Supporting Information

Asymmetric Domino Reaction of Cyclic *N*-Sulfonylimines and Simple Aldehydes with *trans*-Perhydroindolic Acid as an Organocatalyst

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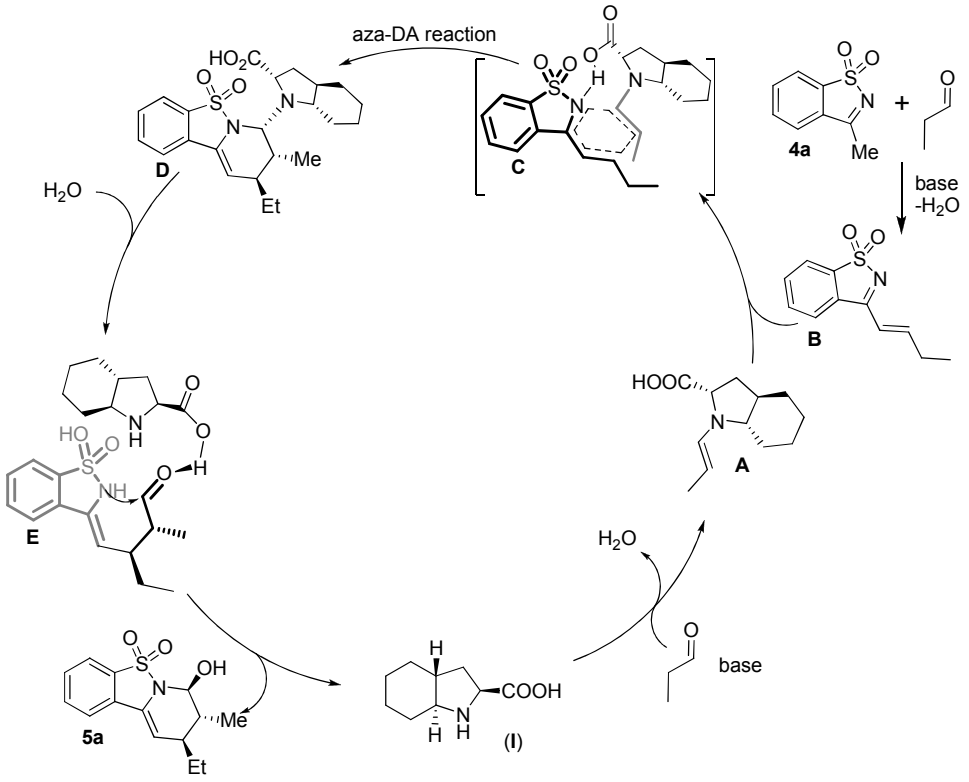
Contents

1. General Information

^{1}H NMR (400 MHz) and ^{13}C NMR (100 MHz) spectra were recorded on a Varian MERCURY plus-400 spectrometer with TMS as an internal standard. NOESY NMR (600 MHz) spectrum was recorded on a BRUKER Avance III spectrometer with TMS as an internal standard. HRMS was performed at the Analysis Center of Shanghai Jiao Tong University. Enantioselectivity was measured by high performance liquid chromatography (HPLC) using Daicel Chiralcel AD-H, OD-H and IC-3 columns with hexane / *i*-PrOH as a eluent. Column chromatography was performed using 100–200 mesh silica gel. Melting points were measured with SGW X-4 micro melting point apparatus. All commercially available substrates were used as received.

2. Proposed Reaction Pathway

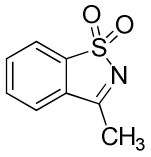


Scheme S1. Proposed reaction pathway

To explore the reaction mechanism, we carried out the asymmetric domino reaction of cyclic *N*-sulfonylimines (**4a**) with (*E*)-2-methylpent-2-enal which was prepared from propanal in advance, but only trace product presented even after 24 h at room temperature. Then, an easily prepared conjugated imine prepared from **4a** and benzaldehyde was reacted with propanal under the same reaction conditions mentioned above, affording the desired product (**5r**) in 97% yield,

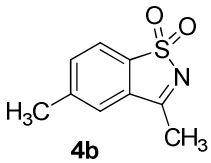
84 : 16 dr and 96% ee. Combined these results with the absolute configuraton of the product **5a**, a reaction pathway was proposed as follows (Scheme S1). Firstly, catalyst **I** reacted with one molecule of propanal to afford the enamine moiety **A**. Meanwhile, the conjugated imine **B** was formed via a condensation of **4a** with another molecule of propanal. Then, under the direction of catalyst **I**, an aza-DA cycloaddition occurred between enamine **A** and the conjugated imine **B** via the transition state **C** to form an intermediate **D**.[1] After a hydrolysis process, **D** leads to the formation of the aldehyde functionality, which forms a weak hydrogen-bonding complex **E** with **I**. The resulting piperidine product **5a** is then obtained via bottom face attack of the sulfimide to the aldehyde group.

3. Data for Substrates



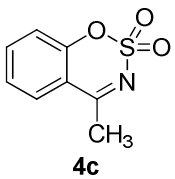
4a

3-Methylbenzo[*d*]isothiazole 1,1-dioxide (4a):[2-4] A white solid (2.6 g, 68%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.93 – 7.91 (m, 1H), 7.76 – 7.74 (m, 2H), 7.70 – 7.68 (m, 1H), 2.67 (s, 3H).



4b

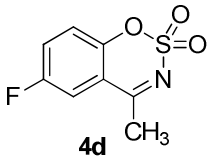
3,5-Dimethylbenzo[*d*]isothiazole 1,1-dioxide (4b):[4,5] A white solid (0.6 g, 65%). m.p. 160 – 162 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.00 (d, J = 7.6 Hz, 1H), 7.85 (s, 1H), 7.68 (d, J = 7.6 Hz, 1H), 2.66 (s, 3H), 2.47 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 175.7, 146.0, 136.3, 135.0, 132.2, 126.7, 122.4, 21.7, 18.1; HRMS (ESI): calcd for $C_9H_8NO_2S$ $[M-H]^-$. 194.0276, found 194.0274.



4c

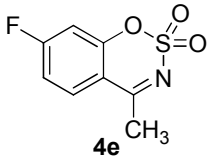
4-Methyl-1,2,3-benzoxathiazine 2,2-dioxide (4c):[6] A white solid (1.1 g, 60%). m.p.: 107 – 108 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.81 (dd, J = 8.0, 1.6 Hz, 1H), 7.74 – 7.69 (m, 1H), 7.40

(td, J = 7.6, 1H), 7.27 (d, J = 8.0 Hz, 1H), 2.72 (s, 3H).



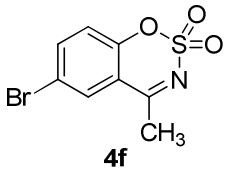
4d

4-Methyl-6-fluoro-1,2,3-benzoxathiazine 2,2-dioxide (4d):[6] A yellow solid (1.3 g, 62%), m.p.:138 – 139 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 – 7.45 (m, 1H), 7.44 – 7.41 (m, 1H), 7.30 (dd, J = 8.4, 4.4 Hz, 1H), 2.71 (s, 3H).



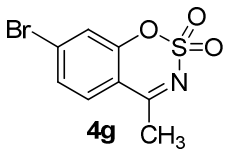
4e

4-Methyl-7-fluoro-1,2,3-benzoxathiazine 2,2-dioxide (4e):[6] A white solid (0.5 g, 70%), m.p.:99 – 100 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 (dd, J = 8.8, 6.0 Hz, 1H), 7.11 (ddd, J = 8.8, 7.6, 2.4 Hz, 1H), 7.01 (dd, J = 8.4, 2.4 Hz, 1H), 2.71 (s, 3H).



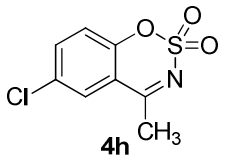
4f

4-Methyl-6-bromo-1,2,3-benzoxathiazine 2,2-dioxide (4f):[6] A yellow solid (1.8 g, 70%). m.p.:133 – 134 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 (d, J = 2.0 Hz, 1H), 7.81 (dd, J = 8.8, 2.4 Hz, 1H), 7.20 (d, J = 8.8 Hz, 1H), 2.72 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 176.4, 152.5, 139.9, 131.2, 121.0, 118.7, 117.8, 23.9; HRMS (ESI): calcd for $C_8H_5BrNO_3S$ [M-H]$^-$: 273.9174, found 273.9174.



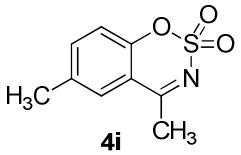
4g

7-Bromo-4-methylbenzo[*e*][1,2,3]oxathiazine 2,2-dioxide (4g):[6] A yellow solid (0.9 g, 78%). m.p. 170 – 171 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.04 (d, J = 8.4 Hz, 1H), 7.92 (d, J = 2.0 Hz, 1H), 7.75 (dd, J = 8.4, 1.6 Hz, 1H), 2.75 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 180.2, 153.2, 132.0, 131.4, 130.2, 122.2, 115.9, 24.6; HRMS (ESI): calcd for $C_8H_5BrNO_3S$ [M-H]$^-$: 273.9174, found 273.9168.



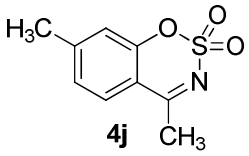
4h

4-Methyl-6-chloro-1,2,3-benzoxathiazine 2,2-dioxide (4h):[6] A yellow solid (0.4 g, 72%) m.p.:142 – 143 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76 (d, J = 2.4 Hz, 1H), 7.66 (dd, J = 8.8, 2.4 Hz, 1H), 7.26 (d, J = 8.8 Hz, 1H), 2.72 (s, 3H).



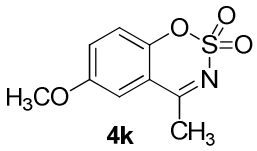
4i

4,6-DiMethyl-1,2,3-benzoxathiazine 2,2-dioxide (4i):[6] A yellow solid (0.5 g, 65%). m.p.:138 – 139 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.57 (d, J = 0.8 Hz, 1H), 7.52 – 7.49 (m, 1H), 7.16 (d, J = 8.4 Hz, 1H), 2.70 (s, 3H), 2.44 (s, 3H).



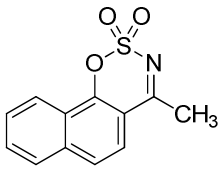
4j

4,7-Dimethylbenzo[*e*][1,2,3]oxathiazine 2,2-dioxide (4j):[6] A yellow solid (0.3 g, 68%). m.p.:129 – 130 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.67 (d, J = 8.4 Hz, 1H), 7.18 (d, J = 8.0 Hz, 1H), 7.08 (s, 1H), 2.68 (s, 3H), 2.48 (s, 3H).



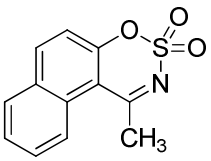
4k

4-Methyl-6-methoxy-1,2,3-benzoxathiazine 2,2-dioxide (4k):[6] A yellow solid (2.6 g, 78%). m.p.:129 – 130 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24 – 7.22 (m, 2H), 7.19 (d, J = 2.4 Hz, 1H), 3.87 (s, 3H), 2.70 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 177.7, 157.0, 147.2, 123.6, 120.1, 117.0, 112.1, 56.3, 23.9; HRMS (ESI): calcd for $C_9H_8NO_4S$ $[M-H]^-$: 226.0175, found 226.0175.



4l

4-Methylnaphtho[2,1-*e*][1,2,3]oxathiazine 2,2-dioxide (4l):[6] A yellow solid (1.6 g, 66%). m.p.: 193 – 194°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.33 (d, J = 8.0 Hz, 1H), 8.13 (d, J = 8.4 Hz, 1H), 8.01 (q, J = 8.8 Hz, 2H), 7.87 (t, J = 6.8 Hz, 1H), 7.79 (t, J = 7.2 Hz, 1H), 2.86 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 181.2, 151.2, 137.6, 131.9, 129.2, 128.9, 126.0, 123.8, 122.8, 122.5, 112.4, 25.1; HRMS (ESI): calcd for $C_{12}H_{10}NO_3S$ $[M+H]^+$: 248.0381, found 248.0382.



4m

1-Methyl-1,2,3-naphthoxathiazine 3,3-dioxide (4m):[6] A yellow solid (1.1 g, 78%). m.p.:178 – 179 °C; ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.43 (dd, J = 8.4, 3.2 Hz, 2H), 8.10 (d, J = 8.0 Hz, 1H), 7.82 – 7.75 (m, 1H), 7.67 (t, J = 7.6 Hz, 1H), 7.57 (d, J = 8.8 Hz, 1H), 3.00 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 182.2, 154.6, 140.4, 131.9, 130.5, 130.3, 129.4, 127.4, 126.5, 117.8, 114.6, 29.7; HRMS (ESI): calcd for $C_{12}H_8NO_3S$ $[M-H]^-$: 246.0212, found 246.0209.

4. References

[1] a) Feng, X.; Zhou, Z.; Ma, C.; Yin, X.; Li, R.; Dong, L.; Chen, Y.-C. *Angew. Chem. Int. Ed*. **2013**, *52*, 14173; b) Gu, J.; Ma, C.; Li, Q.-Z.; Du, W.; Chen, Y.-C. *Org. Lett*. **2014**, *16*, ~~DOI: 10.1021/ol501814p.~~ Replaced by "3986".

[2] Davis, F. A.; Towson, J. C.; Vashi, D. B.; ThimmaReddy, R.; McCauley, J. P.; Harakal, Jr. M. E.; Gosciniak, D. J. *J. Org. Chem*. **1990**, *55*, 1254.

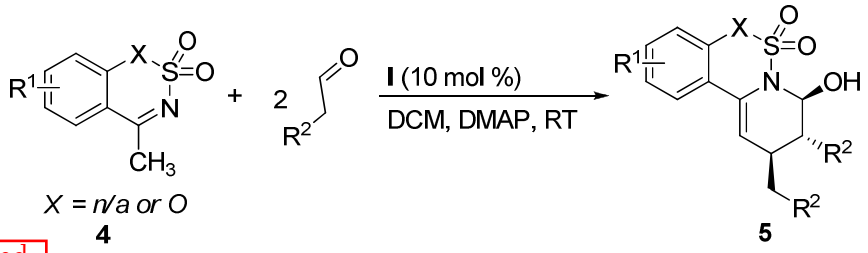
[3] Yang, Q.; Shang, G.; Gao, W. Z.; Deng, J. G.; Zhang, X. M. *Angew. Chem. Int. Ed*. **2006**, *45*, 3832.

[4] Yang G.; Zhang, W. *Angew. Chem. Int. Ed*. **2013**, *52,* 7540.

[5] Lombardino, J. G. *J. Org. Chem*. **1971**, *36*, 1843.

[6] Wang, Y. Q.; Yu, C. B.; Wang, D. W.; Wang, X. B.; Zhou, Y.-G. *Org. Lett.* **2008**, *10*, 2071.

5. General Procedure for the Organocatalytic Cascade Reactions

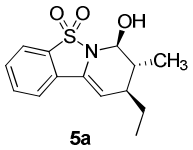


"-" should be deleted.

-Catalyst **I** (1.7 mg, 0.01 mmol), DMAP (12.2 mg, 0.10 mmol) and aldehyde (10 equiv, 1.0 mmol) were dissolved in DCM (1 mL) at 25 °C. The solution was stirred for 5 min, and then the appropriate cyclic sulfamidate (0.10 mmol) was added. The reaction mixture was stirred at 25 ? until the complete consumption of cyclic sulfamidate (monitored by TLC). The solvent was then evaporated and the crude products were purified by flash column silica-gel chromatography (PE / EA = 10 / 1) to give the adduct **5**.

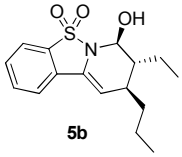
It should be "°C".

In addition, according to one of the reviewer's suggestion, the reaction of cyclic *N*-sulfonylimines (**4a**) with propanal was carried out in DCM at 25 ℃ in the presence of 1 equiv DABCO, using a mixed catalyst (10 mol % **II** + 10 mol % **V**). The reaction proceeded smoothly with a full conversion, providing the desired product with 72 : 28 dr and 25% ee for the major diastereomer, which is not better than that by using our catalyst **I**.



