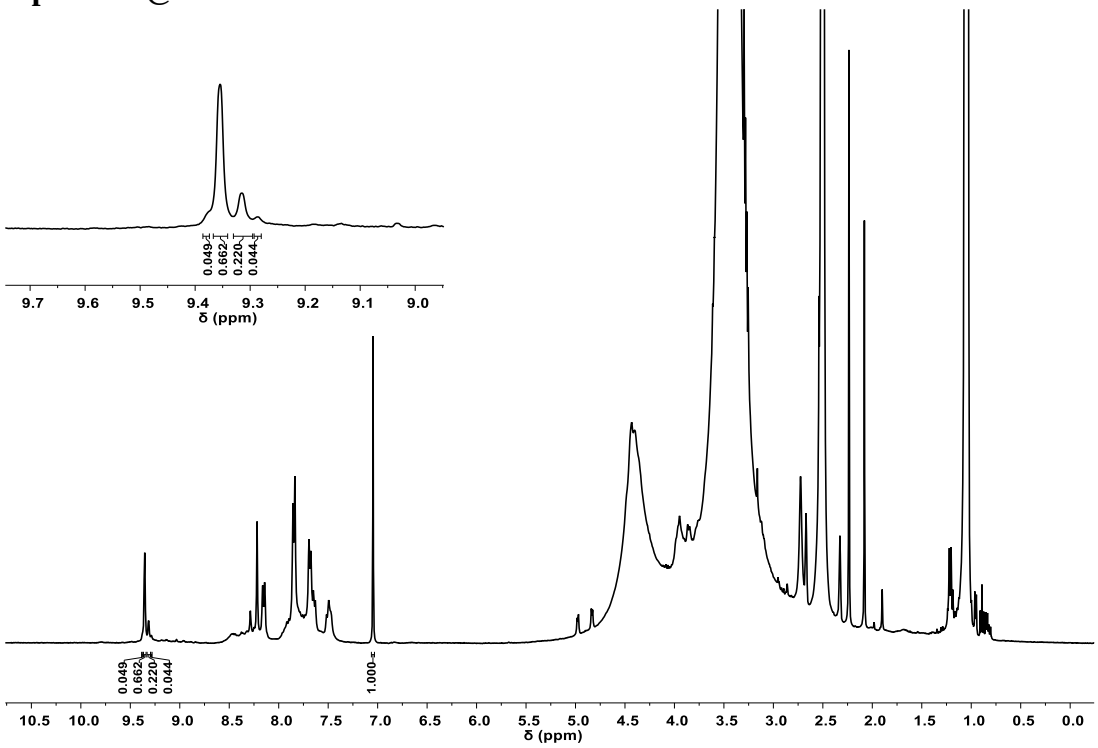


Figure S49 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Valpolicella wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.21 Müller-Thurgau@2a

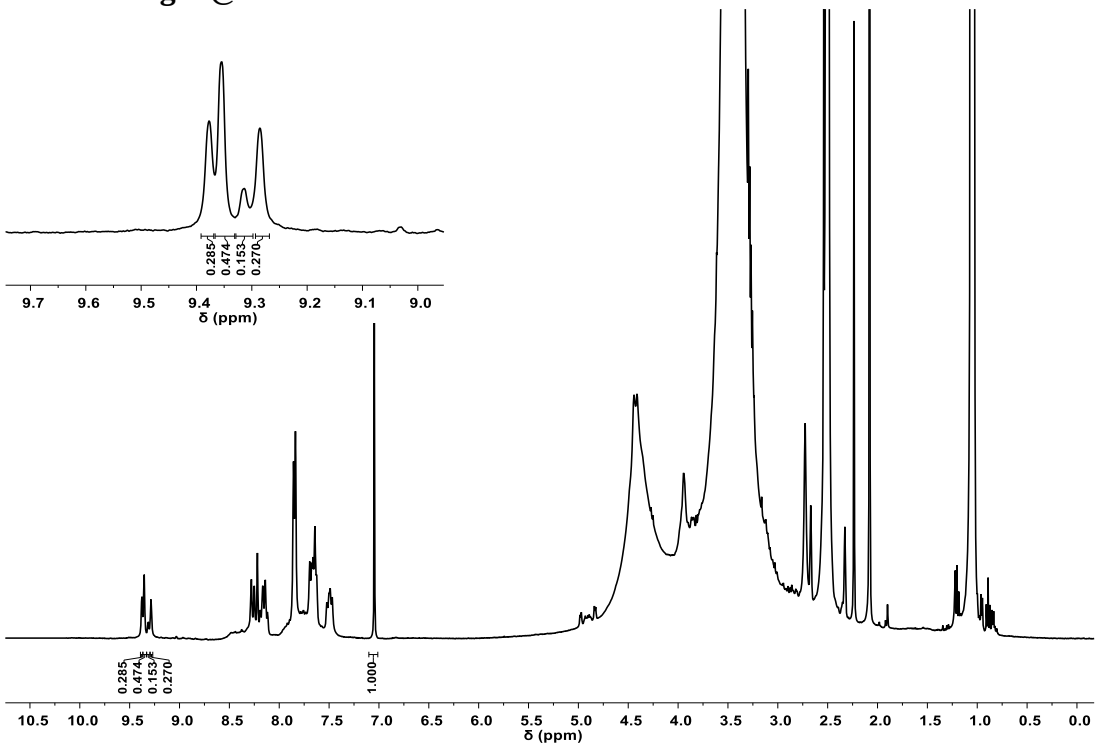


Figure S50 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Müller-Thurgau wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.22 Barbera@2a

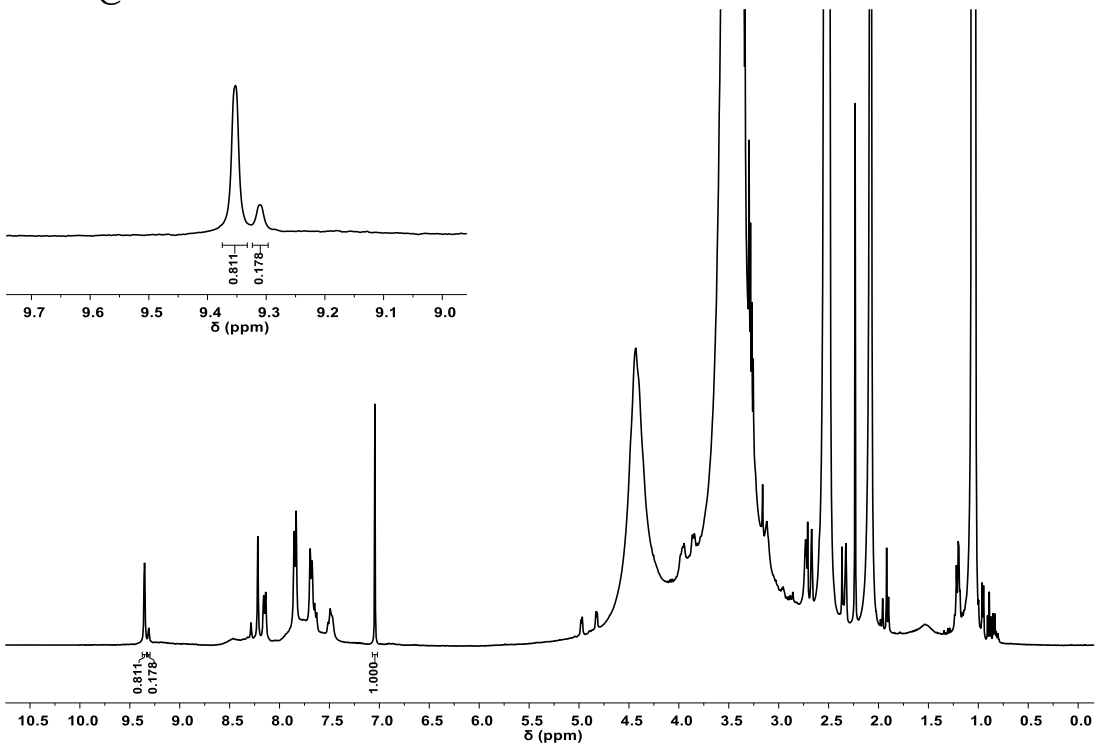


Figure S51 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Barbera wine without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.23 Grapes Juice Squeezed@2a

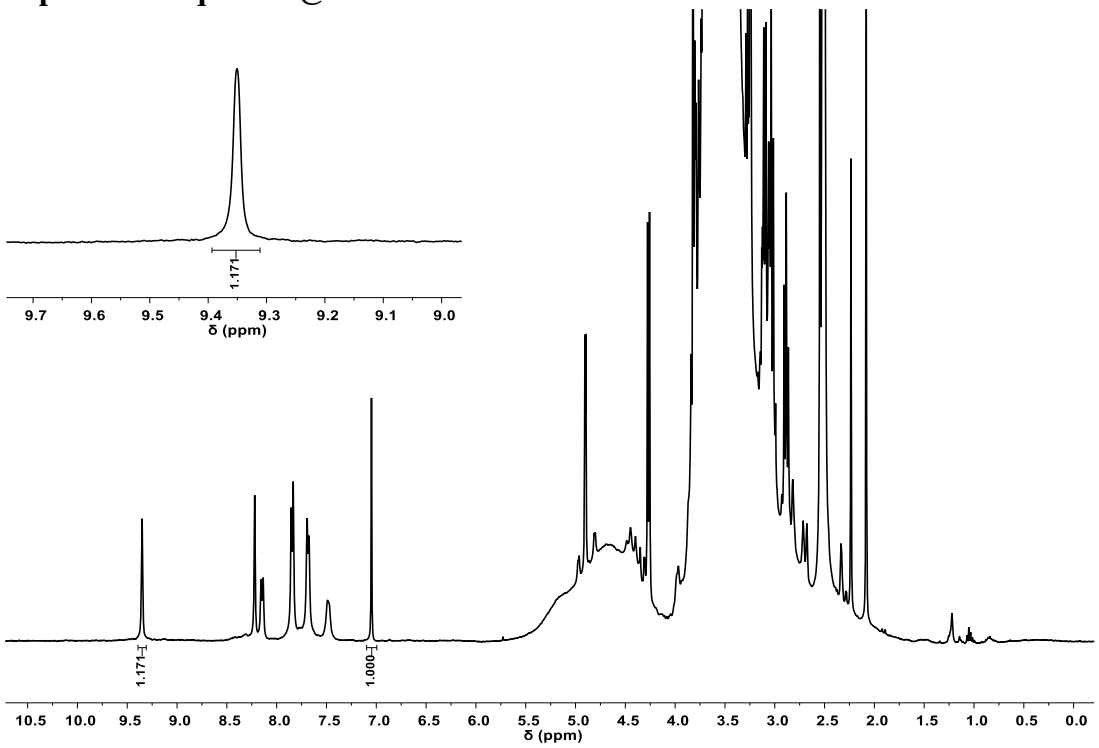


Figure S52 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding freshly squeezed grapes juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.24 Blueberry Alcenera@2a

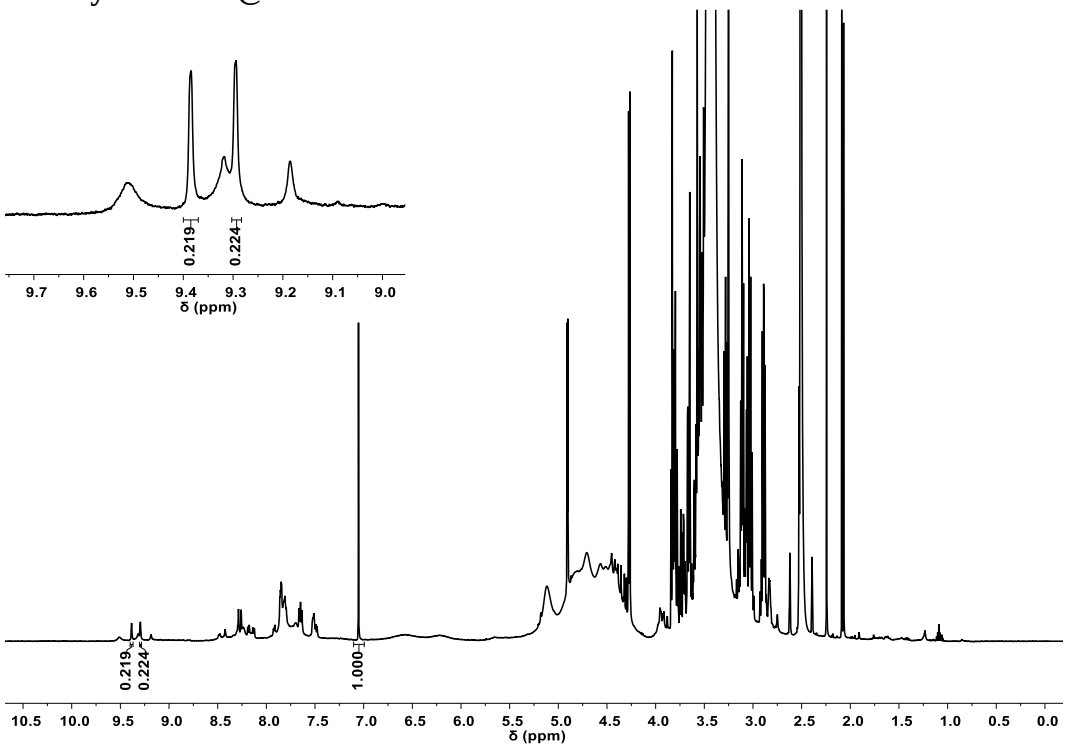


Figure S53 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Blueberry juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.25 Blueberry Zuegg@2a