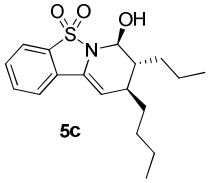
(7*S*,8*R*,9*S*)-9-Ethyl-7-hydroxy-8-methyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5a): A white solid (24.5 mg, 88%). m.p. 111 – 112 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 (d, J = 7.6 Hz, 1H), 7.75 (d, J = 7.6 Hz, 1H), 7.68 (t, J = 7.2 Hz, 1H), 7.58 (t, J = 7.2 Hz, 1H), 5.76 (d, J = 2.8 Hz, 1H), 5.64 (d, J = 2.4 Hz, 1H), 3.49 (s, 1H), 2.43 – 2.38 (m, 1H), 1.92 – 1.79 (m, 2H), 1.53 – 1.43 (m, 1H), 1.23 (d, J = 6.8 Hz, 3H), 1.03 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 133.4, 132.2, 130.3, 130.0, 128.7, 121.5, 121.4, 106.4, 76.3, 36.5, 36.3, 24.7, 15.5, 10.4. HRMS (ESI): calcd for $C_{14}H_{16}NO_3S$ $[M-H]^-$: 278.0827, found 278.0830; IR: 3476, 3066, 2959, 2925, 2855, 2729, 1731, 1669, 1598, 1475, 1378, 1342, 1303, 1247, 1181, 1157, 1135, 1061, 1026, 974, 951, 759, 560, 533; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 90 : 10, UV = 254 nm, flow rate = 1.0 mL / min), t_{R1} = 49.95 min (major) and t_{R2} = 67.81 min (minor); ee = 99%;

$[\alpha]^{25}_{D}$ = –68.2 (*c* 0.3, CH_2Cl_2).



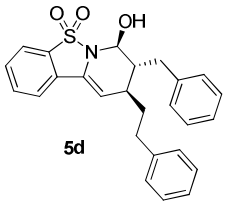
5b

(7*S*,8*R*,9*S*)-8-ethyl-7-hydroxy-9-propyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5b): Colorless oil (27.5 mg, 89%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.79 (d, *J* = 8.0 Hz, 1H), 7.67 – 7.59 (m, 2H), 7.54 – 7.50 (m, 1H), 5.76 (d, *J* = 2.8 Hz, 1H), 5.53 – 5.52 (m, 1H), 3.42 (s, 1H), 2.90 – 2.88 (m, 1H), 1.99 – 1.96 (m, 1H), 1.73 – 1.67 (m, 1H), 1.50 – 1.47 (m, 4H), 1.43 – 1.40 (m, 1H), 1.02 – 0.98 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 133.2, 130.7, 129.9, 129.8, 127.6, 121.4, 121.1, 105.5, 74.0, 41.2, 33.2, 31.8, 20.6, 17.9, 14.4, 12.0; HRMS (ESI): calcd for $C_{16}H_{20}NO_3S$ $[M-H]^-$: 306.1164, found 306.1163; IR: 3449, 2955, 2925, 2854, 2026, 1641, 1460, 1380, 1303, 1261, 1178, 1055, 722, 592; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 90 : 10, UV = 254 nm, flow rate = 0.6 mL / min) t_{R1} = 48.53 min (major) and t_{R2} = 67.56 min (minor); ee = 95%; $[\alpha]^{25}_{D}$ = +27.1 (*c* 0.2, CH_2Cl_2).



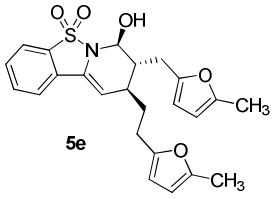
5c

(7*S*,8*R*,9*S*)-9-Butyl-7-hydroxy-8-propyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5c): Colorless oil (29.1 mg, 87%). ^{1}H NMR (400 MHz): δ 7.79 (d, *J* = 8.0 Hz, 1H), 7.67 – 7.61 (m, 2H), 7.55 – 7.49 (m, 1H), 5.71 (d, *J* = 2.8 Hz, 1H), 5.54 – 5.52 (m, 1H), 3.45 (s, 1H), 2.90 – 2.82 (m, 1H), 2.11 – 2.03 (m, 1H), 1.55 – 1.47 (m, 3H), 1.45 – 1.35 (m, 4H), 1.32 – 1.19 (m, 3H), 0.95 (t, *J* = 6.8 Hz, 3H), 0.90 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 133.3, 132.1, 130.0, 129.9, 127.6, 121.4, 121.2, 105.5, 74.4, 39.2, 31.93, 30.7, 29.7, 27.1, 23.0, 20.5, 14.5, 14.3; HRMS (ESI): calcd for $C_{18}H_{24}NO_3S$ $[M-H]^-$: 334.1453, found 334.1465; IR: 3456, 2957, 2930, 2871, 1736, 1639, 1563, 1467, 1383, 1341, 1305, 1250, 1178, 1059, 947, 757, 591, 534; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 88 : 12, UV = 254 nm, flow rate = 0.3 mL / min) t_{R1} = 80.89 min (major) and t_{R2} = 173.70 min (minor); ee = 99%; $[\alpha]^{25}_{D}$ = –36.6 (*c* 0.3, CH_2Cl_2).



5d

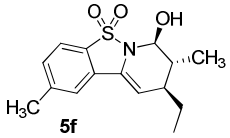
(7*S*,8*R*,9*S*)-8-Benzyl-7-hydroxy-9-phenethyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5d): Colorless oil (35.3 mg, 82%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 – 7.52 (m, 4H), 7.35 – 7.11 (m, 9H), 5.81 (d, J = 2.8 Hz, 1H), 5.37 (d, J = 2.0 Hz, 1H), 3.42 (s, 1H), 3.00 (dd, J = 13.6, 4.0 Hz, 1H), 2.85 – 2.92 (m, 1H), 2.76 – 2.61 (m, 3H), 2.56 – 2.48 (m, 1H), 2.19 – 2.06 (m, 2H), 1.94 – 1.87 (m 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 142.0, 139.0, 133.5, 132.2, 130.2, 129.6, 129.5, 129.0, 128.9, 128.8, 128.6, 126.8, 126.3, 121.5, 121.5, 106.2, 105.1, 75.9, 73.2, 44.1, 42.9, 38.9, 37.1, 36.4, 35.5, 34.6, 34.4, 34.0, 32.6; HRMS (ESI): calcd for $C_{26}H_{25}NO_3S$ $[M-H]^-$: 430.1477, found 430.1483; IR: 3494, 3084, 3061, 3026, 2925, 2855, 1949, 1880, 1812, 1671, 1601, 1583, 1495, 1470, 1454, 1384, 1305, 1260, 1161, 1135, 1106, 1061, 1028, 968, 927, 803, 755, 701, 614, 588, 567, 547, 507; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 91 : 9, UV = 254 nm, flow rate = 0.9 mL / min) t_{R1} = 56.76 min (major) and t_{R2} = 64.04 min (minor); ee = 95%; $[\alpha]^{25}_{D}$ = –30.3 (*c* 0.2, CH_2Cl_2).



5e

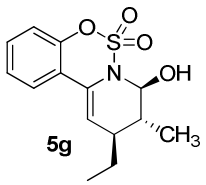
(7*S*,8*R*,9*S*)-7-Hydroxy-9-(2-(5-methylfuran-2-yl)ethyl)-8-((5-methylfuran-2-yl)methyl)-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5e): Colorless oil (34.7 mg, 79%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, J = 7.6 Hz, 1H), 7.69 – 7.62 (m, 2H), 7.55 (t, J = 8.0 Hz, 1H), 6.01 (d, J = 2.8 Hz, 1H), 5.91 – 5.86 (m, 2H), 5.72 (d, J = 2.8 Hz, 1H), 5.56 (t, J = 2.4 Hz, 1H), 3.40 (s, 1H), 2.93 – 2.88 (m, 1H), 2.84 – 2.75 (m, 2H), 2.70 – 2.63 (m, 1H), 2.59 – 2.52 (m, 1H), 2.27 (d, J = 8.4 Hz, 6H), 2.15 – 2.11 (m, 2H), 1.87 – 1.80 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 153.5, 151.9, 151.4, 150.8 133.4, 132.2, 130.2, 130.1, 128.9, 121.5, 121.4, 108.1, 106.4, 106.1, 106.0, 105.9, 73.7, 41.5, 34.1, 30.8, 29.9, 28.1, 13.8, 13.7; HRMS (ESI): calcd for $C_{24}H_{24}NO_5S$ $[M-H]^-$: 438.1365, found 438.1363; IR: 3448, 2957, 2926, 2856, 1743, 1465, 1418, 1380, 1305, 1263, 1163, 1106, 1022, 740, 594; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 91 : 9,

UV = 254 nm, flow rate = 0.3 mL / min) t_{R1} = 120.89 min (major) and t_{R2} = 141.79 min (minor); ee = 97%; $[\alpha]^{25}_{D}$ = –28.9 (*c* 0.2, CH_2Cl_2).



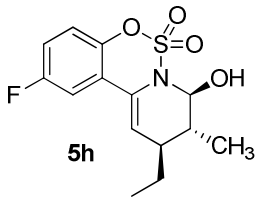
5f

(7*S*,8*R*,9*S*)-9-Ethyl-7-hydroxy-2,8-dimethyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridine 5,5-dioxide (5f): A white solid (25.8 mg, 88%). m.p. 109 – 110 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.66 (d, *J* = 8.0 Hz, 1H), 7.48 (s, 1H), 7.33 (d, *J* = 8.0 Hz, 1H), 5.68 (d, *J* = 2.8 Hz, 1H), 5.57 (d, *J* = 2.4 Hz, 1H), 3.39 (s, 1H), 2.47 (s, 3H), 2.37 – 2.32 (m, 1H), 1.86 – 1.74 (m, 2H), 1.46 – 1.39 (m, 1H), 1.17 (d, *J* = 6.8 Hz, 3H), 0.98 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.3, 131.0, 130.5, 129.6, 128.7, 121.4, 121.1, 105.9, 104.8, 78.2, 76.2, 41.2, 36.5, 36.3, 29.4, 28.2, 24.7, 22.1, 18.0, 15.4, 12.4, 10.4; HRMS (ESI): calcd for $C_{15}H_{18}NO_3S$ [M-H]$^-$: 292.1007, found 292.1003; IR: 3445, 2955, 2925, 2854, 1718, 1652, 1461, 1377, 1306, 1264, 1174, 1096, 1039, 975, 809, 722, 679,597, 559; HPLC: (Chiralcel IC-3, Hexane / *i*-PrOH = 91 : 9, UV = 254 nm, flow rate = 1.0 mL / min) t_{R1} = 77.77 min (major) and t_{R2} = 131.78 min (minor); ee = 96%; $[\alpha]^{25}_{D}$ = –27.8 (*c* 0.3, CH_2Cl_2).



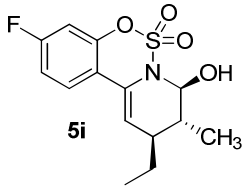
5g

(8*S*,9*R*,10*S*)-10-Ethyl-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5g): Colorless oil (26.0 mg, 88%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.62 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.33 – 7.31 (m, 1H), 7.26 – 7.24 (m, 1H), 7.09 (dd, *J* = 8.0, 1.2 Hz), 5.71 (d, *J* = 2.8 Hz, 1H), 5.64 – 5.63 (m, 1H), 3.01 (d, *J* = 4.0 Hz, 1H), 2.32 – 2.26 (m, 1H), 1.81 – 1.71 (m, 2H), 1.46 – 1.39 (m, 1H), 1.14 (d, *J* = 6.8 Hz, 3H), 0.98 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.2, 130.2, 129.0, 126.4, 124.7, 120.3, 119.3, 110.4, 108.0, 82.0, 79.9, 40.3, 35.7, 35.3, 32.8, 28.0, 24.4, 18.5, 15.5, 12.3, 10.3; HRMS (ESI): calcd for $C_{14}H_{16}NO_4S$ [M-H]$^-$: 294.0789, found 294.0792; IR: 3430, 2925, 2857, 1718, 1643, 1597, 1554, 1456, 1381, 1310, 1264, 1204, 1179, 1122, 1088, 1037, 979, 951, 858, 811, 756, 705, 672, 566; HPLC: (Chiralcel IC-3, Hexane / *i*-PrOH = 92 : 8, UV = 254 nm, flow rate = 0.9 mL / min) t_{R1} = 16.31 min (major) and t_{R2} = 27.84 min (minor); ee = 95%; $[\alpha]^{25}_{D}$ = +29.0 (*c* 0.2, CH_2Cl_2).



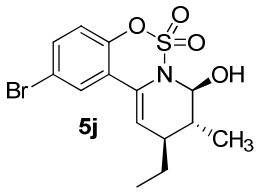
5h

(8*S*,9*R*,10*S*)-10-Ethyl-2-fluoro-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[e]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5h): Colorless oil (25.0 mg, 80%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (dd, J = 9.2, 2.8 Hz, 1H), 7.10 – 7.01 (m, 2H), 5.67 (d, J = 2.8 Hz, 1H), 5.62 (s, 1H), 3.03 (s, 1H), 2.32 – 2.27 (m, 1H), 1.81 – 1.73 (m, 2H), 1.47 – 1.39 (m, 1H), 1.14 (d, J = 6.8 Hz, 3H), 0.98 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.6, 159.2, 144.2, 128.4, 121.9, 121.0, 117.4, 117.1, 111.7, 111.3, 111.3, 111.1, 82.1, 79.9, 35.6, 40.3, 35.7, 35.4, 27.9, 24.3, 18.5, 15.5, 12.3, 10.3; HRMS (ESI): calcd for $C_{14}H_{15}FNO_4S$ [M-H]$^-$: 312.0693, found 312.0690; IR: 3436, 2966, 2937, 2878, 2735, 1718, 1643, 1624, 1589, 1566, 1482, 1461, 1441, 1388, 1305, 1275, 1200, 1167, 1119, 1084, 1025, 975, 862, 819, 766, 643, 539; HPLC: (Chiralcel IC-3, Hexane / *i*-PrOH = 94 : 6, UV = 254 nm, flow rate = 0.6 mL / min) t_{R1} = 22.53 min (major) and t_{R2} = 39.28 min (minor); ee = 94%; $[\alpha]^{25}_{D}$ = +31.0 (*c* 0.4, CH_2Cl_2).

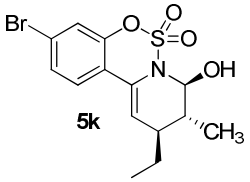


5i

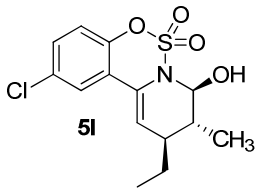
(8*S*,9*R*,10*S*)-10-Ethyl-3-fluoro-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[e]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5i): Colorless oil (21.9 mg, 70%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (dd, J = 8.8, 6.0 Hz, 1H), 7.01 – 6.96 (m, 1H), 6.84 (dd, J = 8.0, 2.4 Hz, 1H), 5.62 (t, J = 2.4 Hz, 2H), 3.09 (s, 1H), 2.30 – 2.24 (m, 1H), 1.82 – 1.74 (m, 2H), 1.46 – 1.38 (m, 1H), 1.13 (d, J = 6.8 Hz, 3H), 0.97 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.2, 161.6, 148.7, 128.2, 126.2, 126.1, 116.7, 114.3, 114.1, 110.3, 110.2, 109.9, 107.3, 107.0, 82.2, 80.0, 40.2, 35.9, 35.7, 35.3, 27.9, 24.4, 18.5, 15.5, 12.3, 10.3; HRMS (ESI): calcd for $C_{14}H_{15}FNO_4S$ [M-H]$^-$: 312.0682, found 312.0684; IR: 3442, 3084, 2966, 2936, 2878, 1718, 1617, 1560, 1501, 1460, 1429, 1390, 1300, 1263, 1198, 1139, 1115, 1056, 975, 947, 924, 890, 855, 821, 750, 709, 617, 563; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 94 : 6, UV = 254 nm, flow rate = 0.4 mL / min) t_{R1} = 25.41 min (major) and t_{R2} = 38.36 min (minor); ee = 95%; $[\alpha]^{25}_{D}$ = +24.7 (*c* 0.3, CH_2Cl_2).