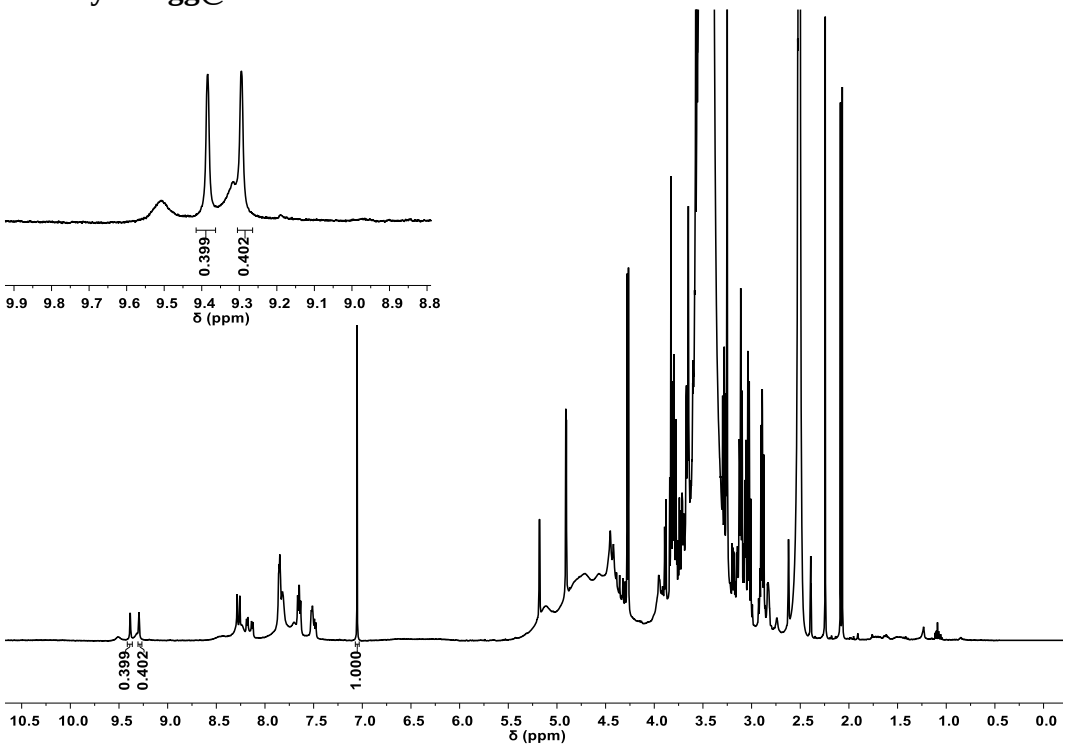


Figure S54 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Blueberry juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.26 Blueberry Juice Squeezed@2a

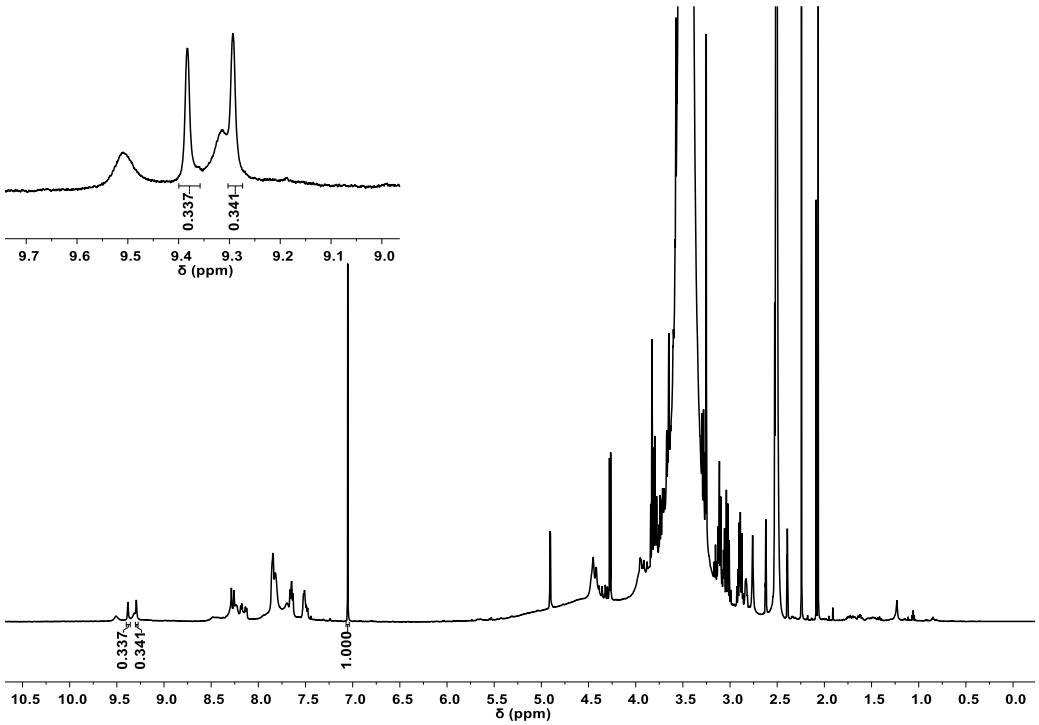


Figure S55 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding freshly squeezed Blueberry juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.27 Apple Juice@2a

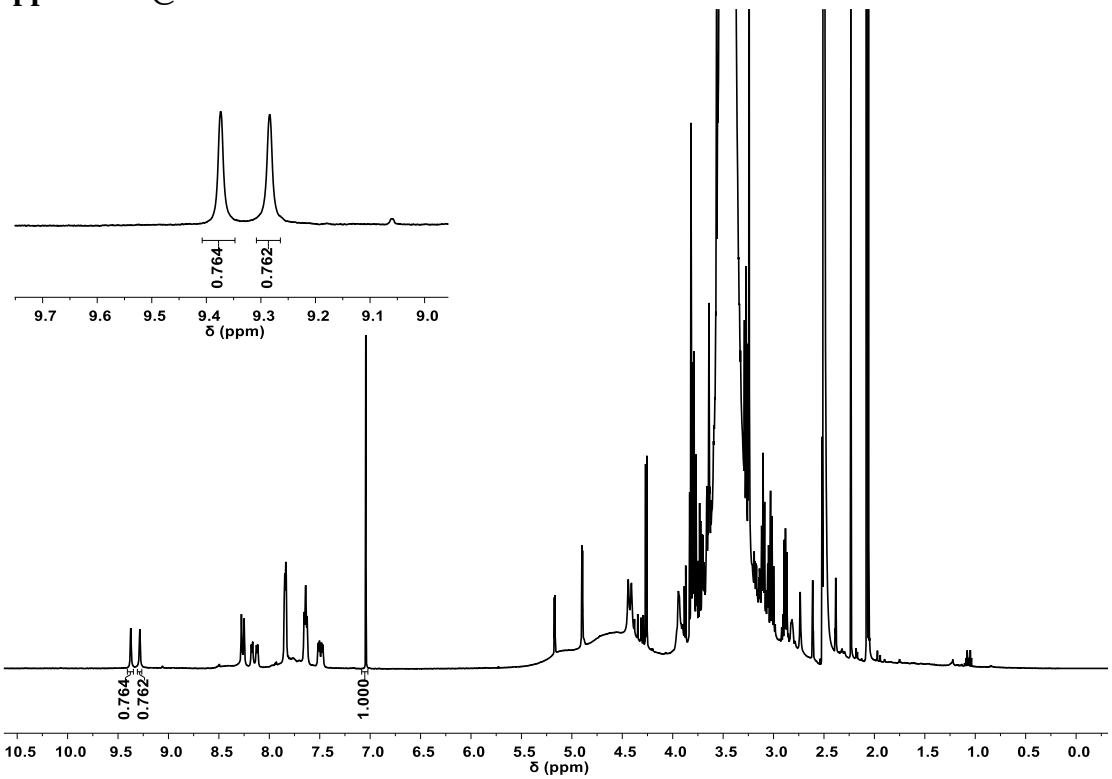


Figure S56 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Apple juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.28 Apple Juice Squeezed@2a

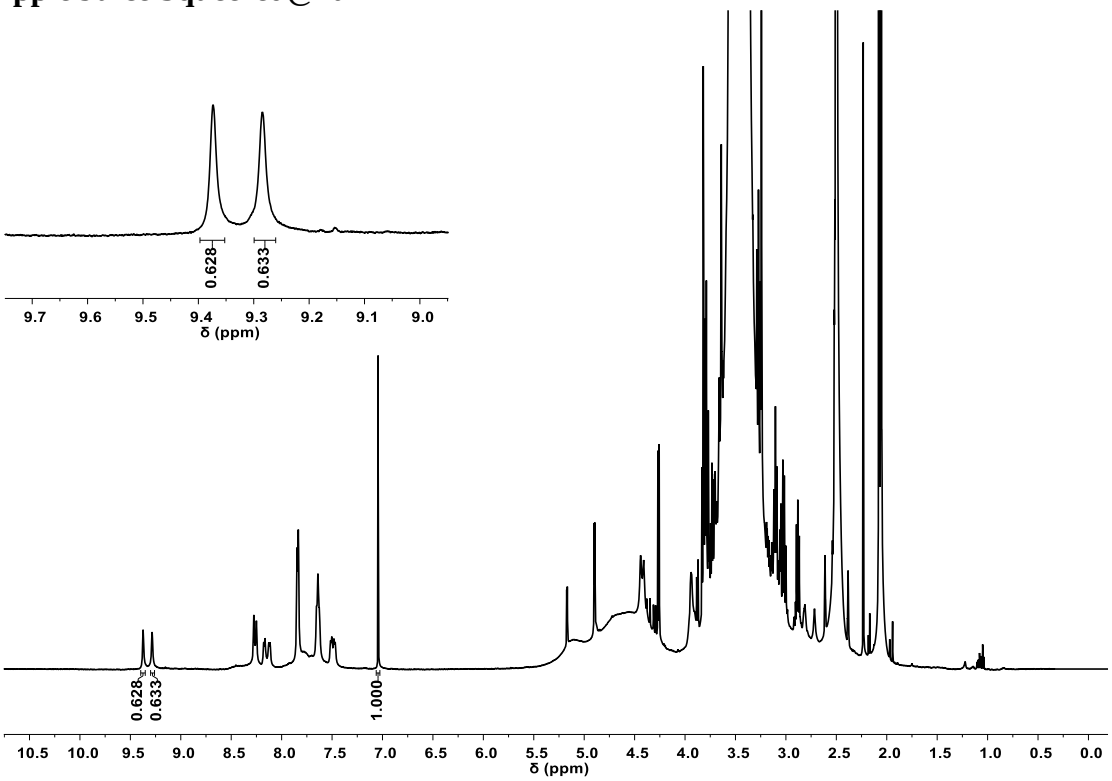


Figure S57 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding freshly squeezed Apple juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.29 Pear Juice@2a

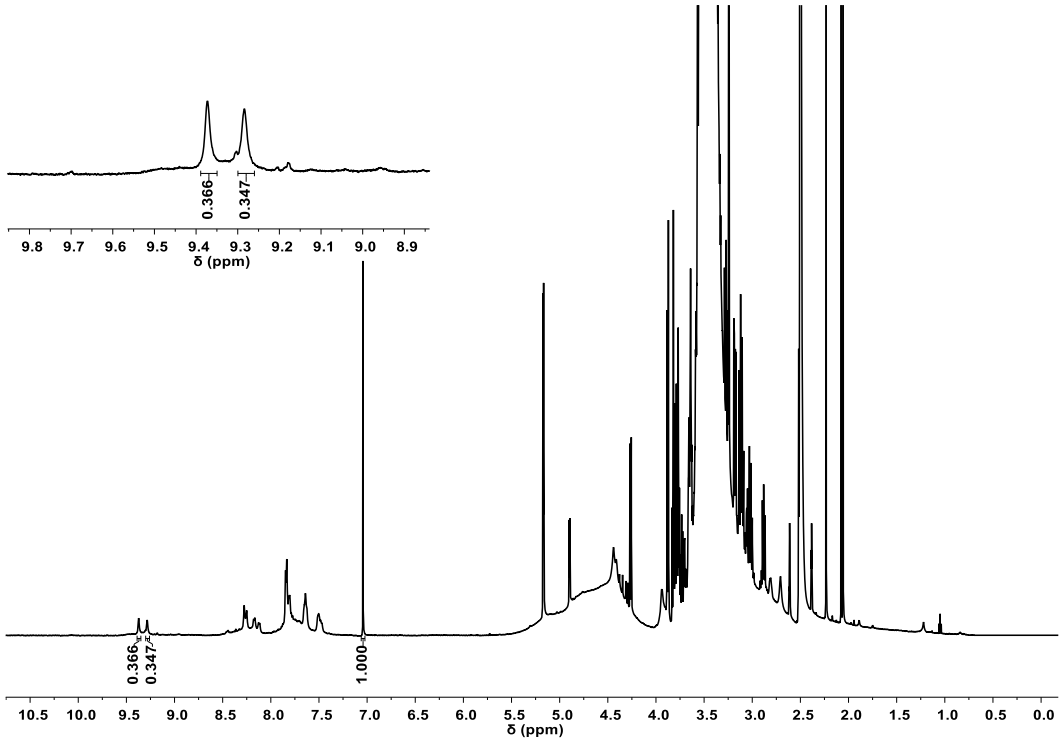


Figure S58 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Pear juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.30 Blueberry-Grape Juice@2a

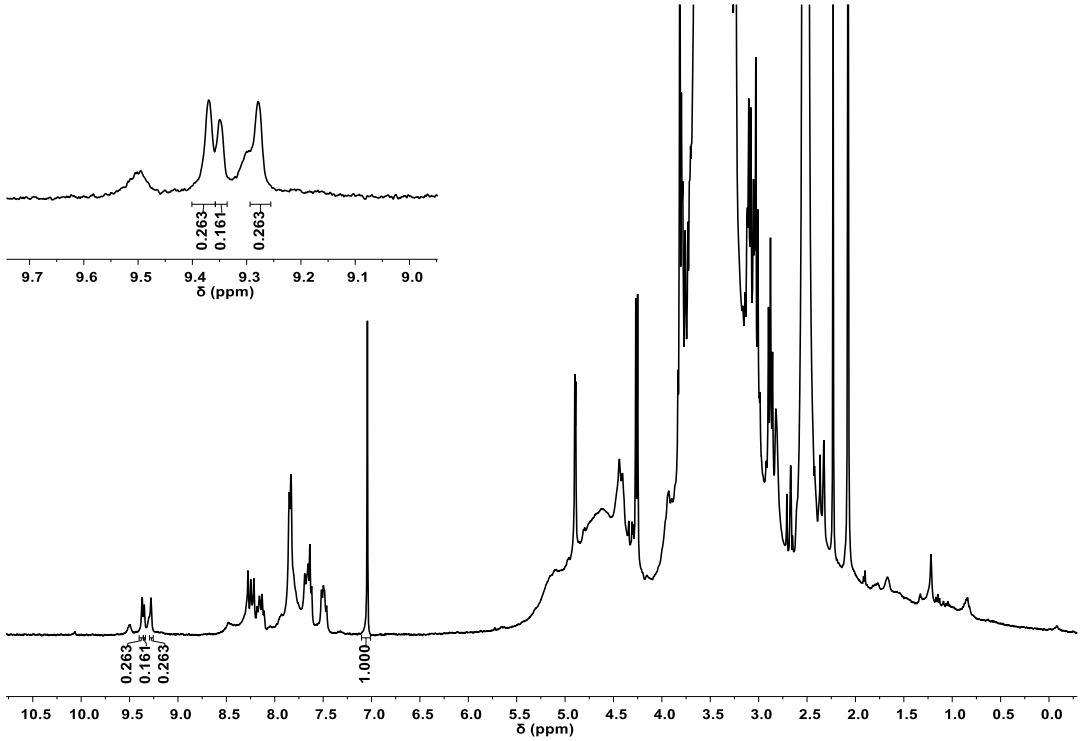


Figure S59 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Blueberry-Grape juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.31 Peach Juice@2a