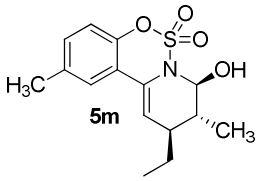
(8*S*,9*R*,10*S*)-2-Bromo-10-ethyl-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5j): A white solid (30.6 mg, 82%). m.p. 129 – 130 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.72 (d, J = 2.4 Hz, 1H), 7.43 (dd, J = 8.8, 2.4 Hz, 1H), 6.98 (d, J = 8.8 Hz, 1H), 5.69 (d, J = 2.4 Hz, 1H), 5.62 (s, 1H), 3.05 (d, J = 3.2 Hz), 2.33 – 2.27 (m, 1H), 1.82 – 1.70 (m, 2H), 1.49 – 1.38 (m, 1H), 1.13 (d, J = 6.8 Hz, 3H), 0.99 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 147.2, 133.0, 128.0, 127.5, 122.2, 121.1, 119.6, 112.0, 111.5, 82.1, 80.0, 40.3, 35.6, 35.8, 35.4, 27.9, 24.3, 18.5, 15.4, 12.3, 10.3; HRMS (ESI): calcd for $C_{14}H_{15}BrNO_4S$ $[M-H]^-$: 371.9908, found 371.9907; IR: 3414, 3076, 2964, 2935, 2877, 2731, 1640, 1604, 1468, 1420, 1396, 1300, 1264, 1181, 1154, 1103, 1022, 955, 859, 826, 754, 692, 633, 574, 535; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 92 : 8, UV = 254 nm, flow rate = 0.7 mL / min) t_{R1} = 15.94 min (major) and t_{R2} = 26.78 min (minor); ee = 95%; $[\alpha]^{25}_{D}$ = +26.3 (*c* 0.4, CH_2Cl_2).



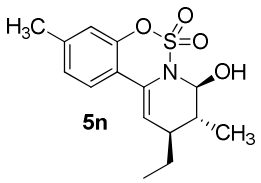
(8*S*,9*R*,10*S*)-3-Bromo-10-ethyl-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5k): A white solid (29.9 mg, 80%). m.p. 131 – 132 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 (d, J = 8.4 Hz, 1H), 7.35 (dd, J = 8.4, 2.0 Hz, 1H), 7.25 (t, J = 2.0 Hz, 1H), 5.70 (d, J = 2.8 Hz, 1H), 5.61 (d, J = 2.4 Hz, 1H), 3.13 (s, 1H), 2.30 – 2.23 (m, 1H), 1.80 – 1.73 (m, 2H), 1.46 – 1.38 (m, 1H), 1.13 (d, J = 6.8 Hz, 3H), 0.97 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.2, 129.7, 129.1, 125.8, 122.9, 122.5, 119.4, 111.2, 110.8, 82.1, 80.0, 40.3, 35.7, 35.8, 35.4, 27.9, 24.3, 18.5, 15.4, 12.3, 10.3; HRMS (ESI): calcd for $C_{14}H_{17}BrNO_4S$ $[M+H]^+$: 374.0062, found 374.0039; IR: 3448, 2966, 2932, 2878, 1715, 1595, 1541, 1479, 1459, 1392, 1281, 1262, 1203, 1188, 1096, 1072, 1032, 969, 902, 880, 817, 773, 690, 567, 543; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 93 : 7, UV = 254 nm, flow rate = 0.6 mL / min) t_{R1} = 21.23 min (major) and t_{R2} = 26.32 min (minor); ee = 94%; $[\alpha]^{25}_{D}$ = +13.7 (*c* 0.2, CH_2Cl_2).



(8*S*,9*R*,10*S*)-2-Chloro-10-ethyl-8-hydroxy-9-methyl-9,10-dihydro-8*H*-benzo[*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5l): A pale yellow solid (28.0 mg, 85%). m.p. 135 – 136 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.57 (d, J = 2.4 Hz, 1H), 7.29 (dd, J = 8.4, 2.4 Hz, 1H), 7.04 (d, J = 8.4 Hz, 1H), 5.70 (d, J = 2.8 Hz, 1H), 5.63 – 5.61 (m, 1H), 3.02 (d, J = 4.0 Hz, 1H), 2.33 – 2.27 (m, 1H), 1.83 – 1.74 (m, 1H), 1.47 – 1.40 (m, 1H), 1.14 (d, J = 6.8 Hz, 3H), 0.99 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.6, 132.0, 130.0, 126.9, 124.3, 121.5, 120.8, 111.5, 109.6, 82.1, 81.5, 40.3, 35.8, 33.0, 32.8, 27.9, 23.8, 18.4, 11.8, 12.3, 10.7; HRMS (ESI): calcd for $C_{14}H_{15}ClNO_4S$ [M-H]$^-$: 328.0392, found 328.0394; IR: 3450, 2963, 2928, 1642, 1471, 1384, 1205, 1181, 1101, 1036, 960, 858, 830, 739, 707, 571; HPLC: (Chiralcel IC-3, Hexane / *i*-PrOH = 94 : 6, UV = 254 nm, flow rate = 0.5 mL / min) t_{R1} = 26.00 min (major) and t_{R2} = 45.00 min (minor); ee = 94%; $[\alpha]^{25}_{D}$ = +30.8 (*c* 0.4, CH_2Cl_2).

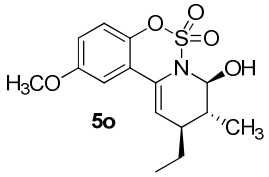


(8*S*,9*R*,10*S*)-10-Ethyl-8-hydroxy-2,9-dimethyl-9,10-dihydro-8*H*-benzo[*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5m): Colorless oil (22.2 mg, 72%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.39 (d, J = 1.2 Hz, 1H), 7.12 (dd, J = 8.4, 1.6 Hz, 1H), 6.97 (d, J = 8.4 Hz, 1H), 5.67 (d, J = 2.4 Hz, 1H), 5.62 (s, 1H), 3.11 (s, 1H), 2.36 (s, 3H), 2.31 – 2.26 (m, 1H), 1.79 – 1.73 (m, 2H), 1.46 – 1.39 (m, 1H), 1.13 (d, J = 6.4 Hz, 3H), 0.99 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.2, 136.3, 131.0, 129.1, 124.9, 119.8, 119.0, 110.0, 109.5, 82.0, 79.9, 40.2, 35.6, 35.7, 35.3, 28.1, 24.4, 21.2, 18.5, 15.5, 12.4, 10.3, 9.4; HRMS (ESI): calcd for $C_{15}H_{18}NO_4S$ [M-H]$^-$: 308.0946, found 308.0946; IR: 3453, 2964, 2931, 2876, 1642, 1561, 1485, 1458, 1384, 1308, 1203, 1179, 1126, 1101, 1040, 964, 858, 761, 640, 537; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 94 : 6, UV = 254 nm, flow rate = 0.5 mL / min) t_{R1} = 41.31 min (major) and t_{R2} = 79.56 min (minor); ee = 90%; $[\alpha]^{25}_{D}$ = +26.2 (*c* 0.2, CH_2Cl_2).



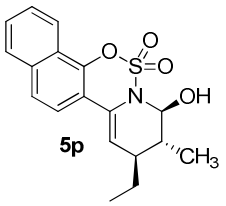
5n

(8*S*,9*R*,10*S*)-10-Ethyl-8-hydroxy-3,9-dimethyl-9,10-dihydro-8*H*-benzo[e]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5n): Colorless oil (22.2 mg, 72%). ^{1}H NMR (400 MHz, DMSO-d_6): δ 7.78 (d, J = 7.6 Hz, 1H), 7.11 (d, J = 8.0 Hz, 1H), 7.03 (s, 1H), 6.80 (d, J = 5.2 Hz, 1H), 5.88 (d, J = 1.6 Hz, 1H), 5.40 (dd, J = 6.0, 1.2 Hz, 1H), 2.30 (s, 3H), 2.17 – 2.13 (m, 1H), 1.71 – 1.63 (m, 1H), 1.60 – 1.54 (m, 1H), 1.35 – 1.28 (m, 1H), 0.98 (d, J = 6.4 Hz, 3H), 0.89 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 148.0, 141.3, 129.0, 127.8, 125.1, 119.5, 117.3, 110.6, 109.9, 81.6, 79.8, 36.3, 33.8, 35.3, 32.9, 28.3, 24.2, 21.1, 18.1, 15.8, 12.7, 12.2, 10.6; HRMS (ESI): calcd for $C_{15}H_{20}NO_4S$ $[M+H]^+$: 310.1113, found 310.1112; IR: 3449, 2966, 2932, 2878, 1720, 1621, 1591, 1543, 1503, 1459, 1387, 1292, 1261, 1235, 1195, 1134, 1032, 946, 875, 822, 792, 748, 665, 614, 568, 535; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 92 : 8, UV = 254 nm, flow rate = 0.3 mL / min) t_{R1} = 67.27 min (major) and t_{R2} = 94.00 min (minor); ee = 90%; $[\alpha]^{25}_D$ = +7.7 (*c* 0.2, CH_2Cl_2).



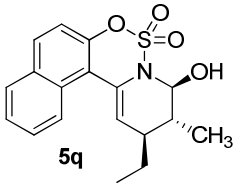
5o

(8*S*,9*R*,10*S*)-10-Ethyl-8-hydroxy-2-methoxy-9-methyl-9,10-dihydro-8*H*-benzo[e]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5o): Colorless oil (25.3 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.06 (d, J = 2.8 Hz, 1H), 7.01 (d, J = 9.2 Hz, 1H), 6.86 (dd, J = 8.8, 2.8 Hz, 1H), 5.64 (d, J = 2.8 Hz, 1H), 5.62 – 5.60 (m, 1H), 3.82 (s, 3H), 3.24 (s, 1H), 2.31 – 2.26 (m, 1H), 1.80 – 1.71 (m, 2H), 1.46 – 1.39 (m, 1H), 1.12 (d, J = 6.8 Hz, 3H), 0.97 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 157.6, 142.2, 129.1, 121.0, 120.2, 115.8, 110.4, 109.4, 109.0, 82.0, 79.9, 64.7, 56.0, 40.3, 35.6, 35.3, 28.0, 25.5, 24.4, 18.5, 15.5, 12.4, 10.3; HRMS (ESI): calcd for $C_{15}H_{18}NO_5S$ $[M-H]^-$: 324.0906, found 324.0901; IR: 3481, 3086, 2964, 2936, 2876, 1718, 1642, 1610, 1584, 1560, 1486, 1383, 1303, 1202, 1176, 1126, 1036, 970, 859, 759, 648, 561, 535; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 90 : 10, UV = 254 nm, flow rate = 0.7 mL / min) t_{R1} = 27.96 min (major) and t_{R2} = 50.62 min (minor); ee = 96%; $[\alpha]^{25}_D$ = +30.9 (*c* 0.3, CH_2Cl_2).



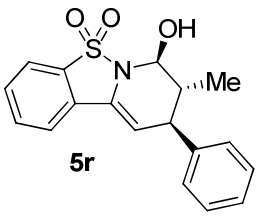
5p

(8*S*,9*R*,10*S*)-10-Ethyl-8-hydroxy-9-methyl-9,10-dihydro-8*H*-naphtho[2,1-*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5p): Colorless oil (27.0 mg, 78%). ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.03 – 7.95 (m, 4H), 7.85 (d, J = 8.8 Hz, 1H), 7.66 – 7.63 (m, 2H), 6.11 (d, J = 2.0 Hz, 1H), 5.50 (s, 1H), 2.23 – 2.21 (m, 1H), 1.77 – 1.70 (m, 1H), 1.66 – 1.61 (m, 1H), 1.40 – 1.33 (m, 1H), 1.01 (d, J = 6.8 Hz, 1H), 0.93 (t, J = 7.2 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6): δ 147.7, 138.6, 133.8, 133.1, 133.0, 131.6, 130.9, 128.9, 126.2, 125.4, 120.2, 117.6, 84.4, 40.8, 40.1, 28.7, 20.2, 15.1; HRMS (ESI): calcd for $C_{18}H_{20}NO_4S$ $[M+H]^+$: 346.1113, found 346.1117; IR: 3428, 2925, 2871, 2255, 1636, 1462, 1385, 1189, 1025, 1002, 892, 825, 763, 571; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 93 : 7, UV = 254 nm, flow rate = 0.4 mL / min) t_{R1} = 29.16 min (major) and t_{R2} = 32.72 min (minor); ee = 90%; $[\alpha]^{25}_{D}$ = +13.7 (*c* 0.2, CH_2Cl_2).



5q

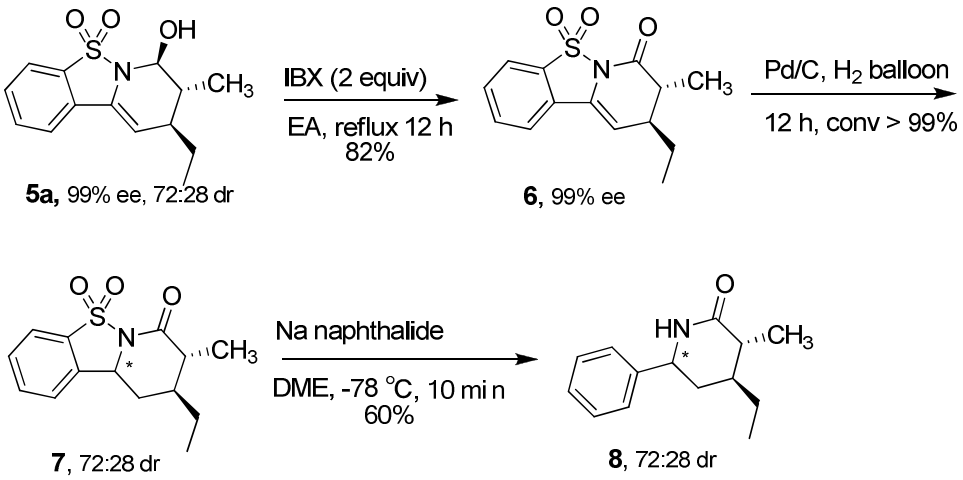
(2*S*,3*R*,4*S*)-2-Ethyl-4-hydroxy-3-methyl-3,4-dihydro-2*H*-naphtho[1,2-*e*]pyrido[1,2-*c*][1,2,3]oxathiazine 6,6-dioxide (5q): Colorless oil (25.9 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.44 (d, J = 8.8 Hz, 1H), 7.86 (d, J = 8.0 Hz, 1H), 7.82 (d, J = 8.8 Hz, 1H), 7.58 (t, J = 8.0 Hz, 1H), 7.51 (t, J = 8.0 Hz, 1H), 7.23 (d, J = 7.6 Hz, 1H), 5.70 (d, J = 2.8 Hz, 1H), 5.61 (d, J = 2.0 Hz, 1H), 3.47 (s, 1H), 2.40 – 2.33 (m, 1H), 2.07 – 2.00 (m, 1H), 1.89 – 1.80 (m, 1H), 1.62 – 1.52 (m, 1H), 1.18 (d, J = 6.8 Hz, 3H), 1.08 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.7, 133.0, 131.1, 130.3, 129.2, 127.9, 127.4, 126.3, 125.1, 117.7, 117.6, 117.1, 116.04, 83.0, 81.5, 40.7, 36.3, 35.7, 33.3, 28.0, 24.8, 18.7, 15.7, 12.3, 10.7; HRMS (ESI): calcd for $C_{18}H_{18}NO_4S$ $[M-H]^-$: 344.0957, found 344.0952; IR: 3446, 2962, 2928, 2874, 1638, 1513, 1457, 1384, 1207, 1187, 1156, 1034, 929, 919, 813, 732, 624, 559, 532; HPLC (Chiralcel IC-3, Hexane / *i*-PrOH = 94 : 6, UV = 254 nm, flow rate = 0.4 mL / min) t_{R1} = 45.69 min (major) and t_{R2} = 69.55 min (minor); ee = 94%; $[\alpha]^{25}_{D}$ = +138.3 (*c* 0.4, CH_2Cl_2).