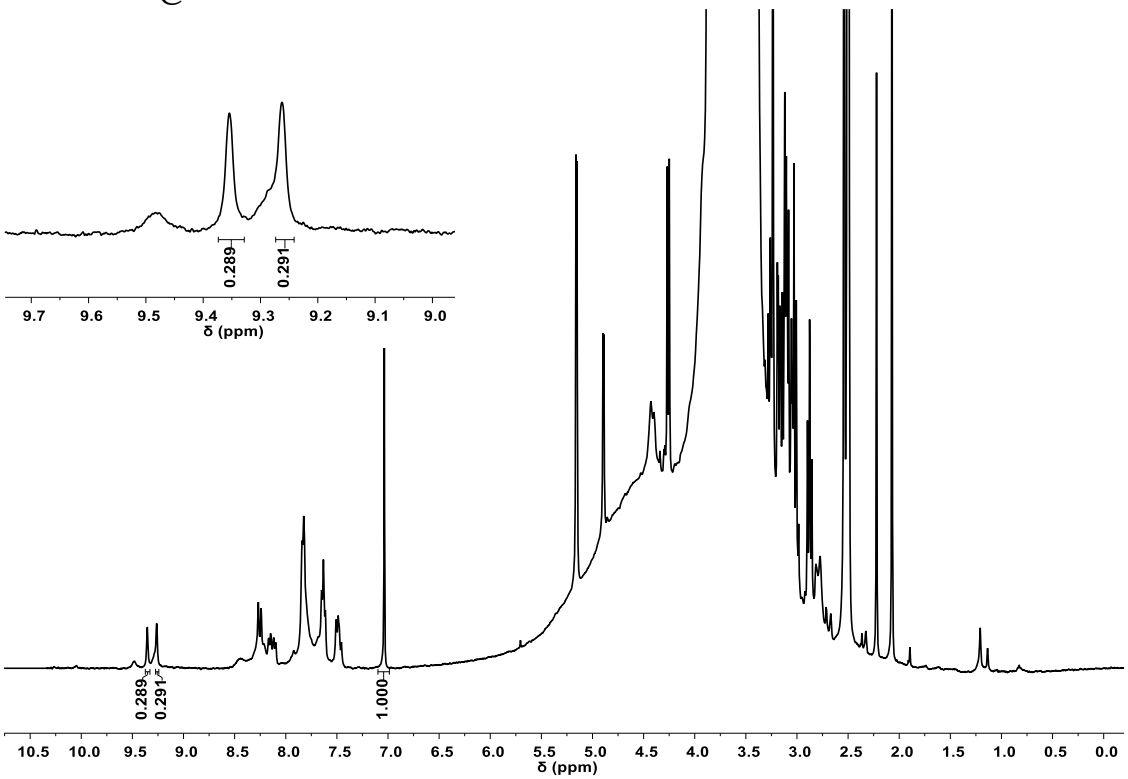


Figure S60 ^{1}H-NMR spectrum (400 MHz, 301 K, DMSO-d_6) of the system formed adding Peach juice without pre-treatment to the DMSO-d_6 solution containing complex **1a** and ethylenediamine.

9.32 Prosecco@(*R*,*R*)-2b

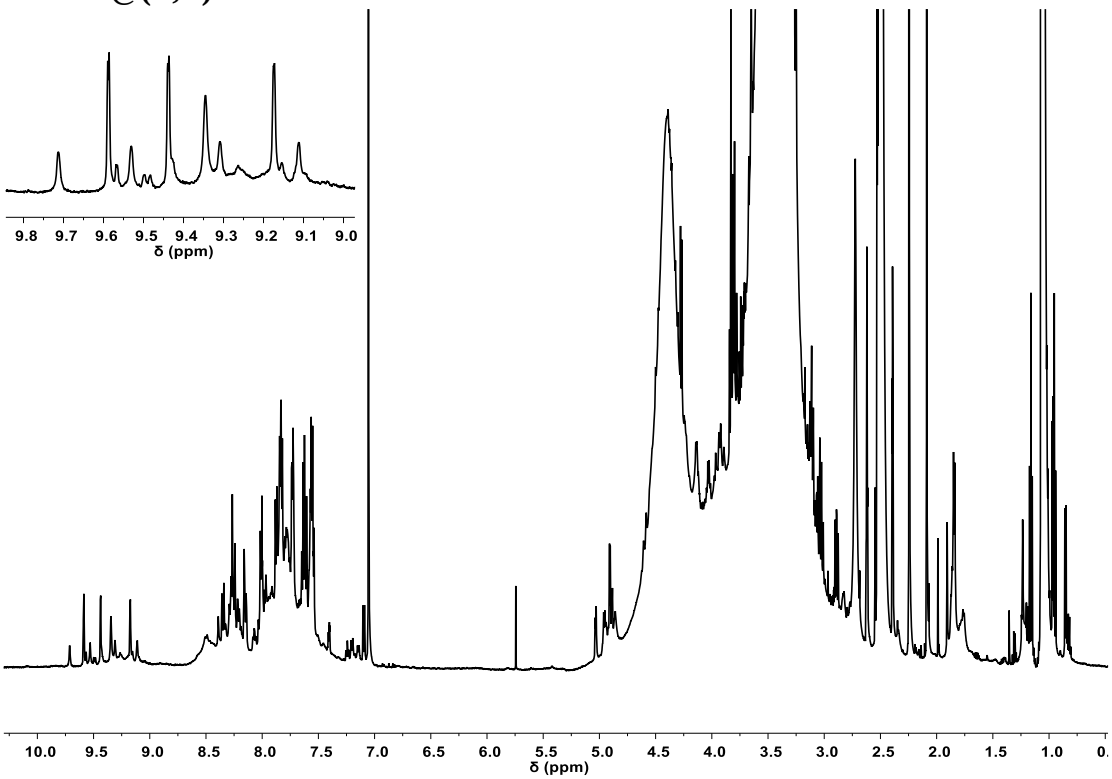


Figure S61 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Prosecco Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.33 Chianti@(*R*,*R*)-2b

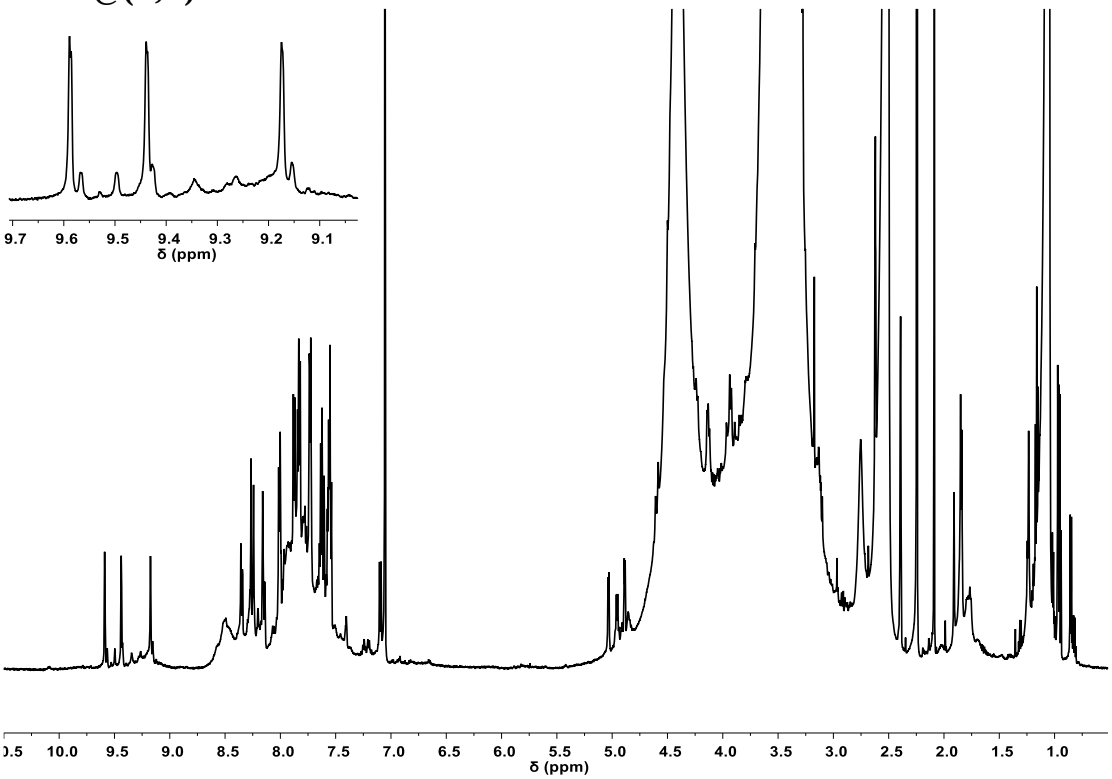


Figure S62 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Chianti Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.34 Chardonnay@(*R*,*R*)-2b

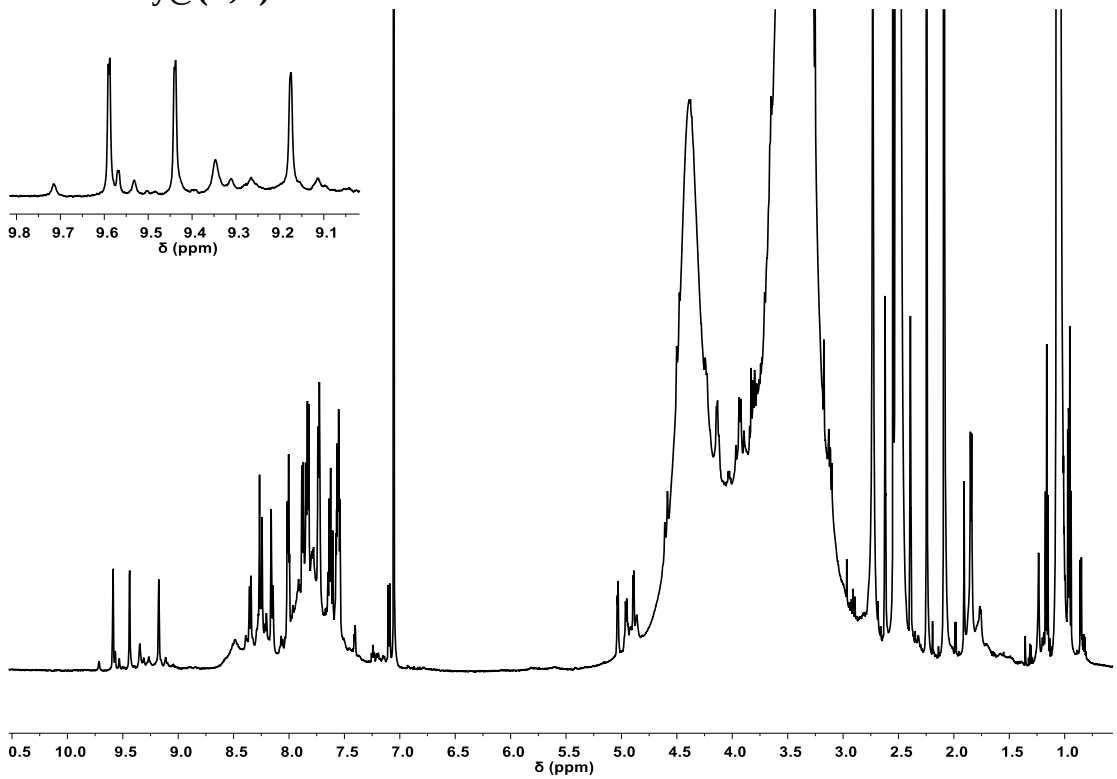


Figure S63 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Chardonnay Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.35 Valpolicella@(*R*,*R*)-2b

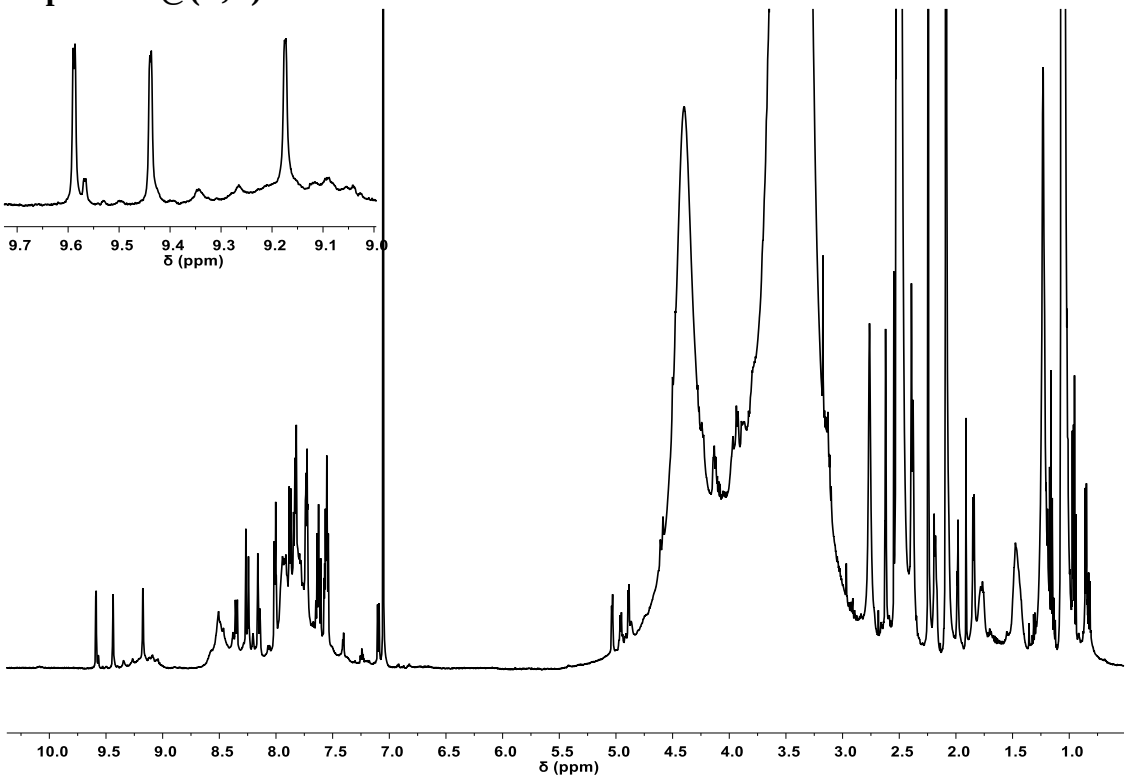


Figure S64 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Valpolicella Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.36 Müller-Thurgau@(*R*,*R*)-2b

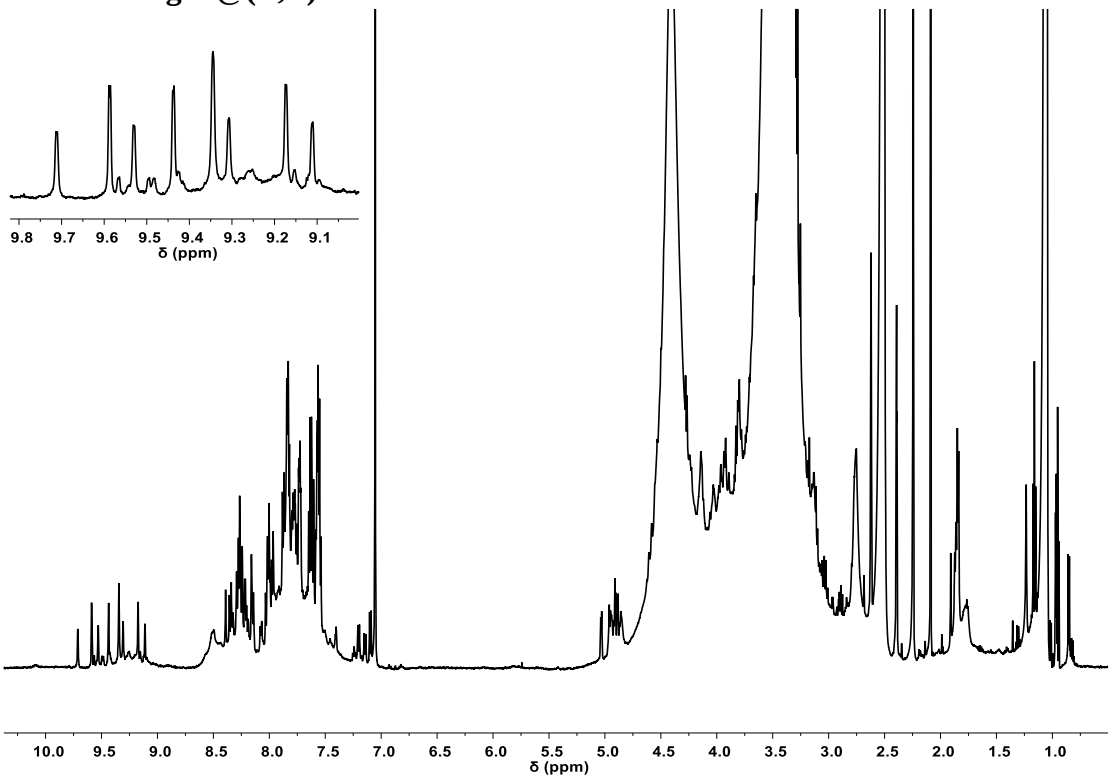


Figure S65 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Müller-Thurgau Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.37 Barbera@(*R*,*R*)-2b

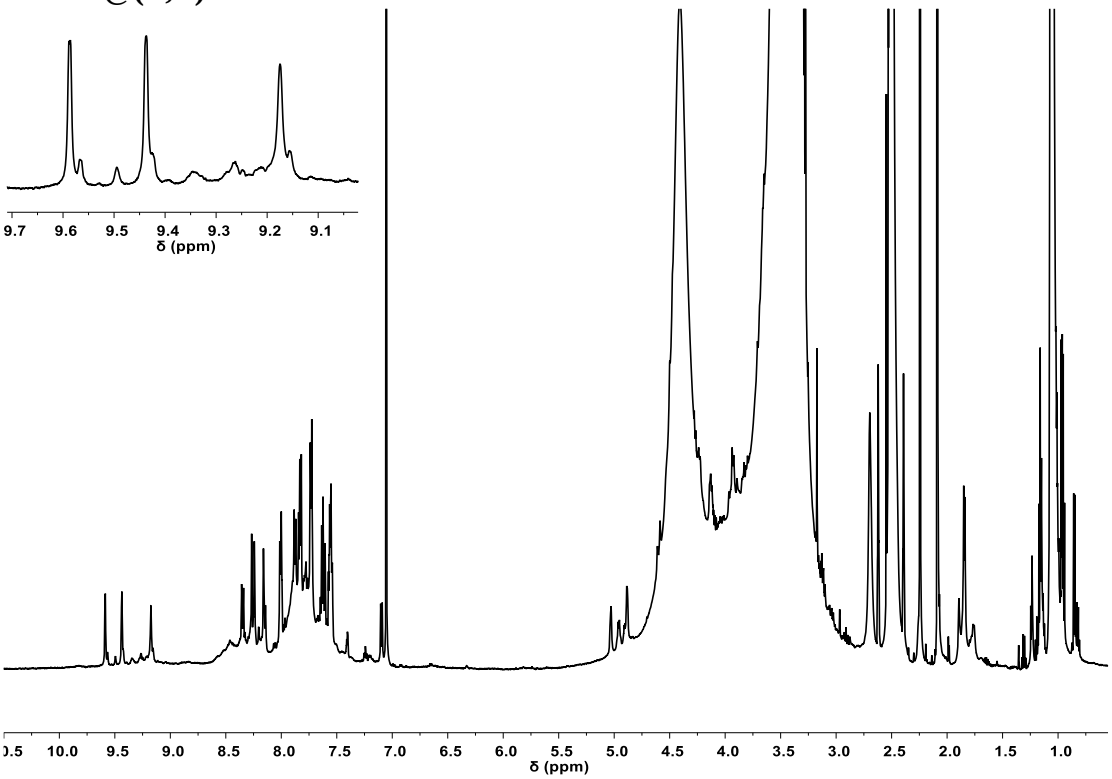


Figure S66 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Barbera Wine without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.38 Blueberry Juice Alcenera@(*R*,*R*)-2b

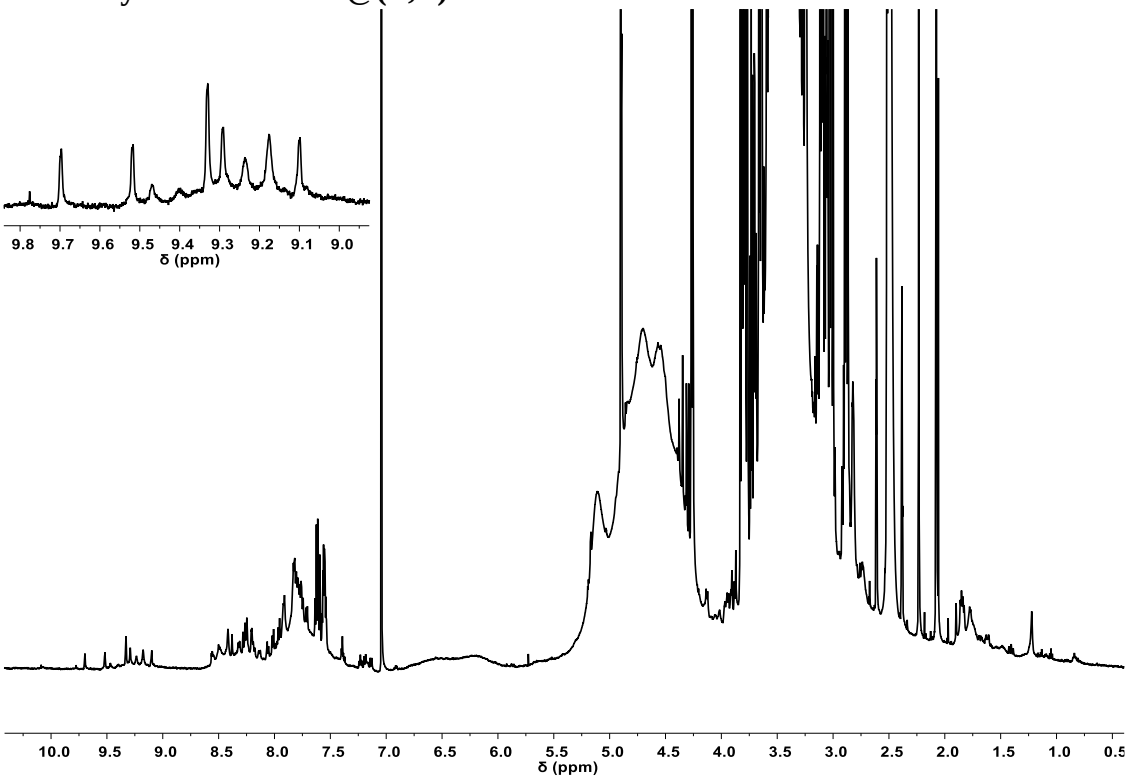


Figure S67 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Blueberry Juice without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.39 Blueberry Juice Zuegg@(*R*,*R*)-2b

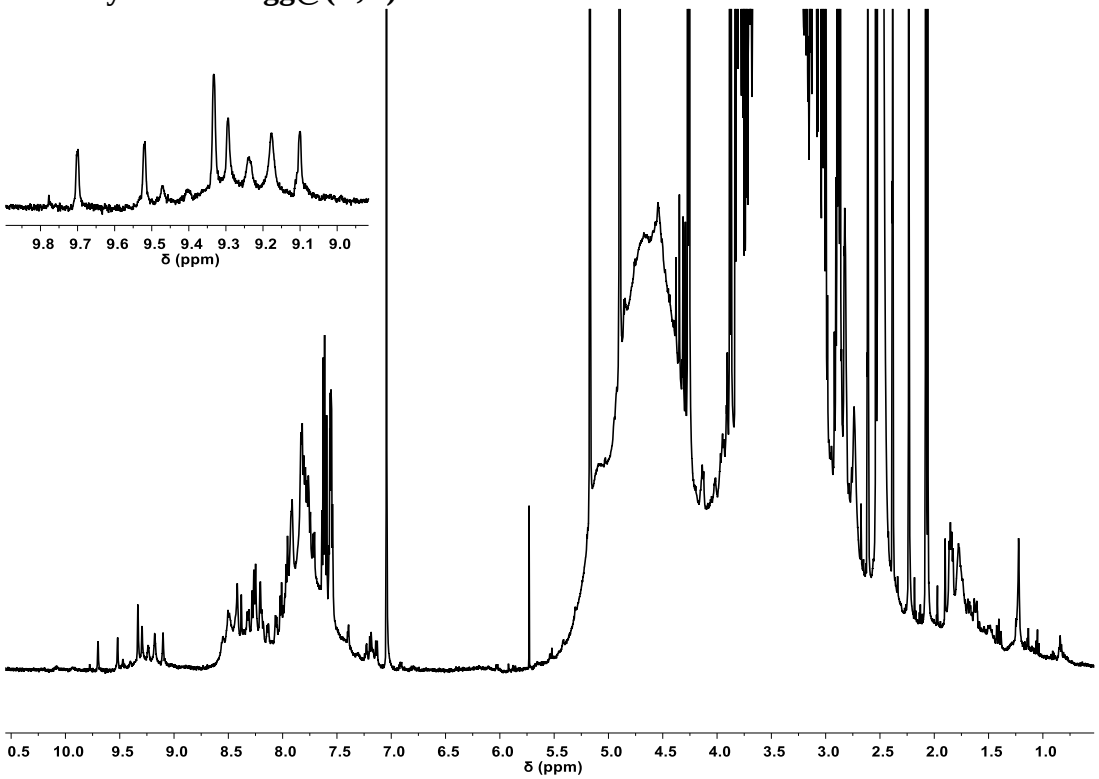


Figure S68 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Blueberry Juice without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.40 Blueberry Juice Squeezed@(*R*,*R*)-2b

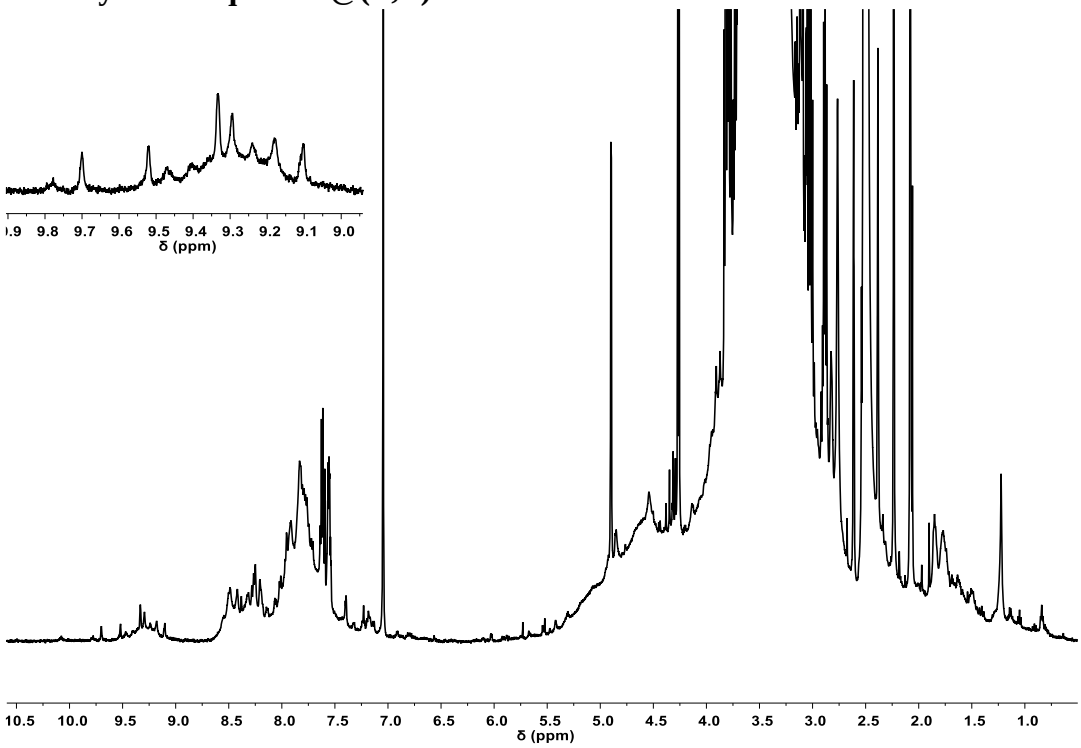


Figure S69 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding freshly squeezed Blueberry Juice without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.41 Apple Juice@(*R*,*R*)-2b