5r

(7*S*,8*R*,9*S*)-7-hydroxy-8-methyl-9-phenyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridin e 5,5-dioxide: A white solid (31.7 mg, 97%). m.p. 142 – 143 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.83 (d, J = 8.0 Hz, 1H), 7.67 – 7.55 (m, 2H), 7.59-7.55 (m, 1H), 7.37 – 7.23 (m, 5H), 5.73 (t, J = 2.4 Hz, 1H), 5.69 (s, 1H), 3.55 (d, J = 11.2 Hz, 2H), 2.17 – 2.11 (m, 1H), 1.03 (dd, J = 6.8, 2.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 142.8, 133.5, 132.3, 130.3, 130.1, 128.9, 128.8, 128.5, 127.3, 121.5, 121.5, 106.6, 76.1, 42.8, 40.1, 15.4; HRMS (ESI): calcd for $C_{18}H_{18}NO_3S$ $[M+H]^+$: 328.1007, found 328.1008; IR: 3480, 2923, 2852, 1662, 1600, 1494, 1470, 1453, 1379, 1305, 1181, 1152, 1060, 1038, 946, 759, 702, 573, 529; HPLC (Chiralcel AS-H, Hexane / *i*-PrOH = 80 : 20, UV = 254 nm, flow rate = 0.7 mL / min) t_{R1} = 18.08 min (major) and t_{R2} = 40.18 min (minor); ee = 96%; $[\alpha]^{25}_{D}$ = +32.2 (*c* 0.3~~1~~, CH_2Cl_2). "1" should be deleted.

6. Procedure for the 8:



5a, 99% ee, 72:28 dr

6, 99% ee

7, 72:28 dr

8, 72:28 dr

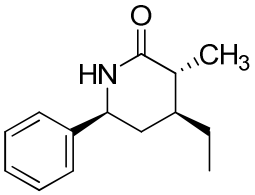
(8*R*,9*S*)-9-Ethyl-8-methyl-8,9-dihydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridin-7-one 5,5-dioxide (6): A suspension of **5a** (83.7 mg, 0.3 mmol) and IBX (168.0mg, 0.6mmol) in EtOAc (5 mL) was heated at reflux temperature for 12 h. The organic layer was filtered and concentrated under reduced pressure. The crude product was determined as a sole pair of enantiomers by ^{1}H NMR which was then purified by a flash chromatography to afford the desired product **6** as a

white solid (68.1 mg, 82%). m.p. 133-134 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 (d, J = 8.0 Hz, 1H), 7.75 – 7.69 (m, 2H), 7.62 – 7.58 (m, 1H), 5.94 (d, J = 4.8 Hz, 1H), 2.68 – 2.61 (m, 1H), 2.46 – 2.40 (m, 1H), 1.71 – 1.64 (m, 1H), 1.59 – 1.52 (m, 1H), 1.32 (d, J = 7.2 Hz, 1H), 0.99 (t, J = 7.2 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 170.0, 134.2, 132.6, 130.9, 128.8, 127.0, 121.8, 121.6, 106.1, 41.4, 41.4, 26.8, 15.4, 10.7; HRMS (ESI): calcd for $[C_{14}H_{15}NO_3S+H]^+$ 278.0851, found 278.0848; IR: 3438, 2965, 2928, 2876, 1710, 1470, 1341, 1258, 1178, 1162, 1064, 760; HPLC (Chiralcel AS-H, Hexane / *i*-PrOH = 90 : 10, UV = 254 nm, flow rate = 0.8 mL / min) t_{R1} = 81.58 min (major) and t_{R2} = 93.85 min (minor); ee = 99%; $[\alpha]^{25}_D$ = +61.6 (*c* 0.3, CH_2Cl_2).

(8*R*,9*S*)-9-Ethyl-8-methyl-8,9,10,10a-tetrahydro-7*H*-benzo[4,5]isothiazolo[2,3-*a*]pyridin-7-one 5,5-dioxide (**7**)**: 6** (68.1 mg) was reduced by Pd/C (10 mol%) with a H_2 balloon in CH_3OH. After the substrate conversion completely, Pd/C was filtered under N_2 atmosphere and organic lower was concentrated under reduced pressure to get the product **7** as a white solid (conv. > 99%, dr = 72:28). m.p. 218-219 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 (d, J = 8.0 Hz, 1H), 7.70 (t, J = 7.6 Hz, 1H), 7.58 (t, J = 8.0 Hz, 1H), 7.48 (dd, J = 13.2, 4.4 Hz, 1H), 5.04 (dd, J = 12.4, 4.4 Hz, 1H), 2.43 – 2.36 (m, 1H), 2.28 – 2.24 (m, 1H), 1.99 – 1.90 (m, 1H), 1.73 – 1.70 (m, 2H), 1.52 – 1.44 (m, 1H), 1.27 (d, J = 6.8 Hz, 3H), 1.01 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.0, 171.0, 134.8, 134.6, 134.3, 134.1, 134.0, 133.8, 129.9, 123.7, 123.3, 121.8, 121.7, 57.9, 55.3, 43.1, 42.1, 41.6, 39.1, 33.4, 26.9, 26.5, 15.1, 14.0, 10.9, 10.4; HRMS (ESI): calcd for $[C_{14}H_{17}NO_3S+H]^+$ 280.1010, found 280.1002; IR: 3430, 3085, 2961, 2936, 2876, 2344, 1694, 1683, 1598, 1452, 1361, 1328, 1301, 1263, 1247, 1231, 1216, 1193, 1172, 1129, 1101, 1063, 967, 876, 852, 826, 768, 754, 715, 685, 651, 613, 585, 578, 561, 522, 505.

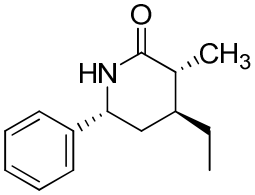
(3*R*,4*S*)-4-Ethyl-3-methyl-6-phenylpiperidin-2-one (**8**)**:** A flame dried Schlenk tube was charged with a solution of sulfamide **7** (55.8 mg, 0.2 mmol, 1.0 equiv) dissolved in DME (5 mL) at -70 °C under a N_2 atmosphere. Sodium naphthalide (2 mmol in 10.0 mL DME, 10 equiv) was added dropwise over 30 seconds. After 2 min, the solution was quenched with 5% aqueous HCl (10 mL) and extracted with DCM (3 × 30 mL). The combined organic layers were washed with brine (10 mL) and dried with Na_2SO_4. After filtration, the solvent was evaporated and the residue was purified by column chromatography to give crude product, which was separated by preparative TLC on silica gel (petroleum ether/EtOAc = 1/1) to give two diastereomers (**8-1:** 18.6 mg, **8-2: 7**.4 mg, 60%). The major diastereomer **8-1** was assigned as *S*-configuration at 6-position by NOESY

difference method between the hydrogen atoms located at 4 and 6-position of **8-1**.



8-1

(3*R*,4*S*,6*R*)-4-Ethyl-3-methyl-6-phenylpiperidin-2-one: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.34 (m, 2H), 7.31-7.24 (m, 3H), 6.16 (brs, 1H), 4.61 (t, J = 6.0 Hz, 1H), 2.27-2.21 (m, 1H), 1.93-1.89 (m, 2H), 1.56 – 1.49 (m, 2H), 1.37 (dd, J = 14.8, 7.6 Hz, 1H), 1.33 (d, J = 7.2 Hz, 3H), 0.88 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 176.2, 142.7, 128.6, 127.5, 125.9, 54.2, 40.7, 37.2, 33.2, 25.9, 17.1, 10.9; IR: 3267, 2962, 2928, 2875, 1656, 1461, 1344, 1308, 1029, 753, 699, 597. HRMS (ESI): calcd for $[C_{14}H_{19}NO+Na]^+$ 240.1364, found 240.1367.

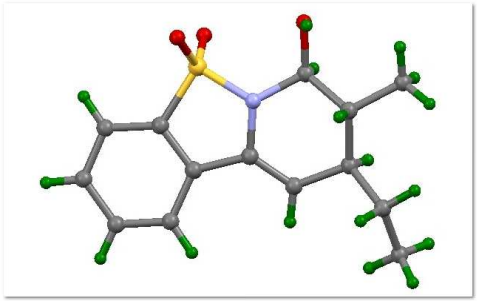


8-2

(3*R*,4*S*,6*S*)-4-Ethyl-3-methyl-6-phenylpiperidin-2-one: ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38 – 7.35 (m, 2H), 7.32-7.29 (m, 3H), 5.87 (brs, 1H), 4.45 (dd, J = 11.6, 3.6 Hz, 1H), 2.13 – 2.09 (m, 2H), 1.74 – 1.69 (m, 1H), 1.63-1.55 (m, 1H), 1.38 (dd, J = 25.2, 12.0 Hz, 1H), 1.32 (d, J = 7.2 Hz, 3H), 1.22 – 1.18 (m, 1H), 0.91 (t, J = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 175.5, 142.5, 128.8, 128.0, 126.0, 57.5, 41.0, 37.8, 26.1, 14.7, 10.4; IR: 3444, 2963, 2925, 2875, 1645, 1456, 1384, 1331, 1280, 1030, 756, 700, 658, 559, 534. HRMS (ESI): calcd for $[C_{14}H_{19}NO+Na]^+$ 240.1364, found 240.1359.

7. X-ray Data of Compound 5a

Structure of Compound **5a**



Data of crystal 5a

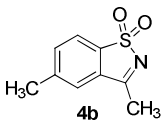
Table 1. Crystal data and structure refinement of 5a

Identification code	**5a**
Empirical formula	$C_{14}H_{17}NO_3S$
Formula weight	279.34
Temperature	237 K
Wavelength	0.71073 A
Crystal system, space group	orthorhombic, P 21 21 21
Unit cell dimensions	a = 8.0008(13) A alpha = 90 deg. b = 8.3075(13) A beta = 90 deg. c = 20.717(3) A gamma = 90 deg.
Volume	1377.0(4) A^3
Z, Calculated density	4, 1.347 mg/m^3
Absorption coefficient	0.238 mm^-1
F(000)	592.0
Theta range for data collection	1.96 to 27.50 deg.
Limiting indices	-10 <=h<= 4, -9 <=k<=7, -19 <=l<= 26
Absorption correction	Semi-empirical from equivalents
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	2715 / 0 / 175
Goodness-of-fit on F^2	1.026
Final R indices [I>2sigma(I)]	R_1 = 0.0591, wR_2 = 0.1406

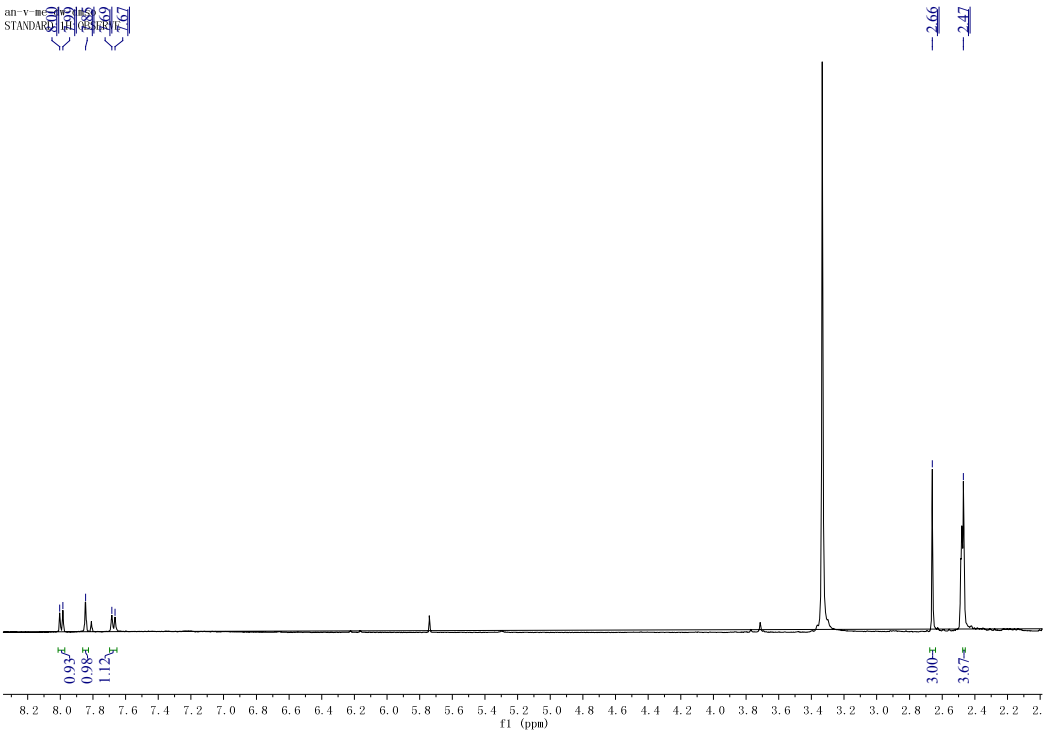
R indices (all data)	$R_1 = 0.0996$, $wR_2 = 0.1641$
Extinction coefficient	0.0030(19)
Largest diff. peak and hole	0.659 and -0.310 e.A^-3

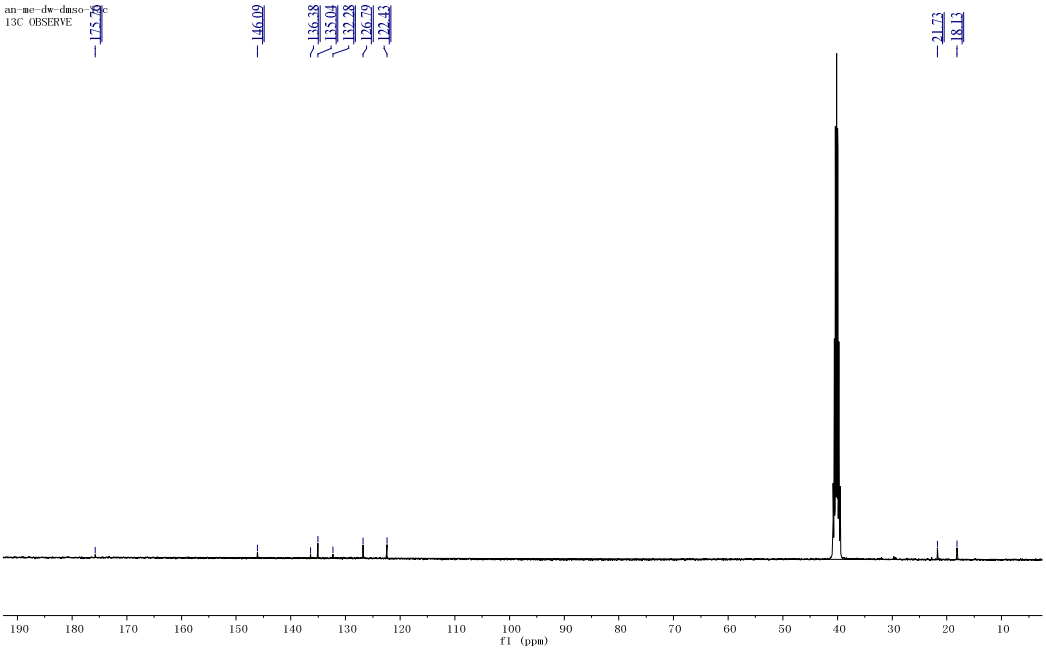
Note: These data (CCDC 987247) can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac. uk/data_request/cif.

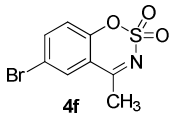
8. NMR Spectrum "um" should be "a".



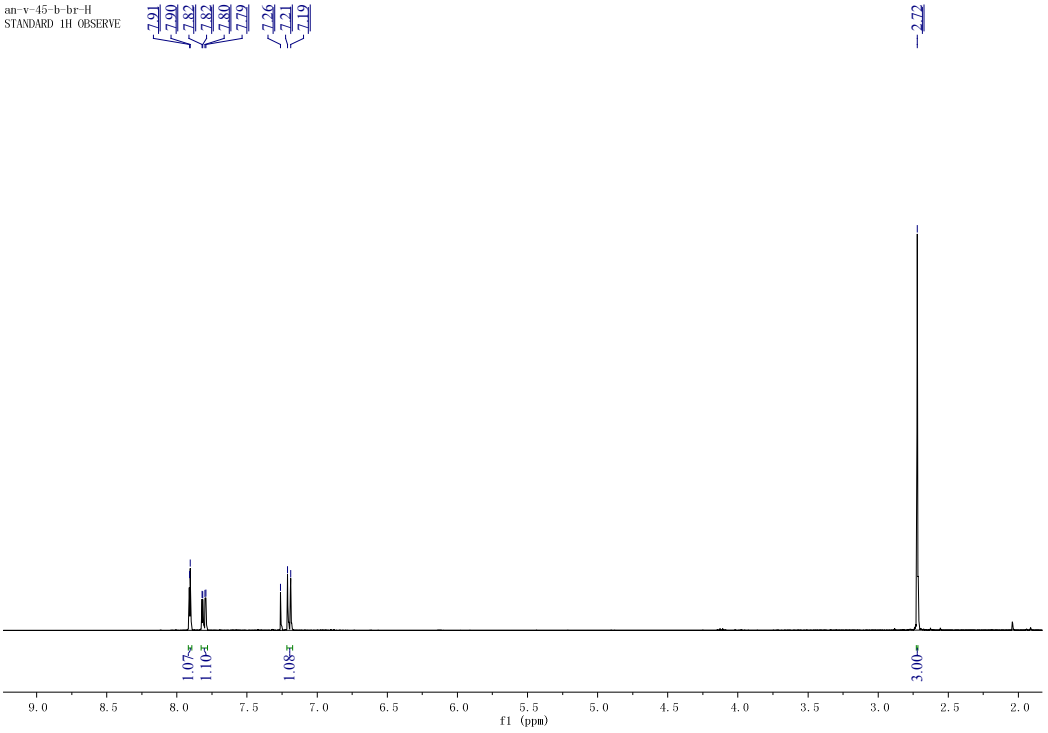
4b






O
O
S
O
N
Br
CH3

4f


an-v-45-b-br-H
STANDARD 1H OBSERVE
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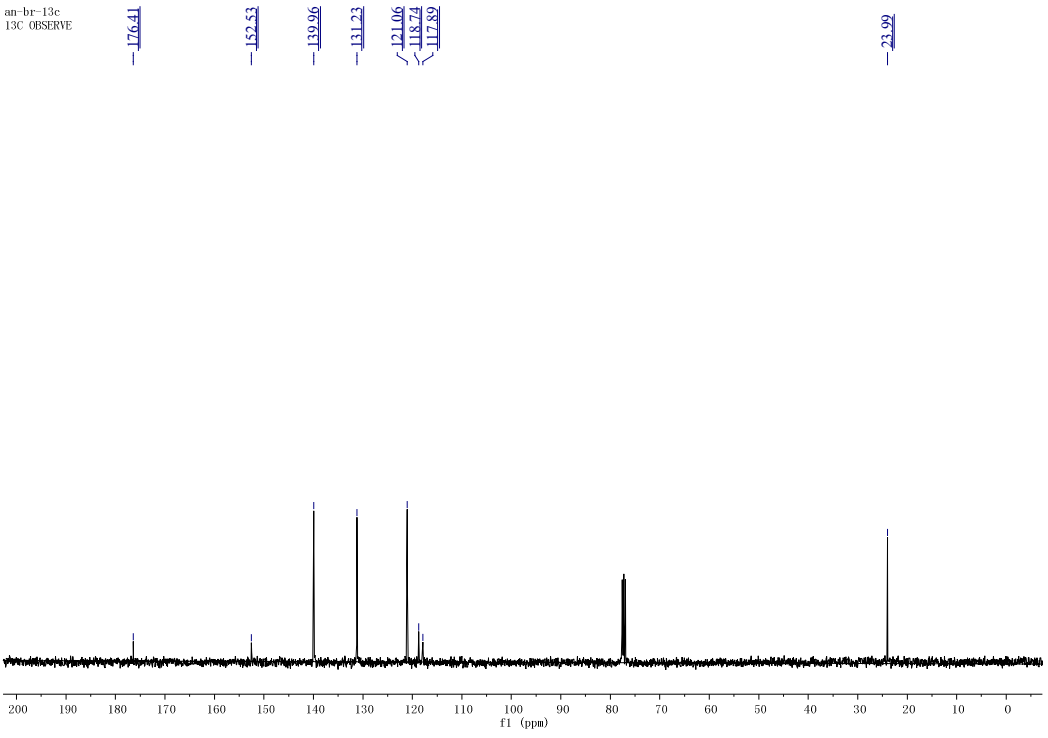
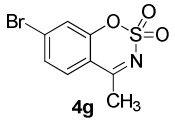
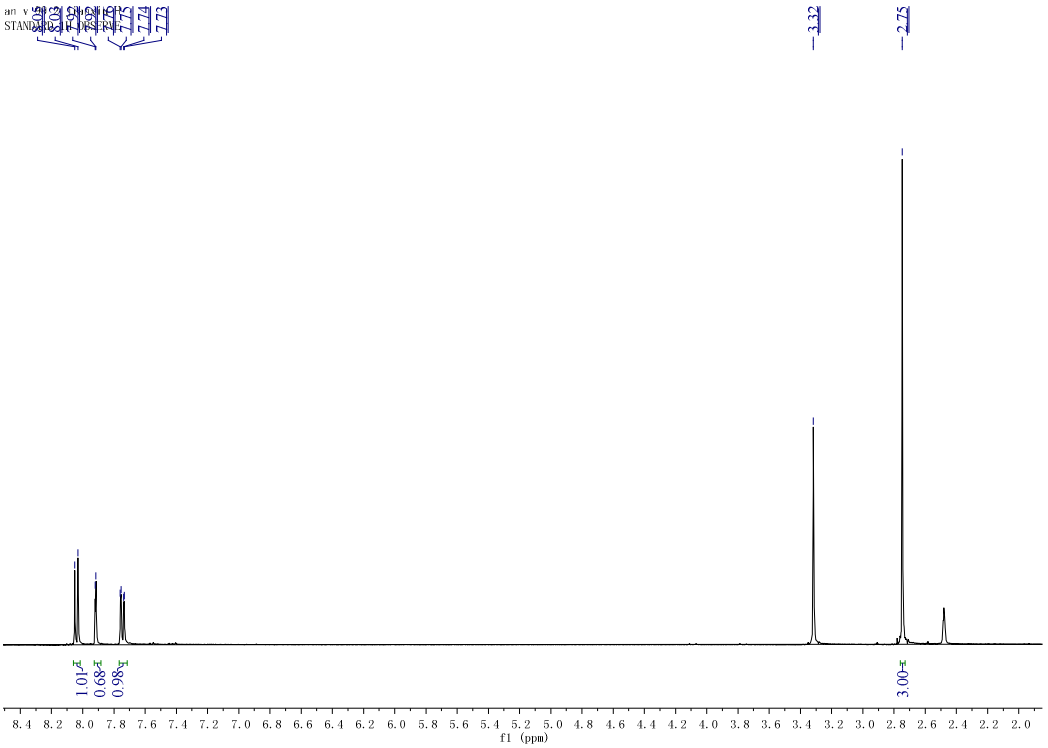
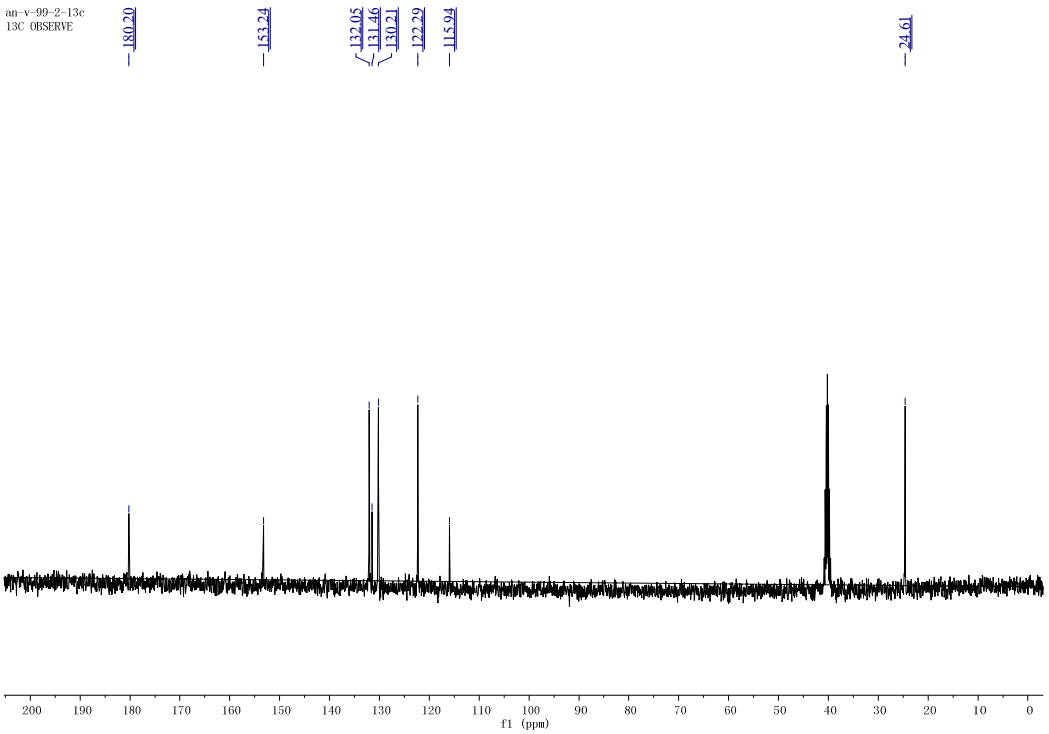
7.90
7.82
7.82
7.80
7.79
7.26
7.21
7.19
2.72
1.07
1.10
1.08
3.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
f1 (ppm)


an-br-13c
13C OBSERVE
176.41
152.53
139.96
131.23
121.06
118.74
117.89
23.99
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


Br
O
O
S
O
N
CH3

4g


an v
STANDARD PROTON
8.03
7.92
7.75
7.72
7.74
7.73
3.32
2.75
1.01
0.68
0.98
3.00
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0 5.8 5.6 5.4 5.2 5.0 4.8 4.6 4.4 4.2 4.0 3.8 3.6 3.4 3.2 3.0 2.8 2.6 2.4 2.2 2.0
f1 (ppm)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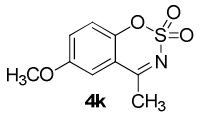
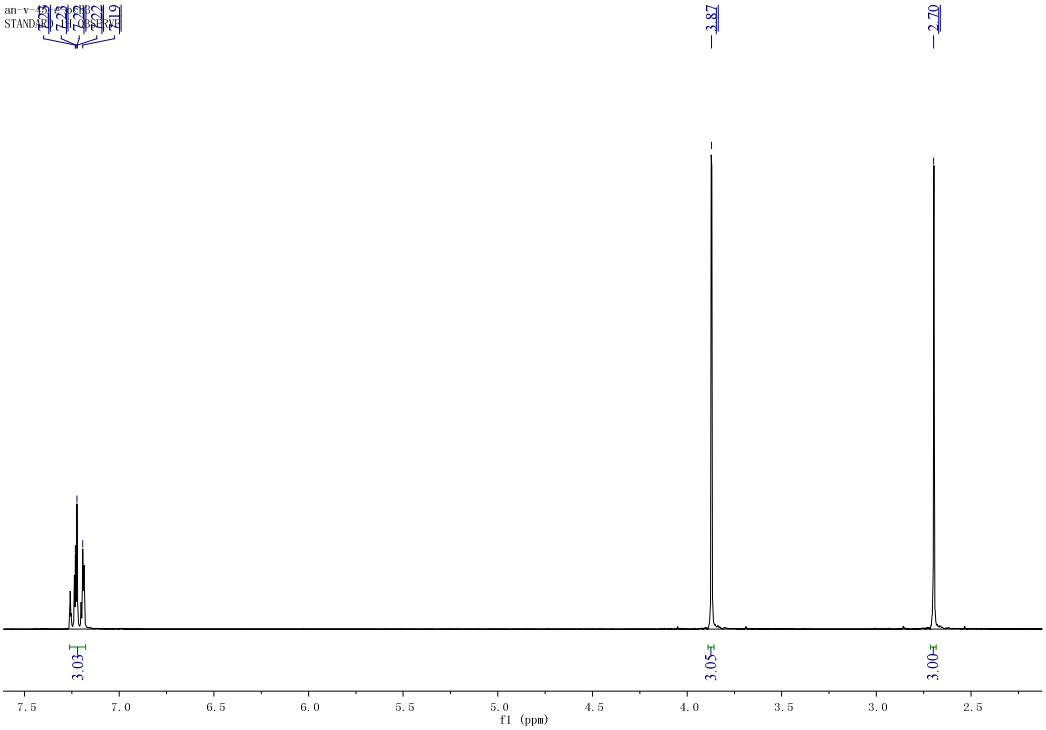
153.24
132.05
131.46
130.21
122.29
115.94
24.61
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