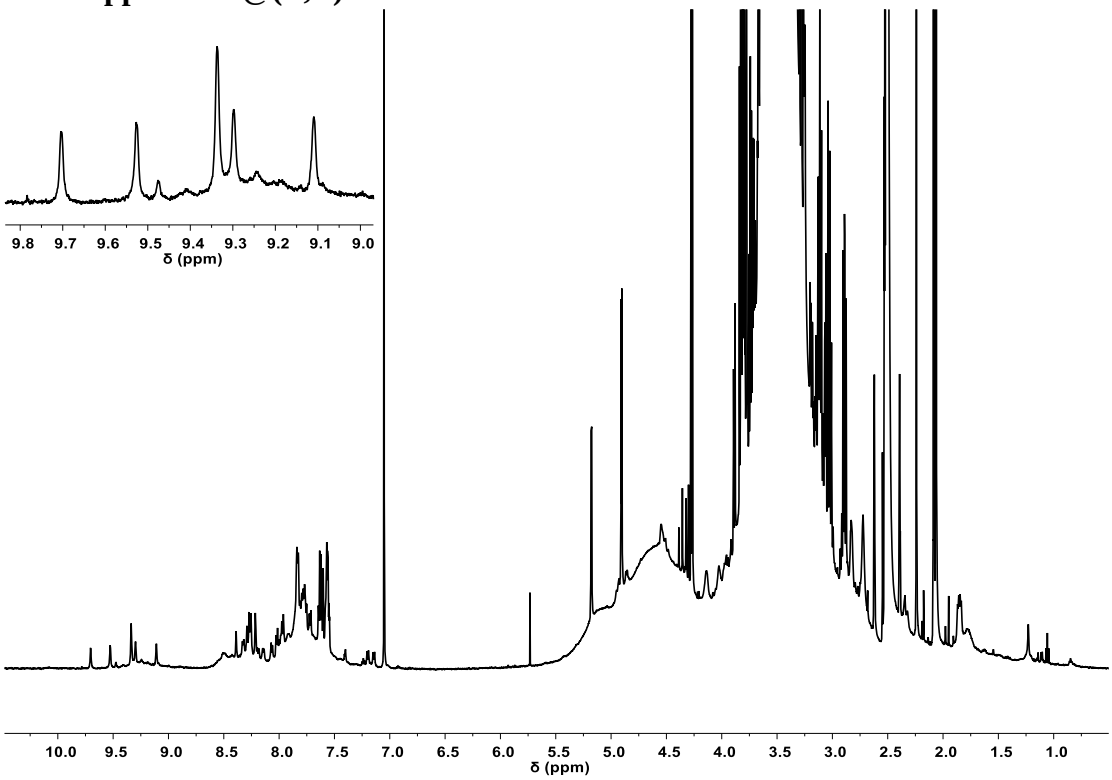


Figure S70 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Apple Juice without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.42 Apple Squeezed@(*R*,*R*)-2b

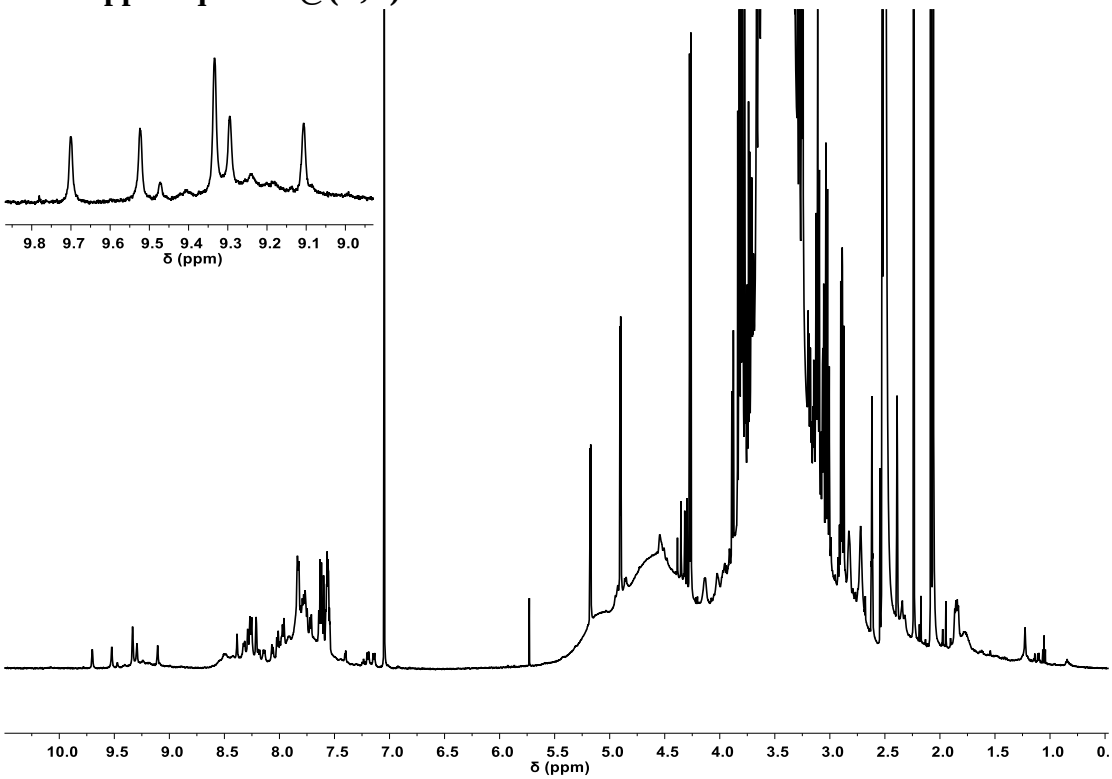


Figure S71 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding freshly squeezed Apple Juice without pre-treatment to the DMSO-d_6 solution containing complex **(*R*)-1b** and ethylenediamine.

9.43 Pear Juice@(*R*,*R*)-2b

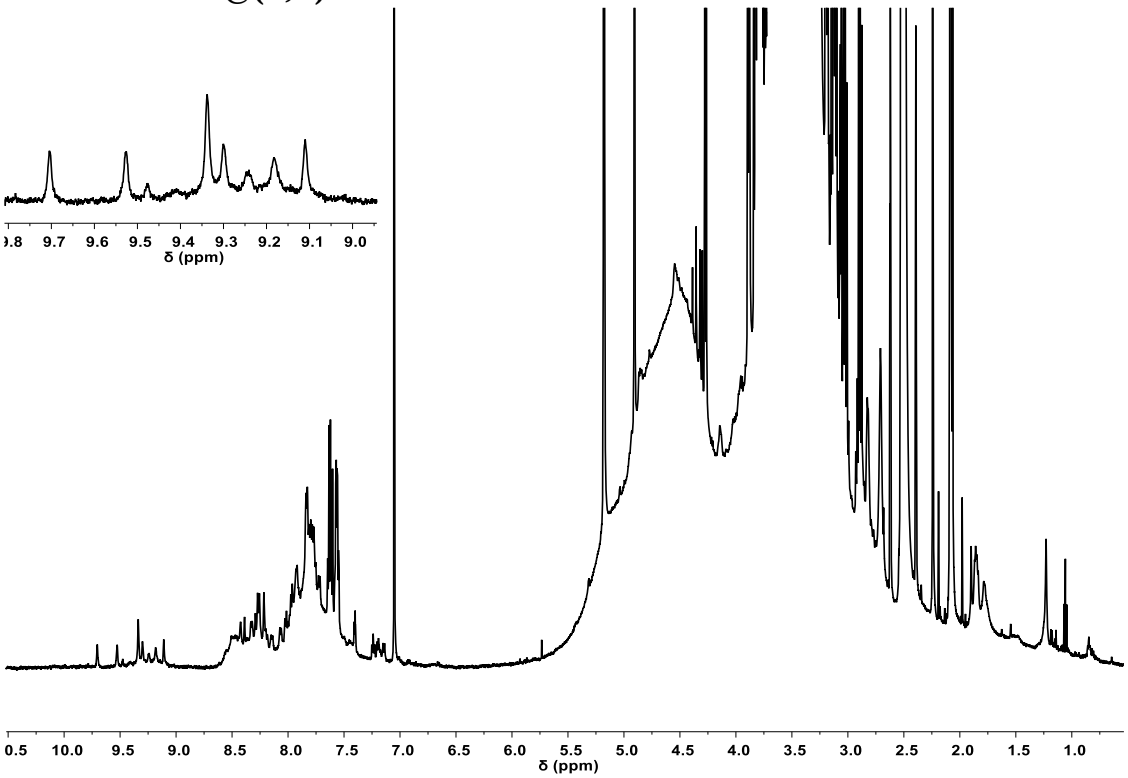


Figure S72 ^{1}H-NMR spectrum (600 MHz, 301 K, DMSO-d_6) of the system formed adding Pear Juice without pre-treatment to the DMSO-d_6 solution containing complex **1b** and ethylenediamine.

10 Quantification of Dicarboxylic acids Content in Complex mixtures

In order to determine the concertation of Tartaric, Malic, and Succinic acids in the complex mixtures, the concentration of cages **L-Tar@2a, L-Mal@2a,** and **L-Suc@2a** has been determined using p-xylene as internal standard.

Table S1. Quantification of Tartaric, Malic, and Succinic acids content in the complex mixtures.

Complex Mixture	**Tartaric Acid (g/L)**	**Malic Acid (g/L)**	**Succinic Acid (g/L)**
Prosecco	1.3	1.6	0.3
Chianti	2.4	n.d	0.7
Chardonnay	1.5	1.6	0.2
Valpolicella	2.0	0.3	0.7
Müller-Thurgau	1.5	1.7	0.5
Barbera	2.5	n.d	0.5
Grapes Juice Squeezed	3.6	n.d	n.d
Blueberry Alcenera	n.d	1.4	n.d*
Blueberry Zuegg	n.d	2.5	n.d*
Blueberry Juice Squeezed	n.d	2.1	n.d*
Apple Juice	n.d	4.7	n.d
Apple Juice Squeezed	n.d	3.9	n.d
Pear Juice	n.d	2.1	n.d
Blueberry-Grape Juice	0.5	1.6	n.d*
Peach Juice	n.d	1.8	n.d*

*The peak of succinic acid could be overlapped to the citric acid peak at 9.33 ppm

11 Chromatographic Analysis

In order to verify the reliability of the quantification of Tartaric, Malic, and Succinic acids *via* ^{1}H-NMR using the supramolecular cage **2a** as probe, a chromatographic analysis has been performed.

The HPLC method parameters have been reported in Table S2.

Table S2. HPLC Method Parameters.

HPLC Method Parameters	
Column	Eurospher II 100-5 C18, 5 µm, 4.6 x 250 mm
Mobile Phase	Isocratic, 25 mM K-phosphate buffer; pH 2.4
Flow Rate	1.5 mL/min. (~ 2600 psi)
Oven Temp.	30 °C
UV detection	Wavelength: 210 nm
Injection Volume	20 µL

The Chromatogram of the mixtures of the three dicarboxylic acids is reported in Fig. S73.

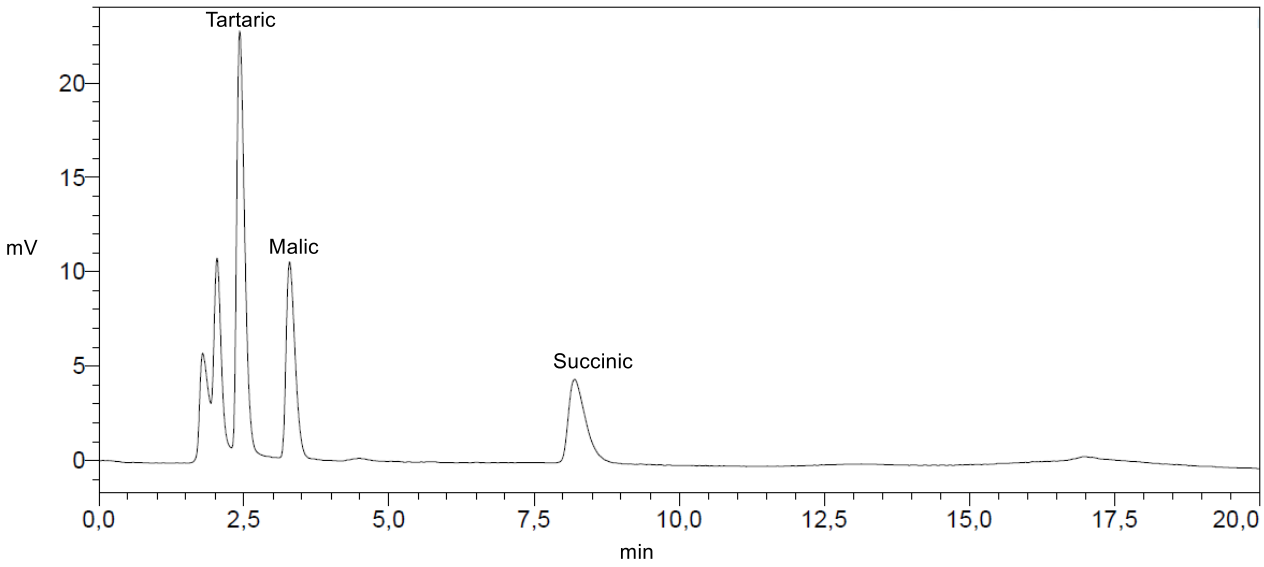


Figure S73: Chromatogram of the mixture of Tartaric (ret. time 2.43 min), Malic (ret. time 3.29 min), and Succinic (ret. time 8.20 min) acids.

For calibration purposes, five solutions with different concentrations (ranging from 20 to 1000 ppm) have been prepared for Tartaric, Malic, and Succinic acids (Fig. S74-S76).

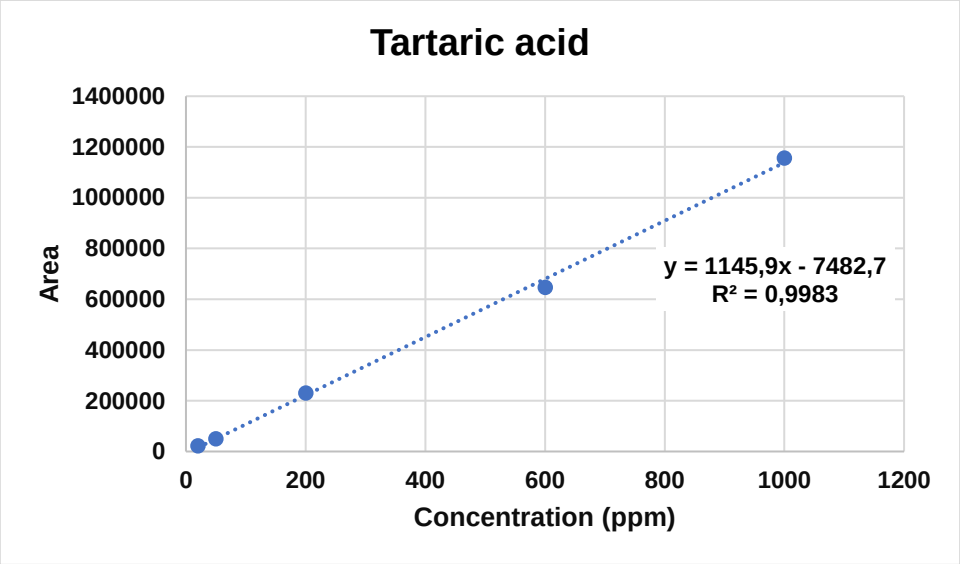


Fig S74 Calibration curve for Tartaric acid.