O
O
S
O
N
H3CO
4k
CH3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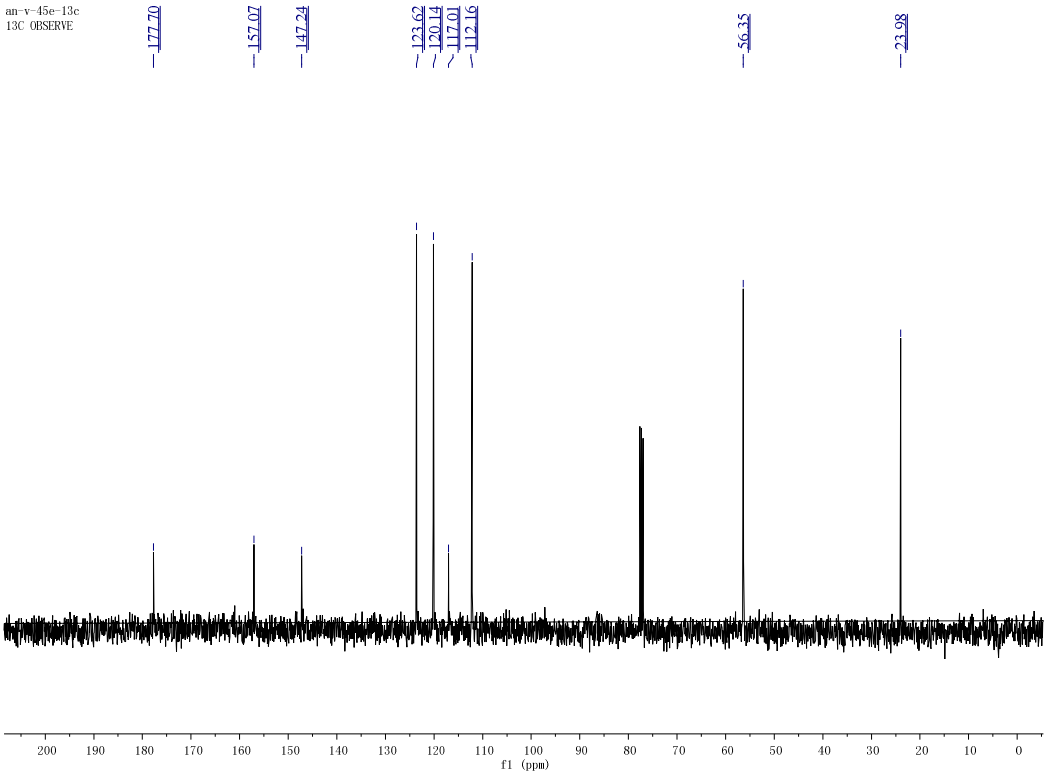
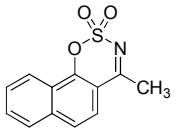
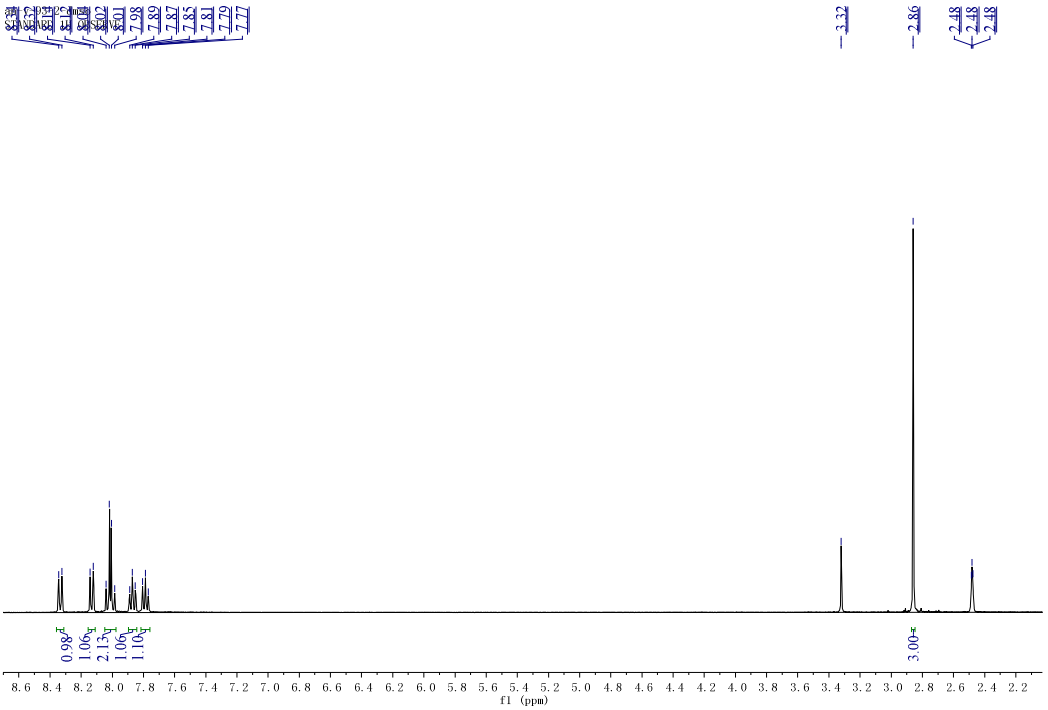
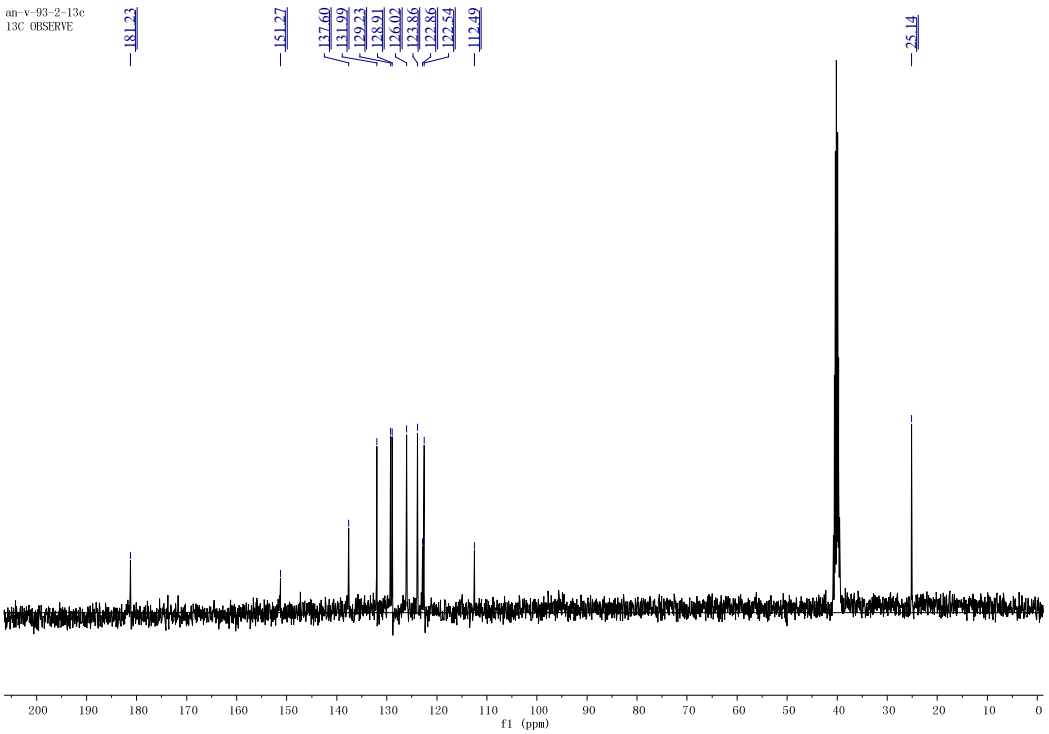
2.70
3.03
3.05
3.00
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
f1 (ppm)

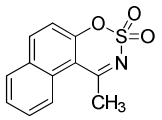

an-v-45e-13c
13C OBSERVE
177.70
157.07
147.24
123.62
120.14
117.01
112.16
56.35
23.98
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)



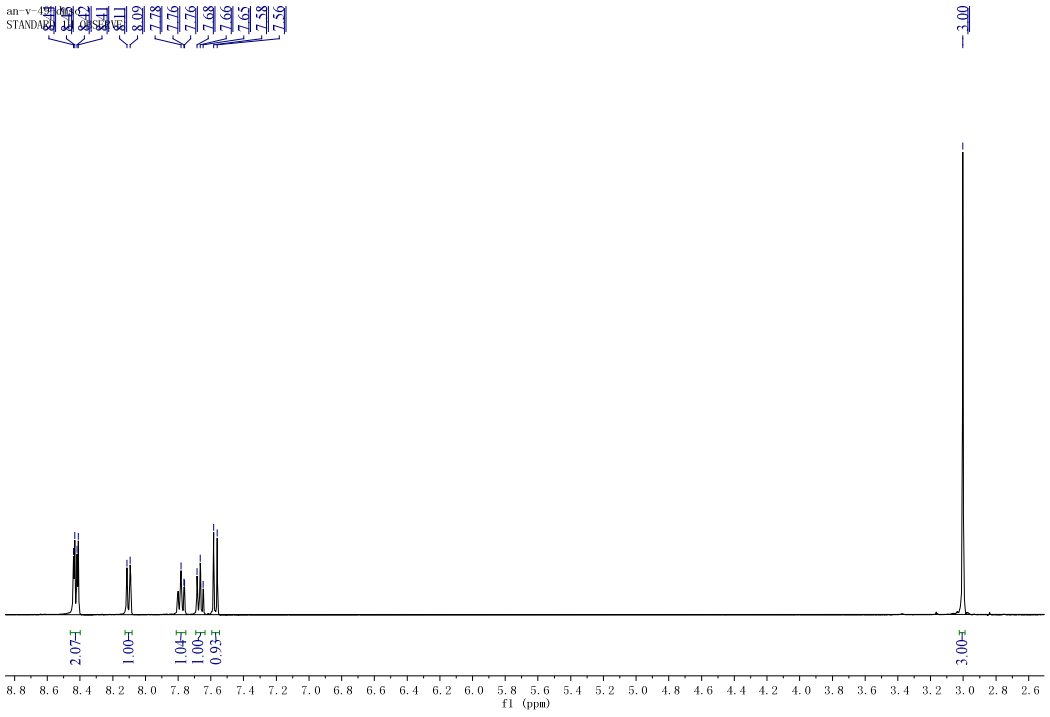
4l

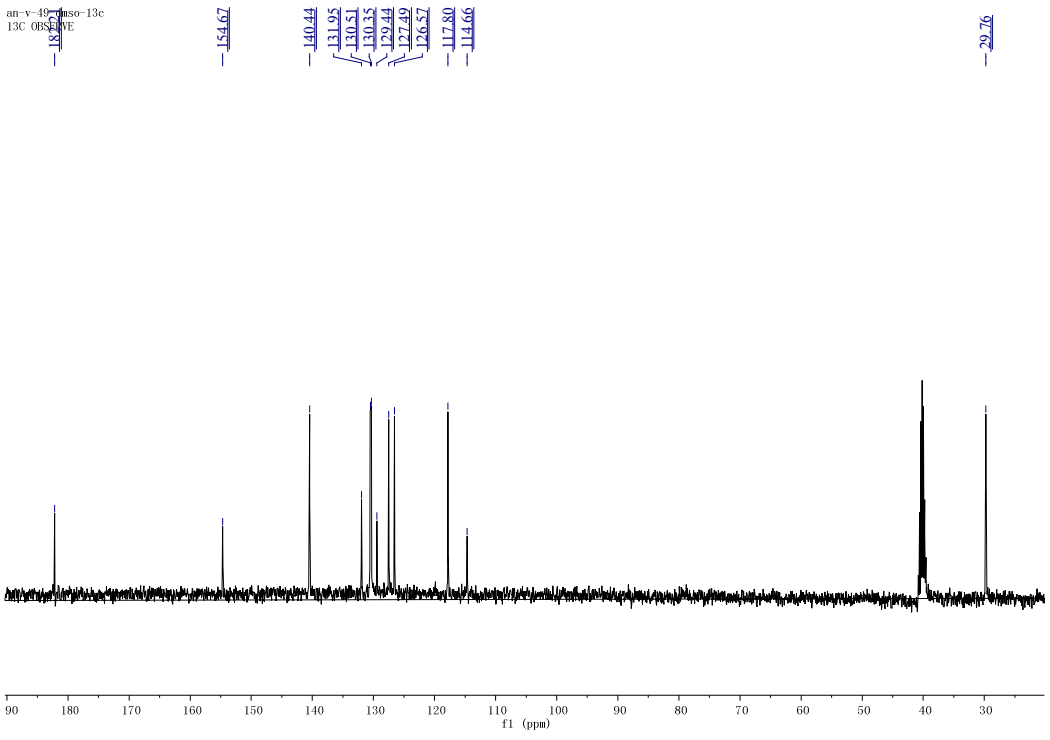


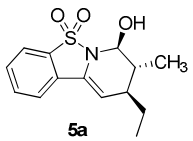




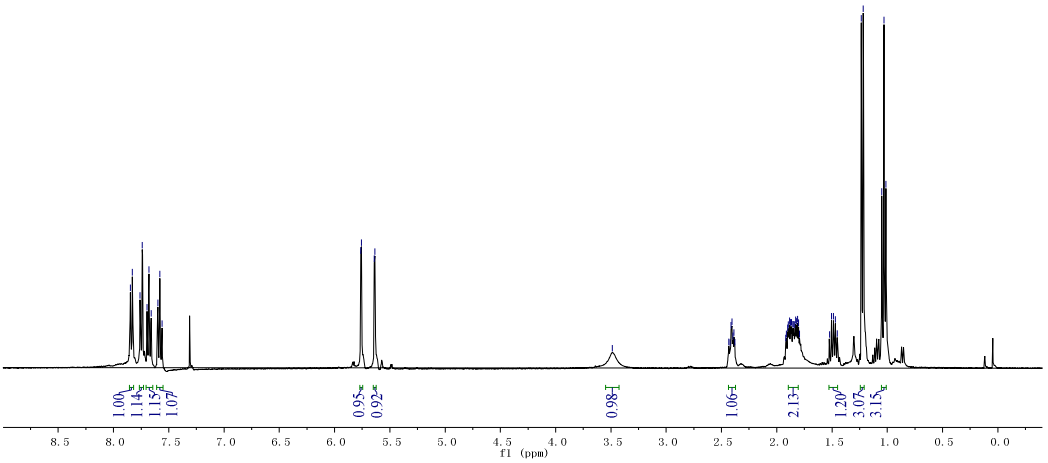
4m

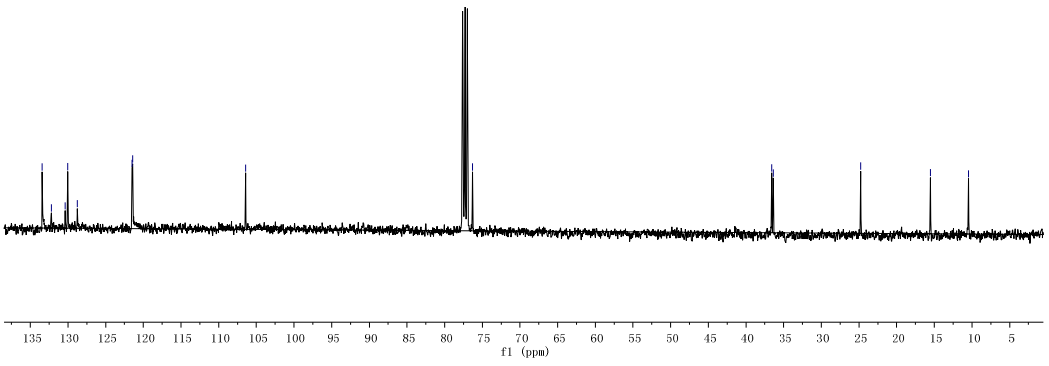

8.11
8.09
7.78
7.76
7.76
7.68
7.66
7.65
7.58
7.56
3.00
2.07
1.00
1.04
1.00
0.93
3.00
f1 (ppm)

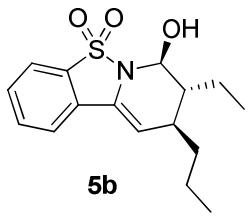

154.67
140.44
131.95
130.51
130.35
129.44
127.49
126.57
117.80
114.66
29.76
f1 (ppm)