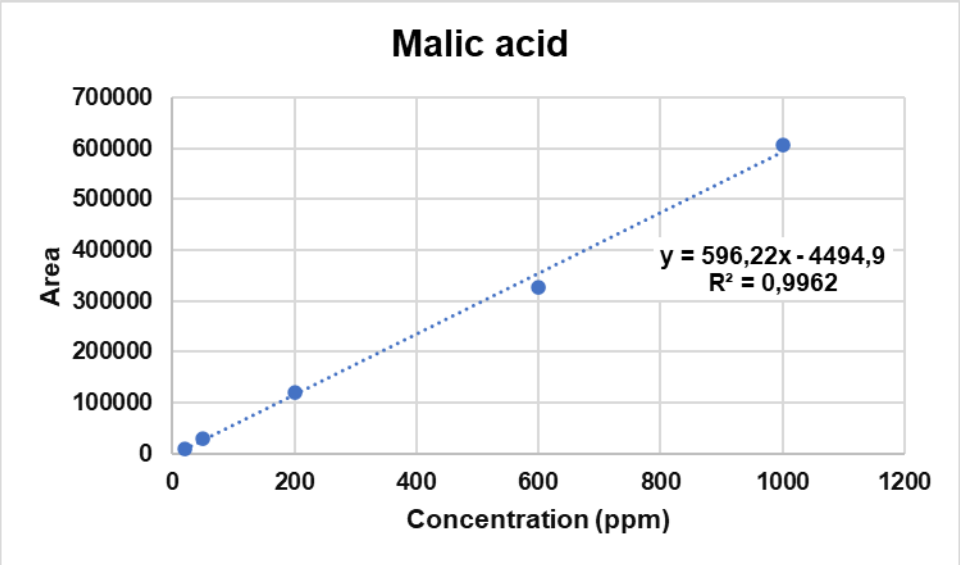


Fig S75 Calibration curve for Malic acid.

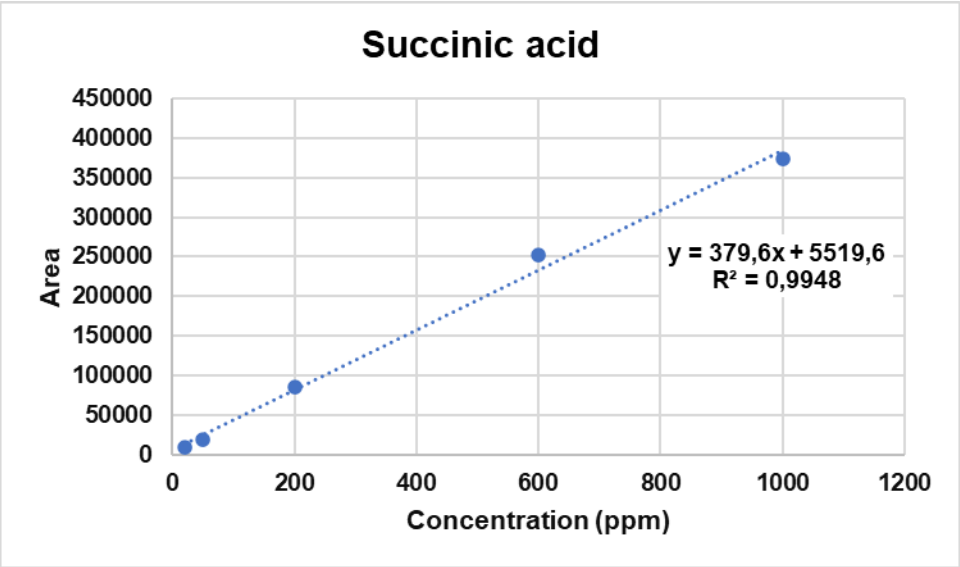
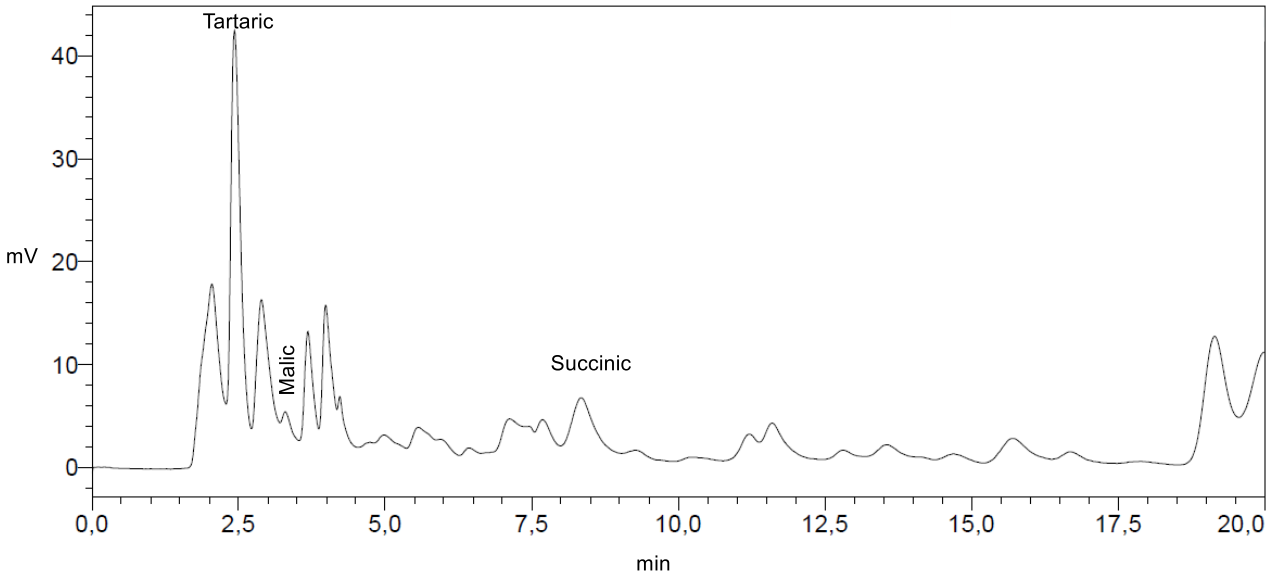


Fig S76 Calibration curve for Succinic acid.

Commercial red wine (Valpolicella), white wine (Müller-Thurgau), and apple juice have been diluted 5:1 with HPLC-grade water, filtered and then injected.

The three chromatograms are reported in Figure S77.

a)



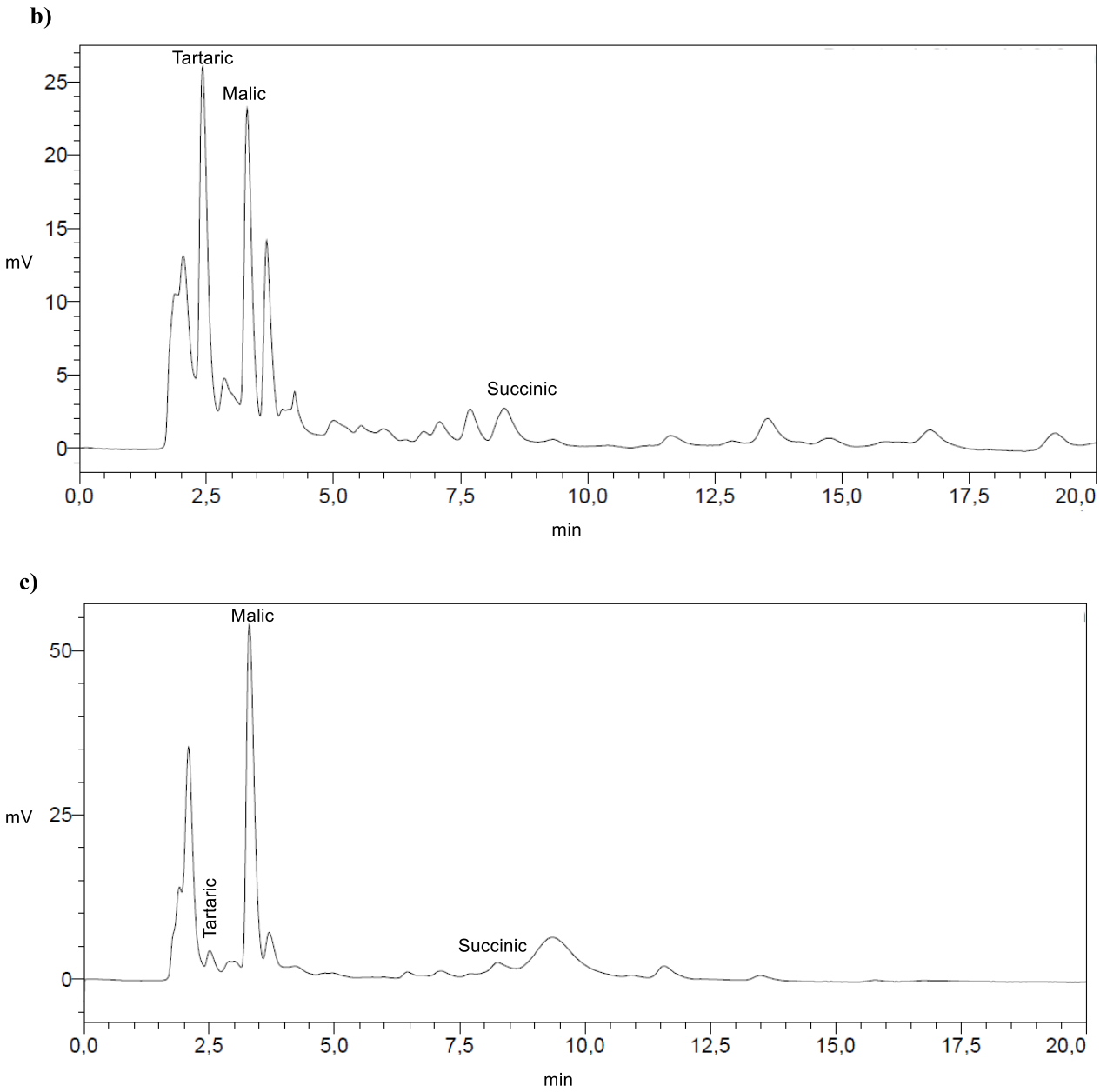


Figure S77 Chromatogram of a) Valpolicella wine, b) Müller-Thurgau wine, and c) apple juice.

As reported in Table S3 a good agreement between the two measurements has been found.

Table S3. Quantification of Tartaric, Malic, and Succinic acids content in the complex mixtures with HPLC and *via* ^{1}H-NMR using cage **2a** as probe.

Complex Mixtures		**HPLC (g/L)**	**^{1}H-NMR (g/L)**
Valpolicella Wine	Tartaric	1.8	2.0
	Malic	0.2	0.3
	Succinic	0.9	0.7
Müller-Thurgau Wine	Tartaric		1.5
	Malic	1.7	1.7
	Succinic	0.6	0.5
Apple Juice	Tartaric	0.1	n.d.*
	Malic	4.6	4.7
	Succinic	0.1	n.d.*

* In the case of apple juice tartaric and succinic acids were not observed in the ^{1}H-NMR spectrum (Fig S56). This could be probably due to the fact that the concentration of malic acid is such high that the cage is completely saturated by malic acid.

12 ESI-MS Characterization

12.1 ESI-MS spectrum of 4

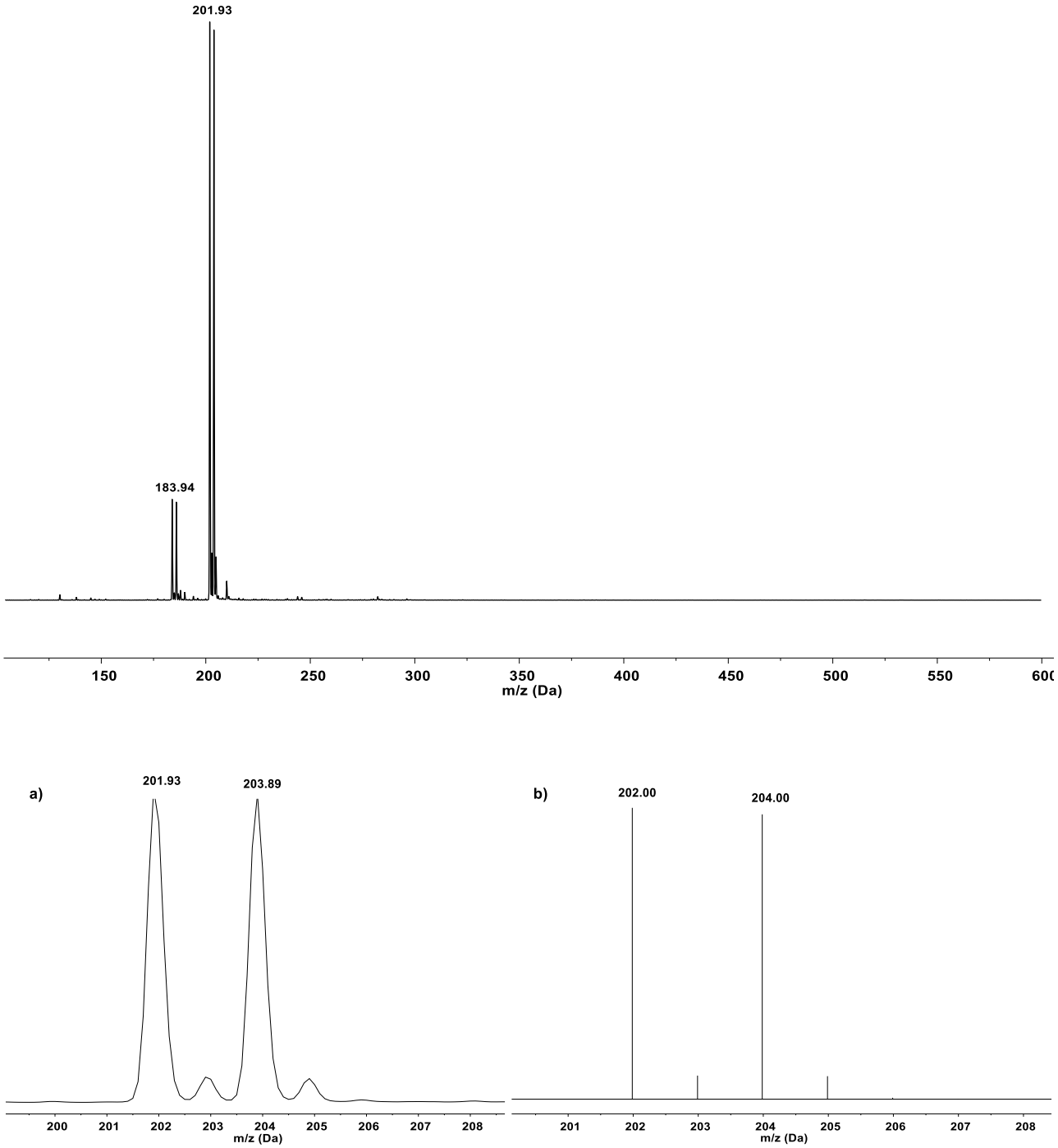


Figure S78 a) Experimental, and b) calculated ESI-MS pattern of **4** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.2 ESI-MS spectrum of 5