O
O
S
N
OH
CH3

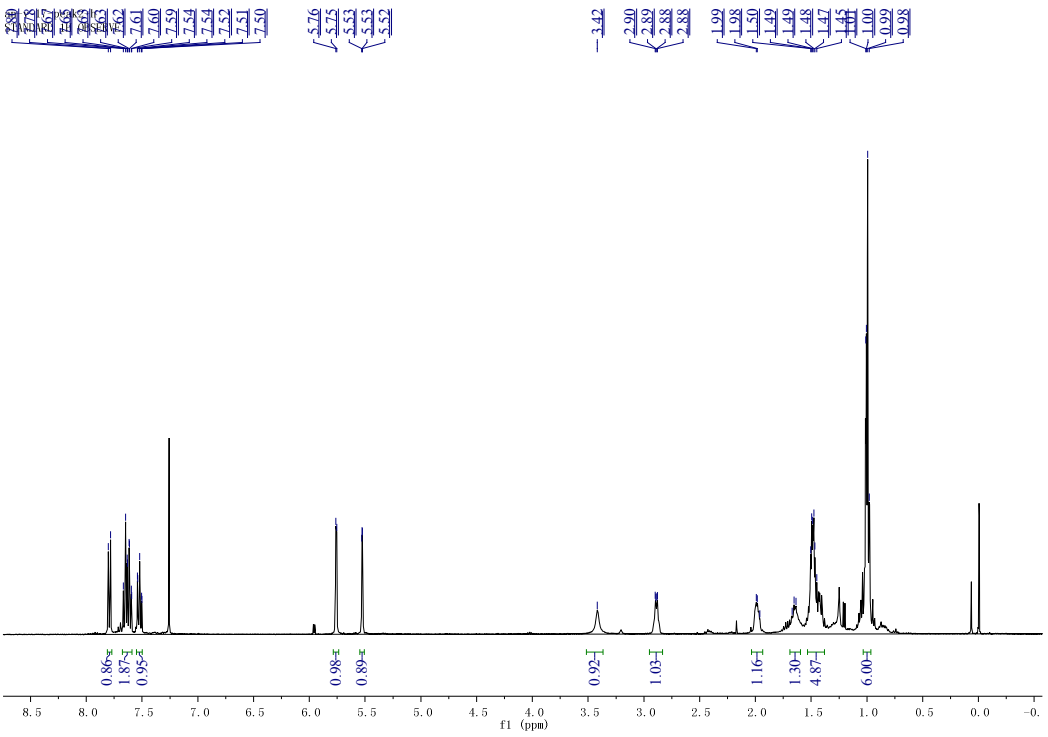
5a

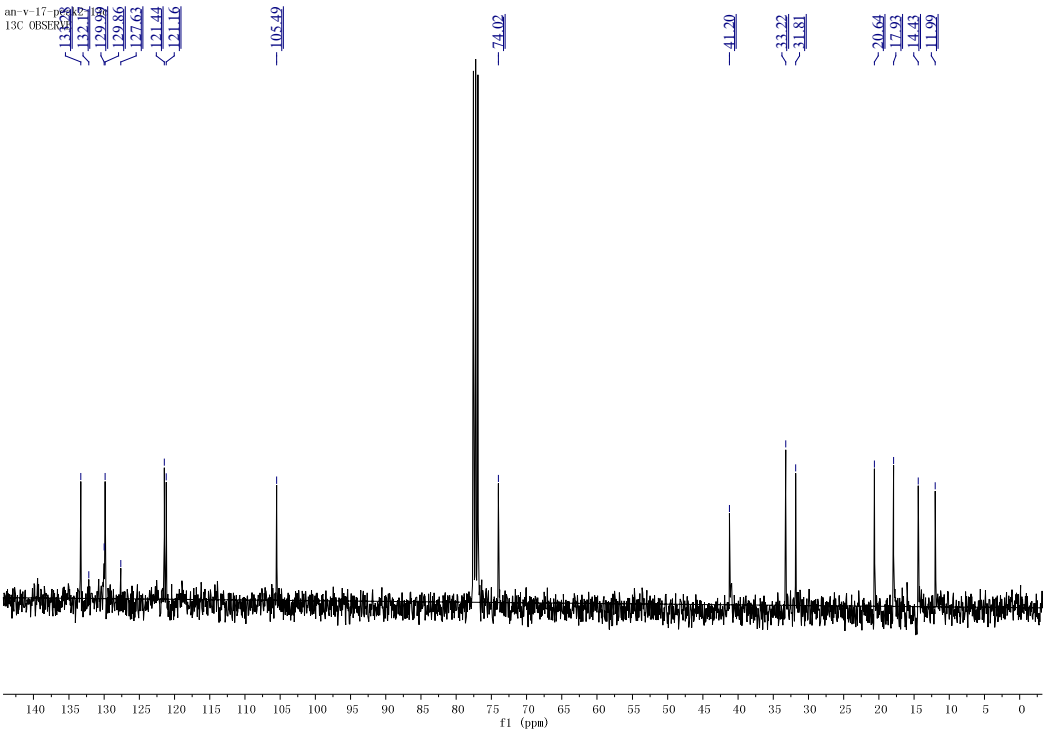

1.00
1.14
1.15
1.07
0.95
0.92
0.98
1.06
2.13
1.20
3.07
3.15
f1 (ppm)

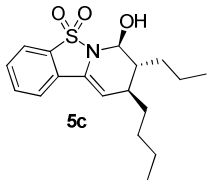

f1 (ppm)

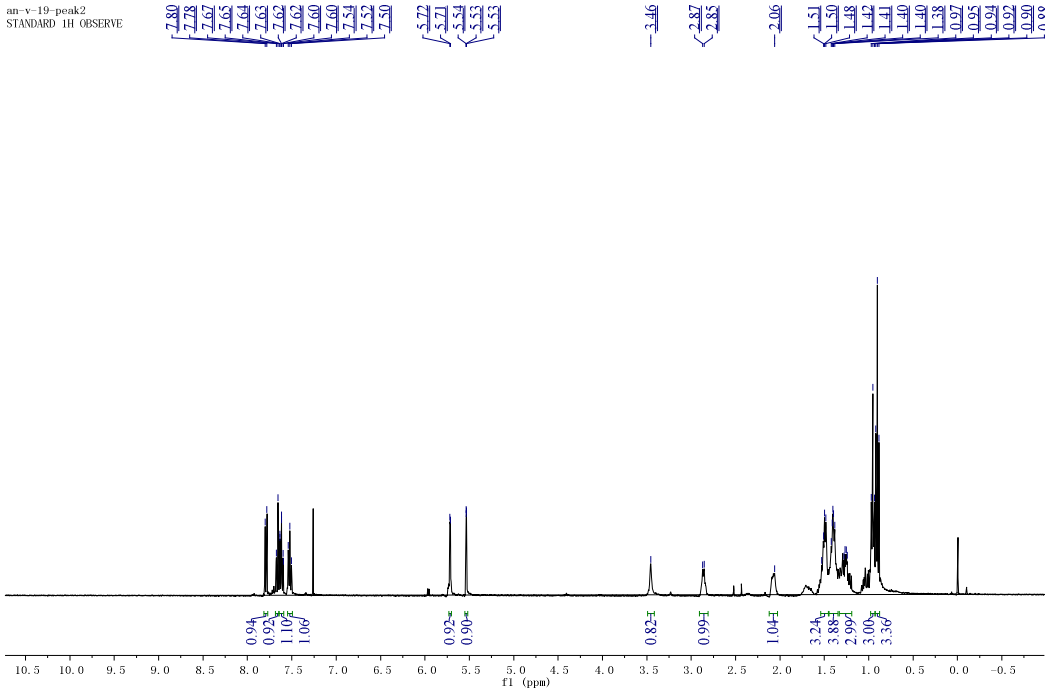

O
O
S
N
OH

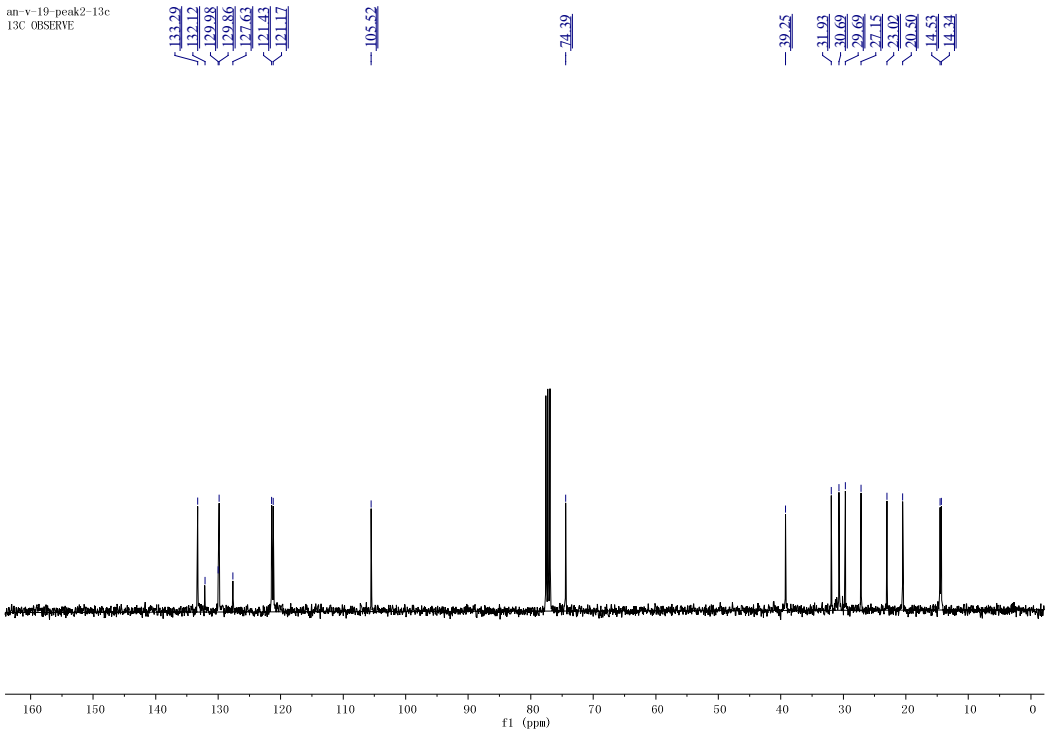
5b

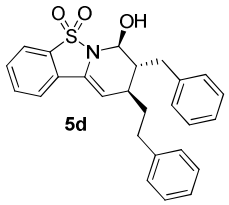

7.61
7.60
7.59
7.54
7.54
7.52
7.51
7.50
5.76
5.75
5.53
5.53
5.52
3.42
2.90
2.89
2.88
2.88
1.92
1.98
1.50
1.49
1.49
1.48
1.47
1.45
1.00
0.99
0.98
0.86
1.87
0.95
0.98
0.89
0.92
1.03
1.16
1.30
4.87
6.00
f1 (ppm)

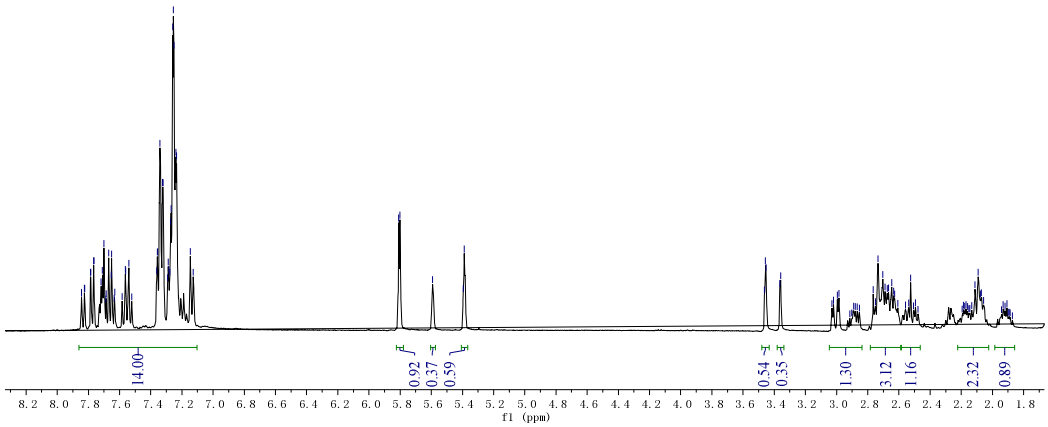

135.23
132.15
129.98
129.86
127.63
121.44
121.16
105.49
74.02
41.20
33.22
31.81
20.64
17.93
14.43
11.99
f1 (ppm)

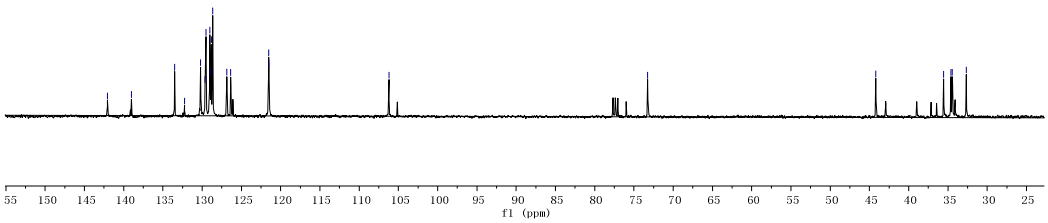

O
O
S
N
OH
5c

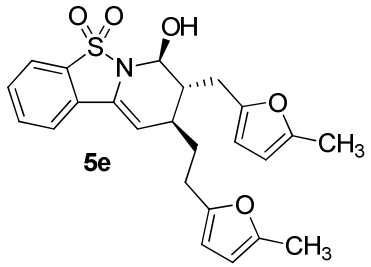

an-v-19-peak2
STANDARD 1H OBSERVE
7.80
7.78
7.67
7.65
7.64
7.63
7.62
7.62
7.60
7.60
7.54
7.52
7.50
5.72
5.71
5.54
5.53
5.53
3.46
2.87
2.85
2.06
1.51
1.50
1.48
1.42
1.41
1.40
1.40
1.38
0.97
0.95
0.94
0.92
0.90
0.94
1.10
1.06
0.92
0.90
0.82
0.99
1.04
3.24
3.88
2.99
3.00
3.36
f1 (ppm)


an-v-19-peak2-13c
13C OBSERVE
133.29
132.12
129.98
129.86
127.63
121.43
121.17
105.52
74.39
39.25
31.93
30.69
29.69
27.15
23.02
20.50
14.53
14.34
f1 (ppm)

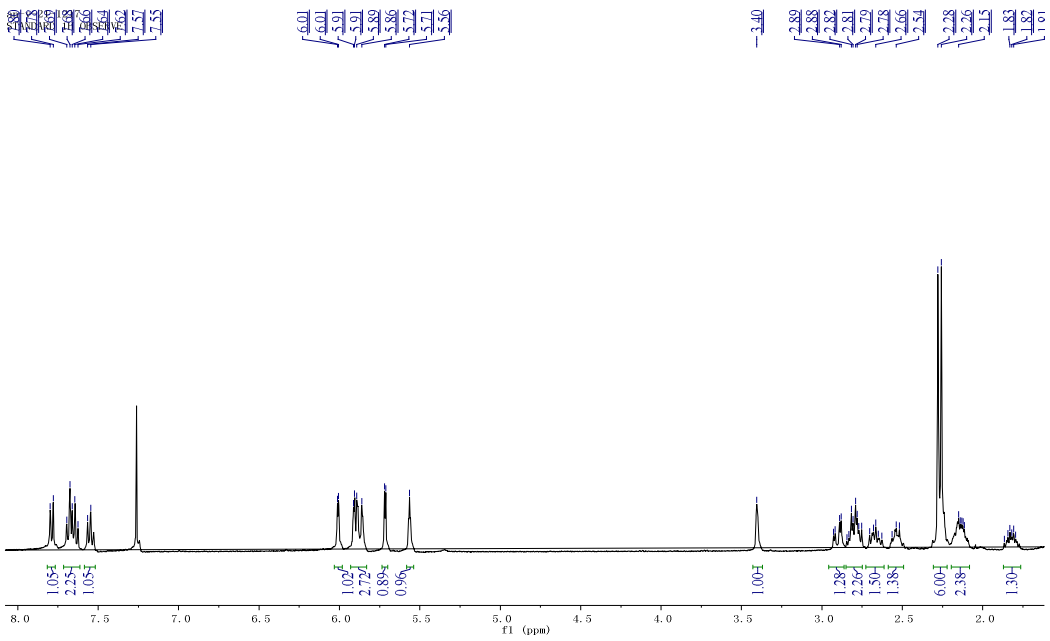

O
O
S
N
OH
5d

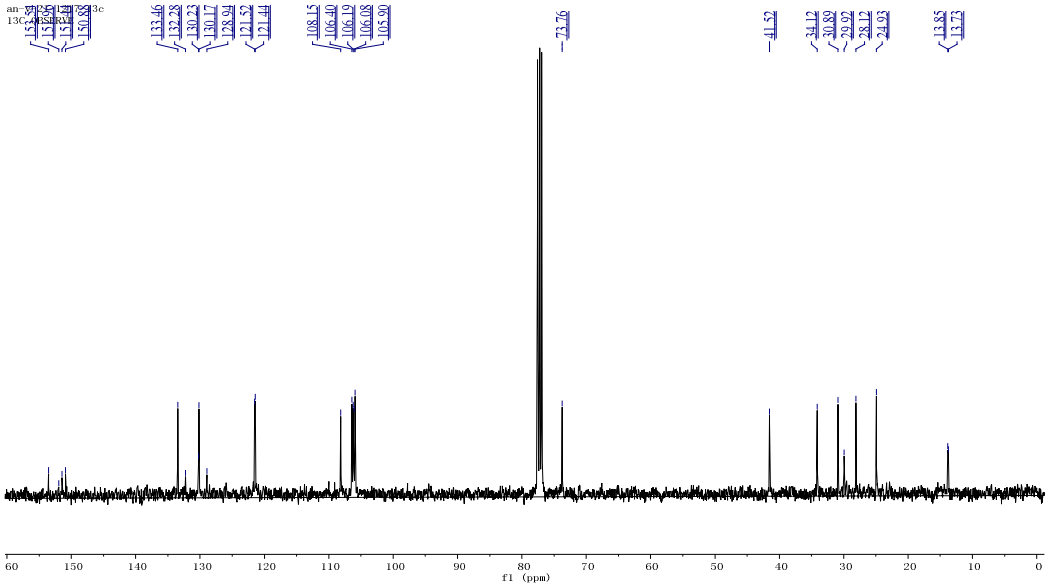

14.00
0.92
0.37
0.59
0.54
0.35
1.30
3.12
1.16
2.32
0.89
f1 (ppm)