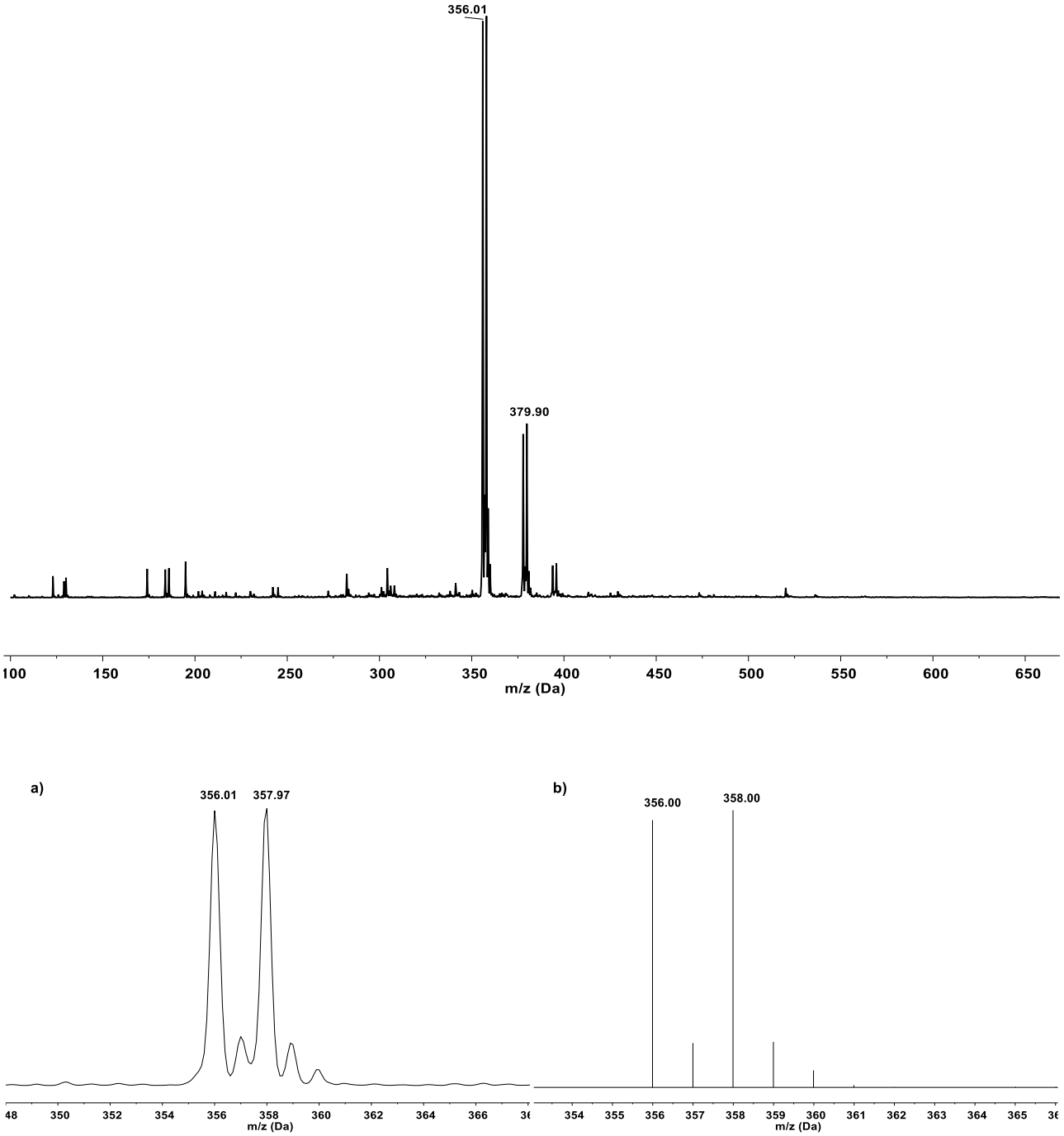


Figure S79 a) Experimental, and b) calculated ESI-MS pattern of **5** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.3 ESI-MS spectrum of 6

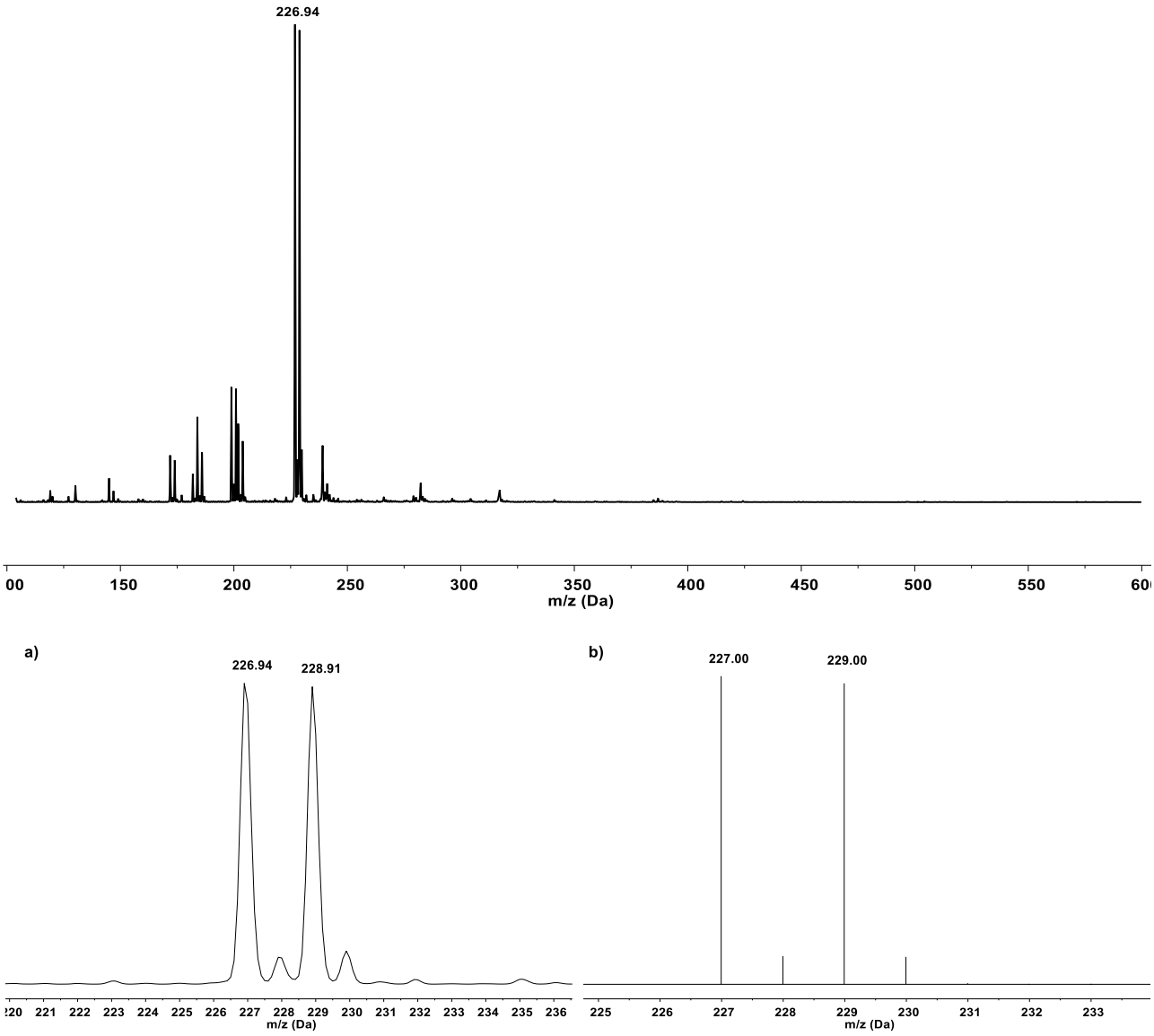


Figure S80 a) Experimental, and b) calculated ESI-MS pattern of **6** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.4 ESI-MS spectrum of 7

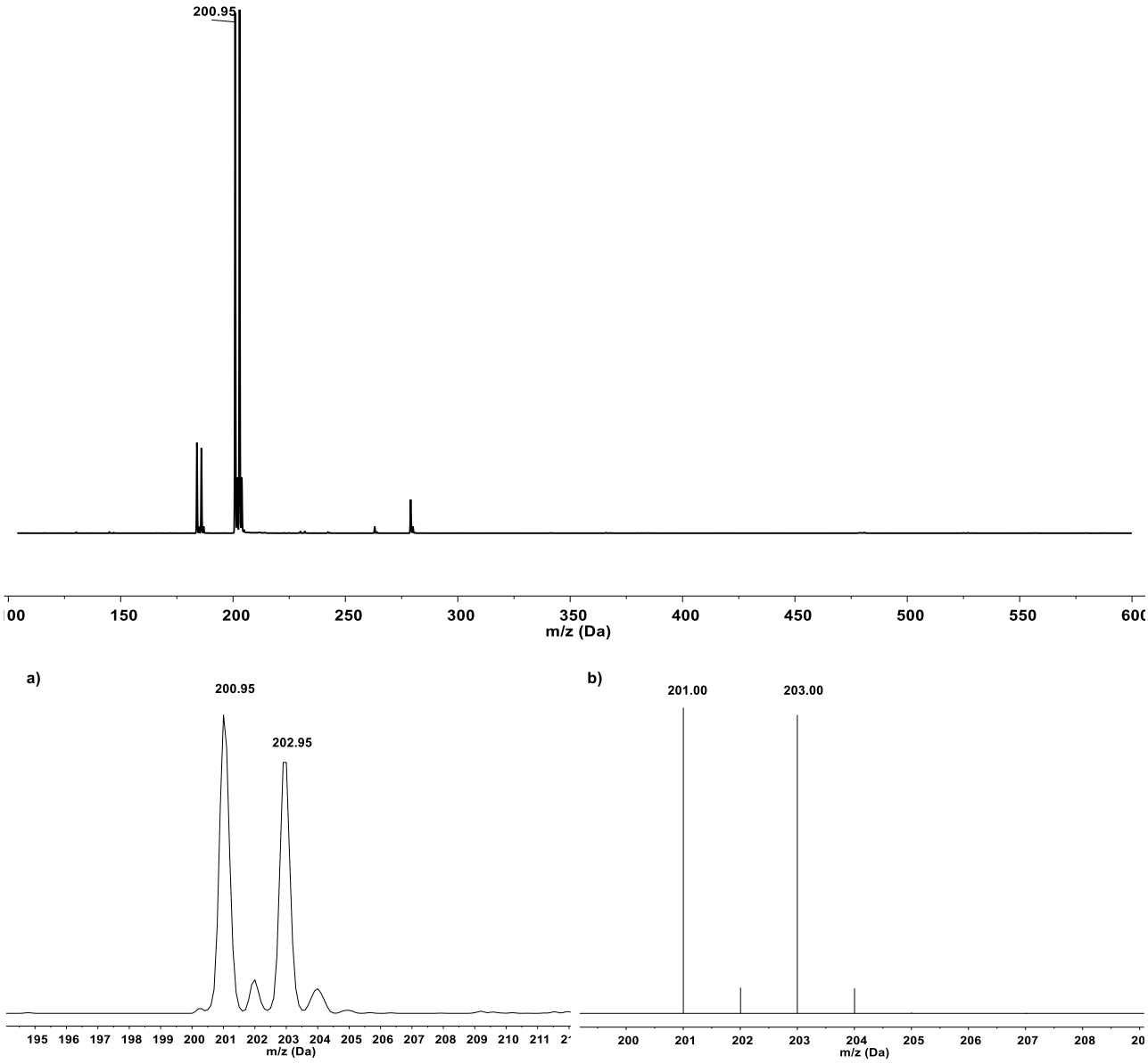


Figure S81 a) Experimental, and b) calculated ESI-MS pattern of **7** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.5 ESI-MS spectrum of (*R*)-8

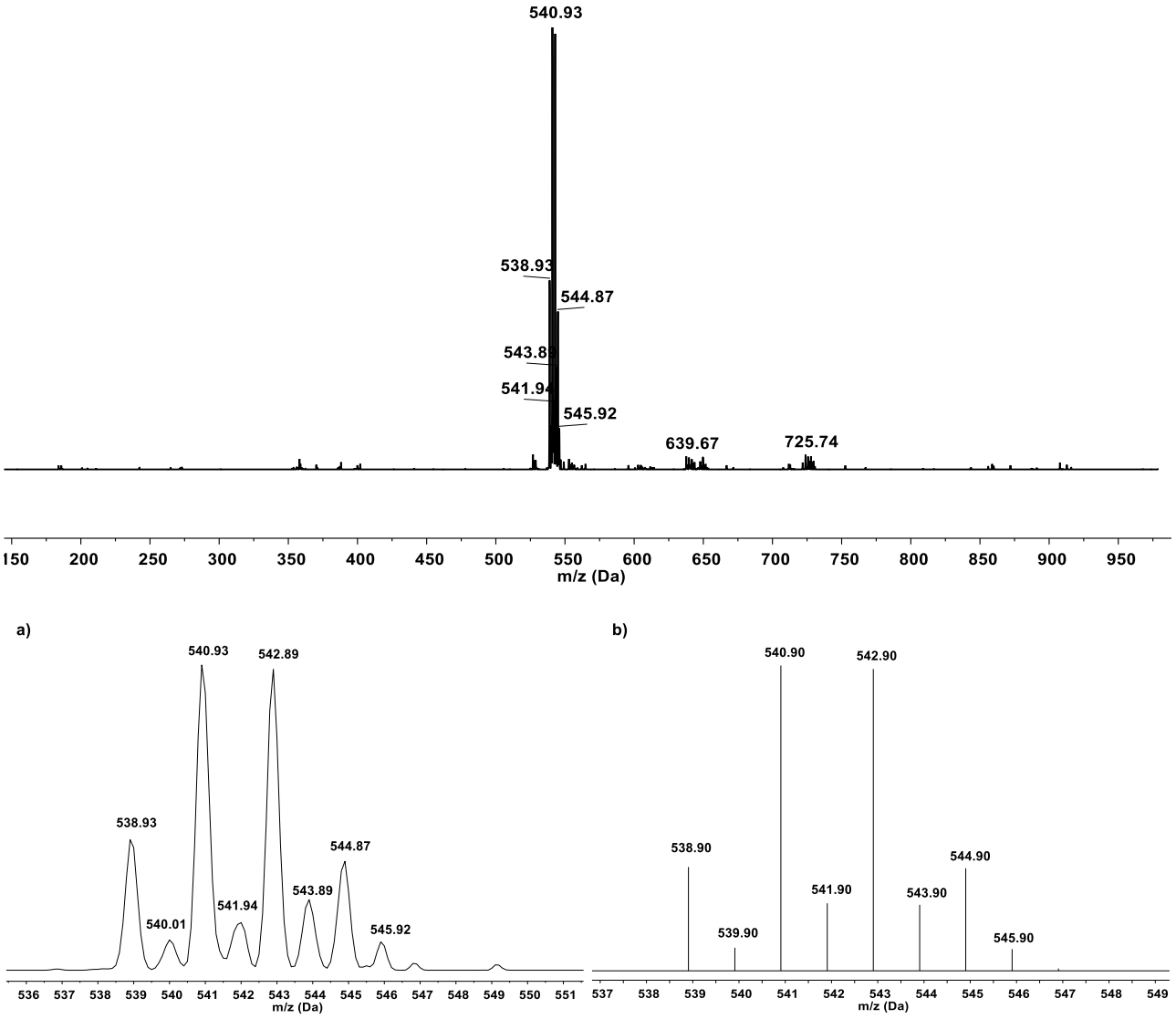


Figure S82 a) Experimental, and b) calculated ESI-MS pattern of **(*R*)-8** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.6 ESI-MS spectrum of (*R*)-9

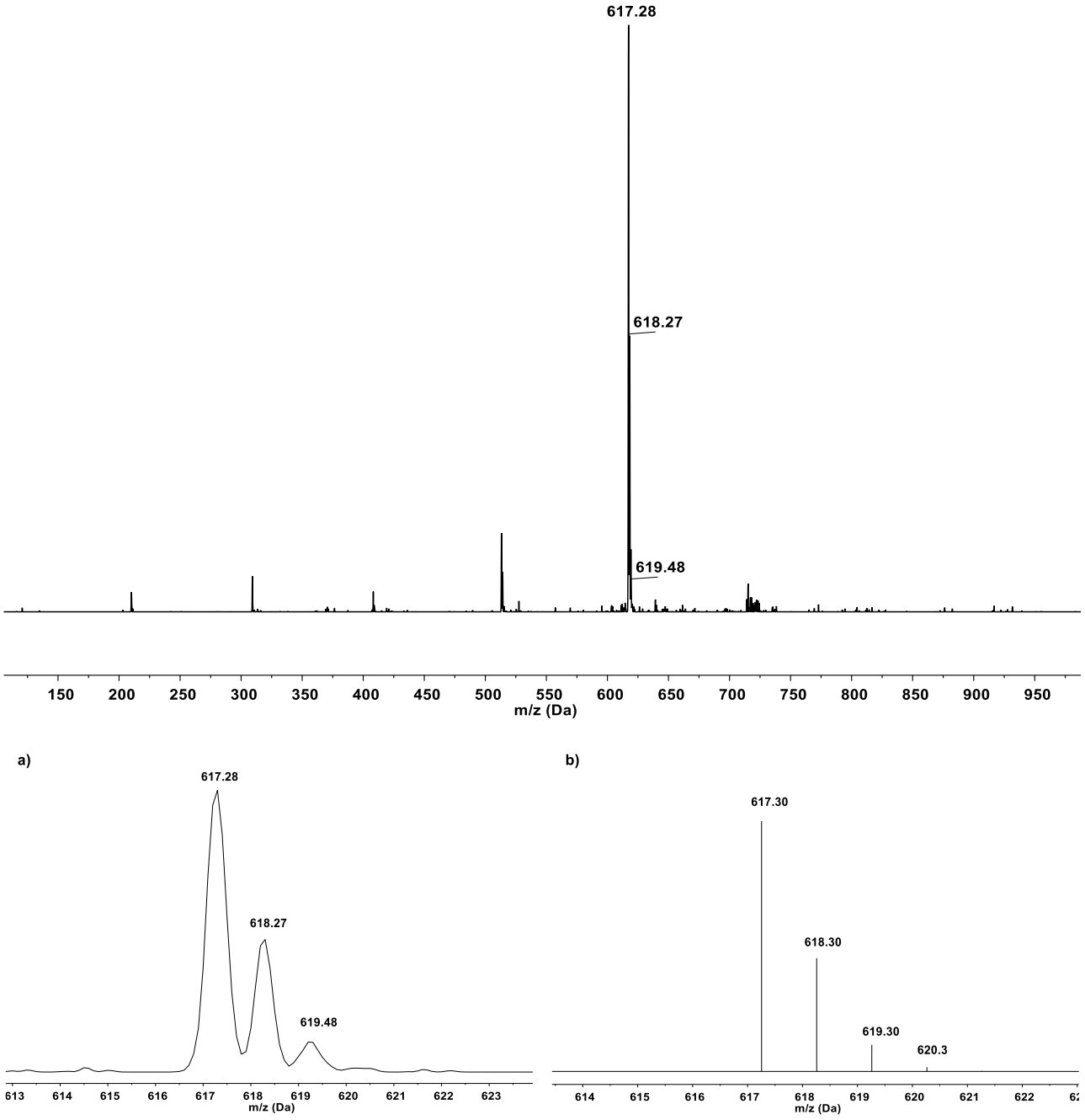


Figure S83 a) Experimental, and b) calculated ESI-MS pattern of **(*R*)-9** for $[M+H]^+$ adducts in CH_3CN/0.1% HCOOH.

12.7 ESI-MS spectrum of (*R*)-1b

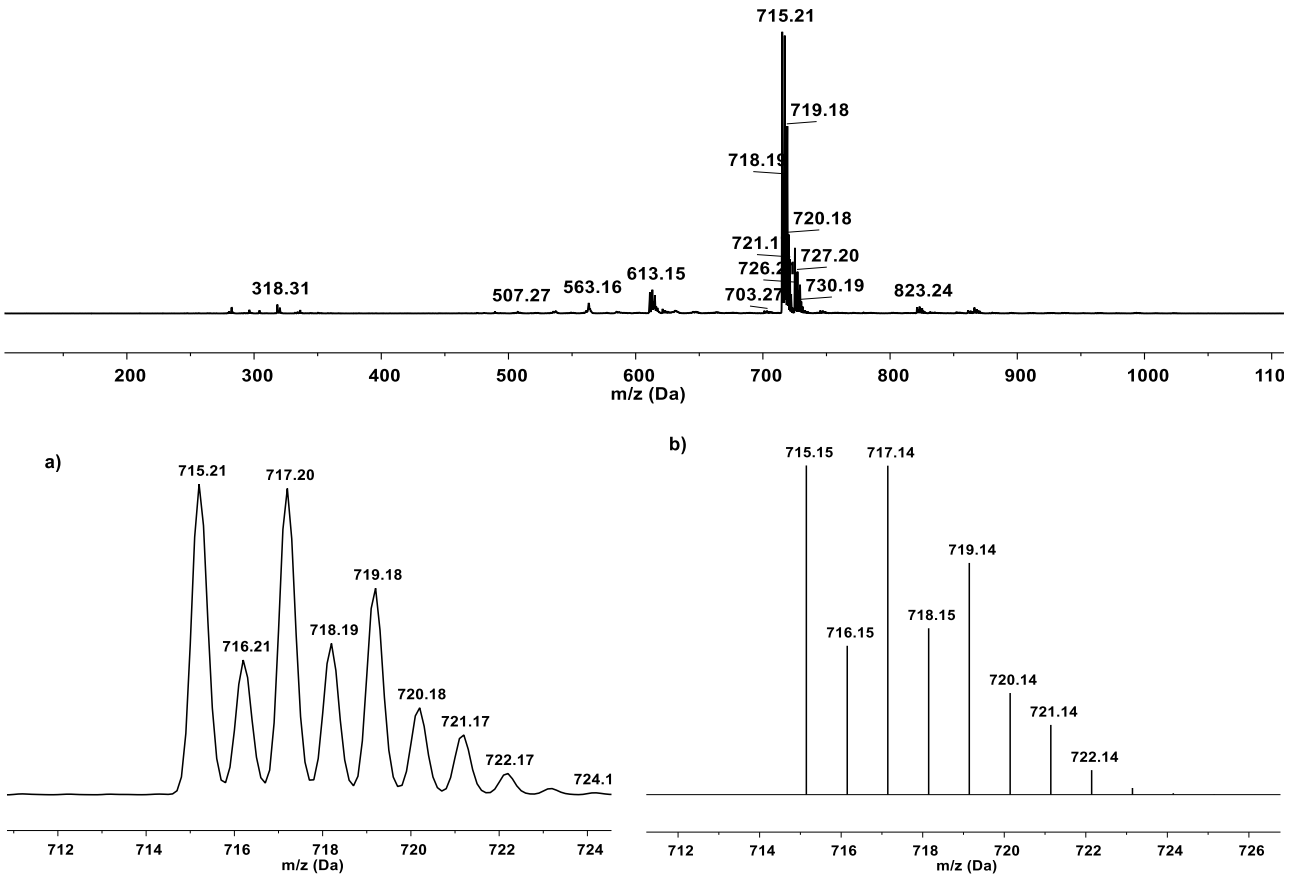


Figure S84 a) Experimental, and b) calculated ESI-MS pattern of **(*R*)-1b** corresponding to $[C_{40}H_{32}N_4O_3Zn + Cl]^+$ in CH_3CN/0.1% HCOOH.

12.8 ESI-MS spectrum of L-Tar@(*R*,*R*)-2b

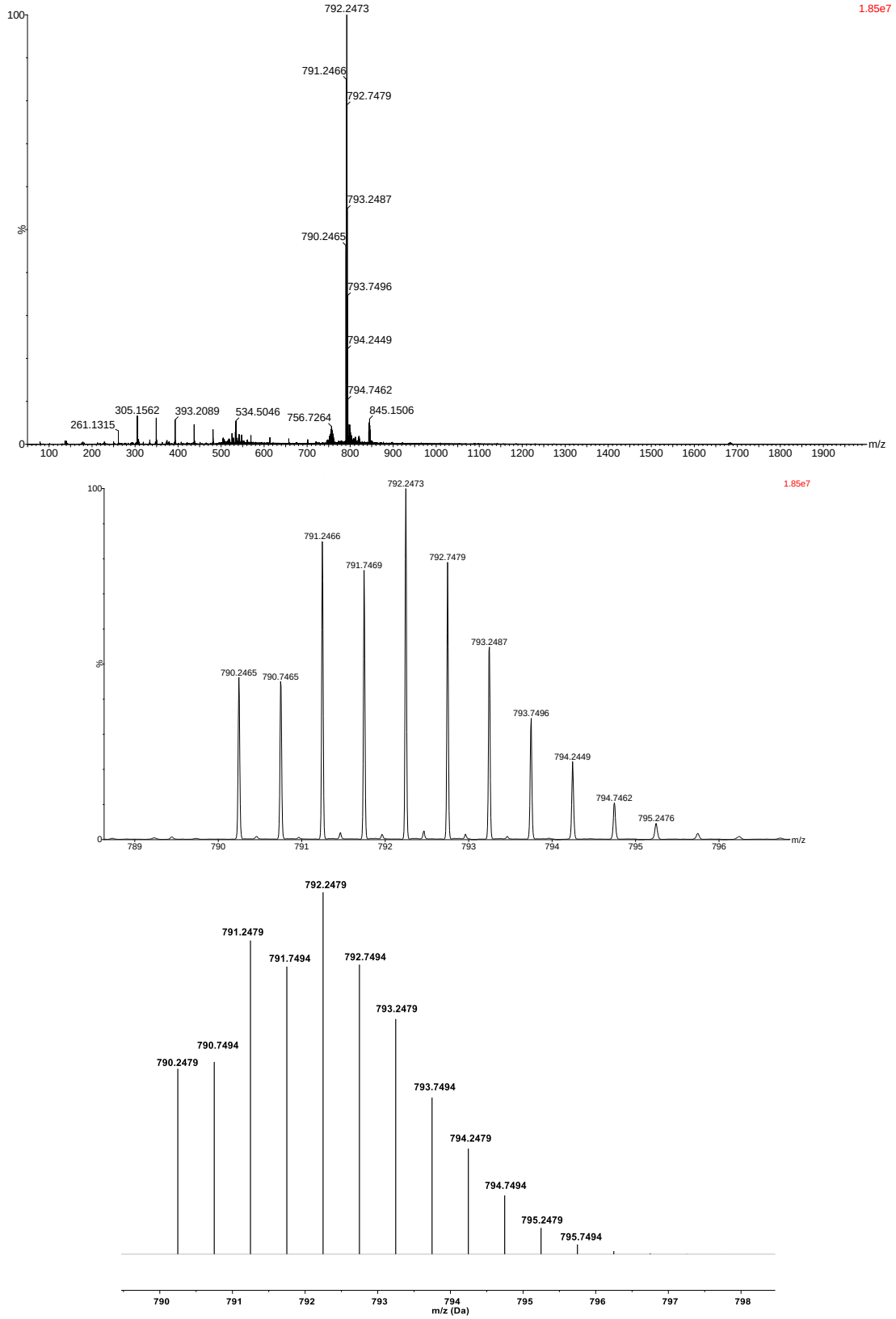


Figure S85 Experimental (top), and calculated (bottom) HRMS (ESI-TOF) pattern of **L-Tar@(*R*,*R*)-2b** corresponding to $[C_{90}H_{80}N_{14}O_6Zn_2]^{2+}$ in CH_3CN/0.1% HCOOH.

13 References

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