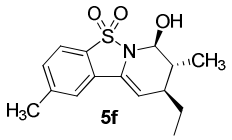

f1 (ppm)



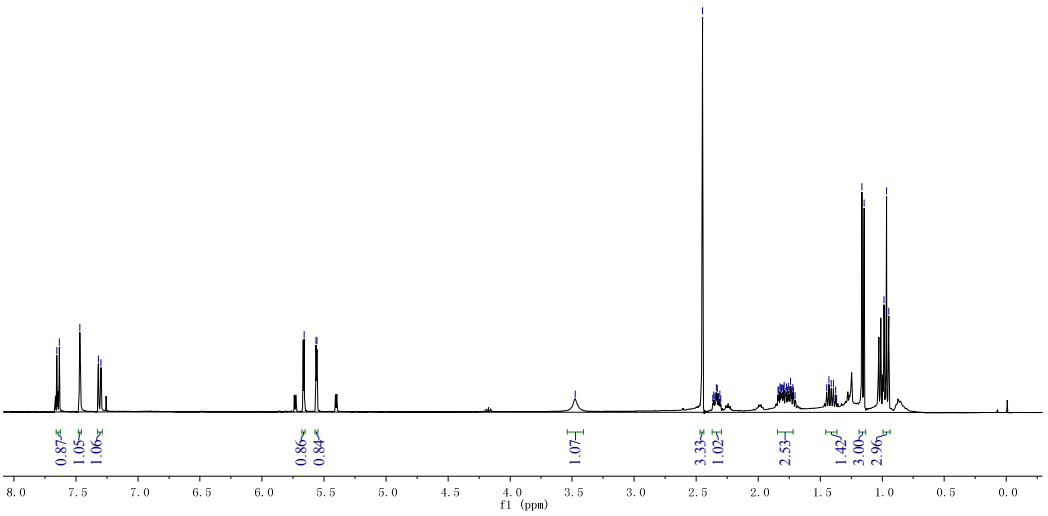
5e

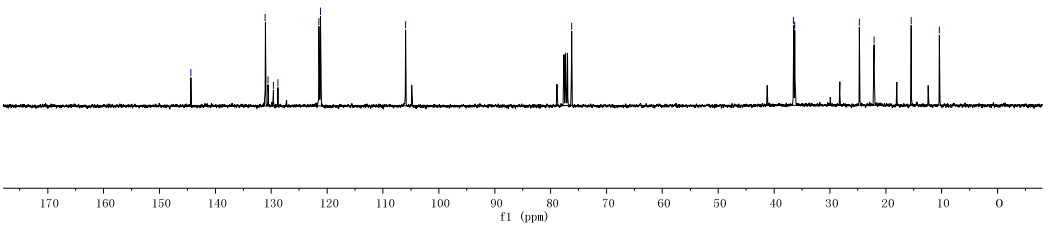


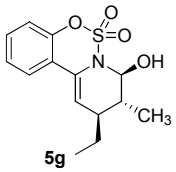



O
O
S
N
OH
CH3
H3C

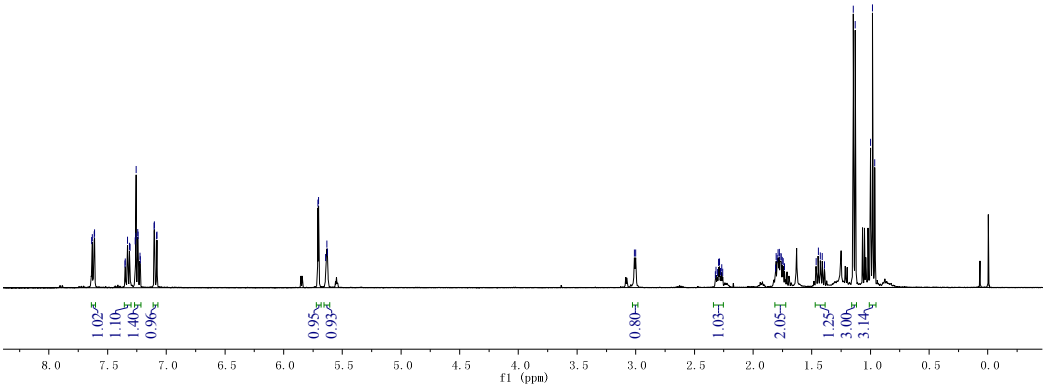
5f

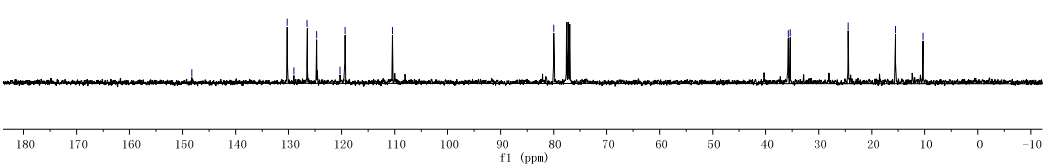

0.87
1.05
1.06
0.86
0.84
1.07
3.33
1.02
2.53
1.42
3.00
2.96
f1 (ppm)

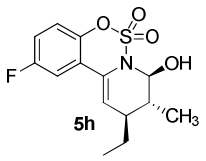

f1 (ppm)


O
O
S
O
N
OH
CH3

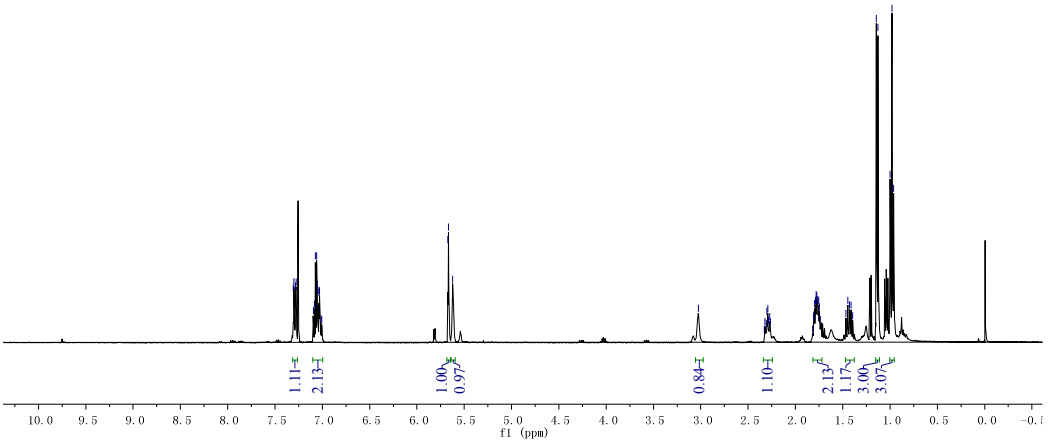
5g


1.02
1.10
1.40
0.96
0.95
0.93
0.80
1.03
2.05
1.25
3.00
3.14
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

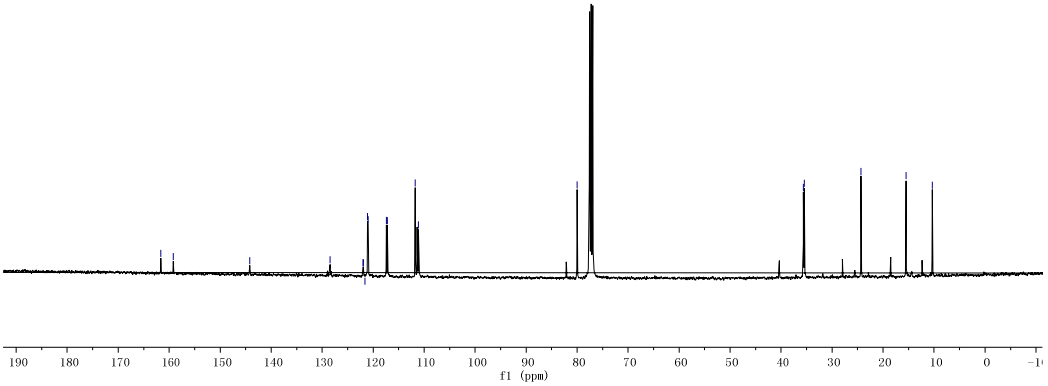

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

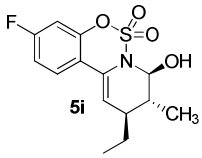


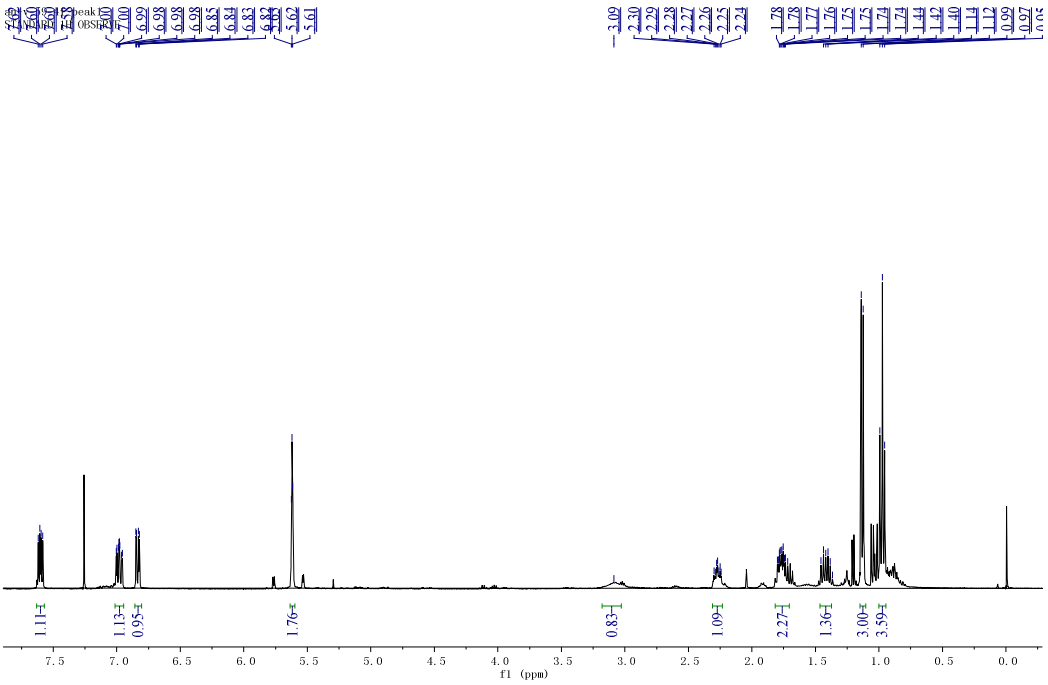
an-v-53-5f-peak1
STANDARD 1H OBSERVE

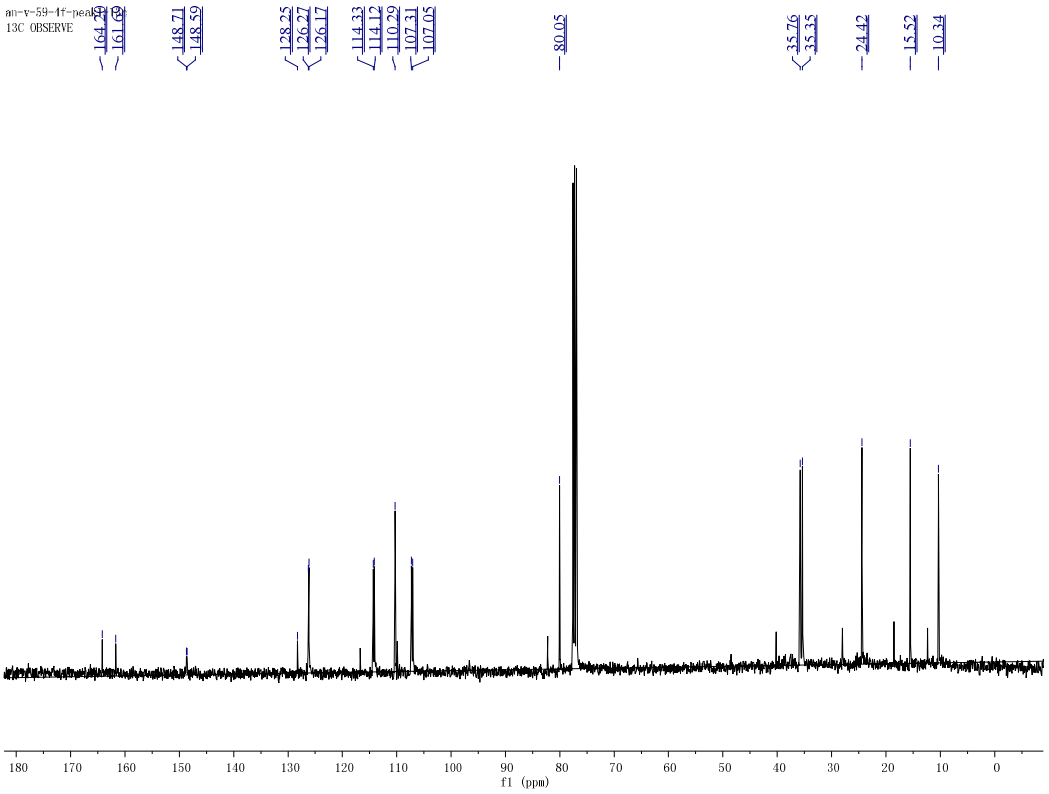


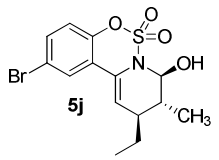
an-v-5f-13c
13C OBSERVE



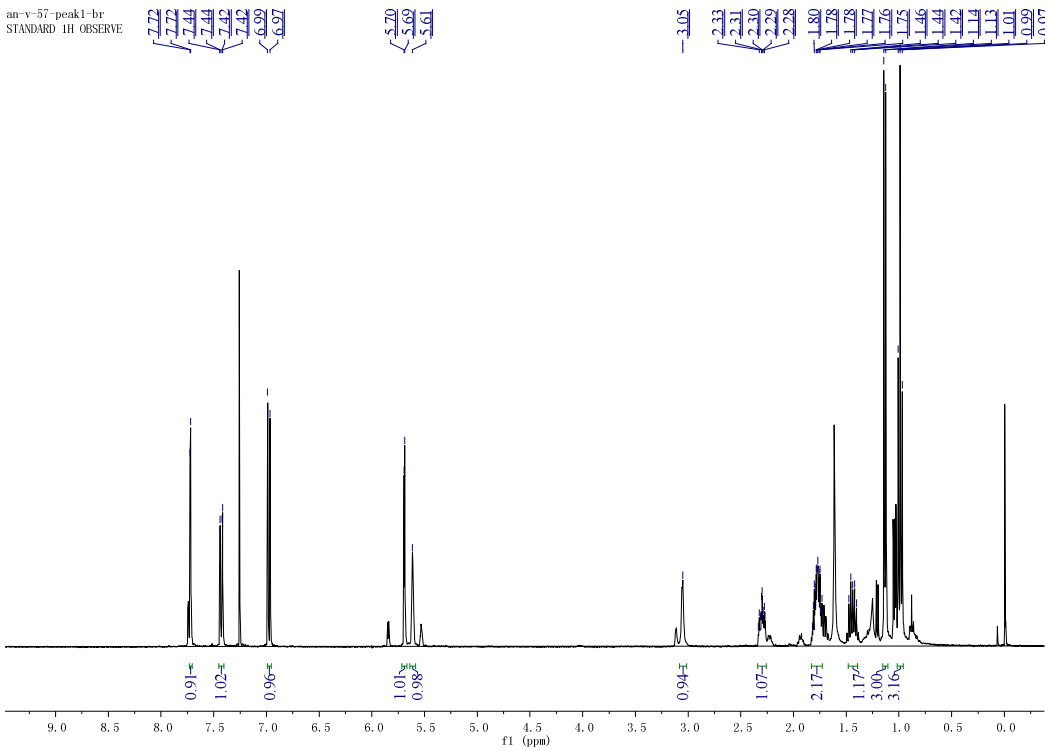

F
O
S
O
O
N
OH
5i
CH3

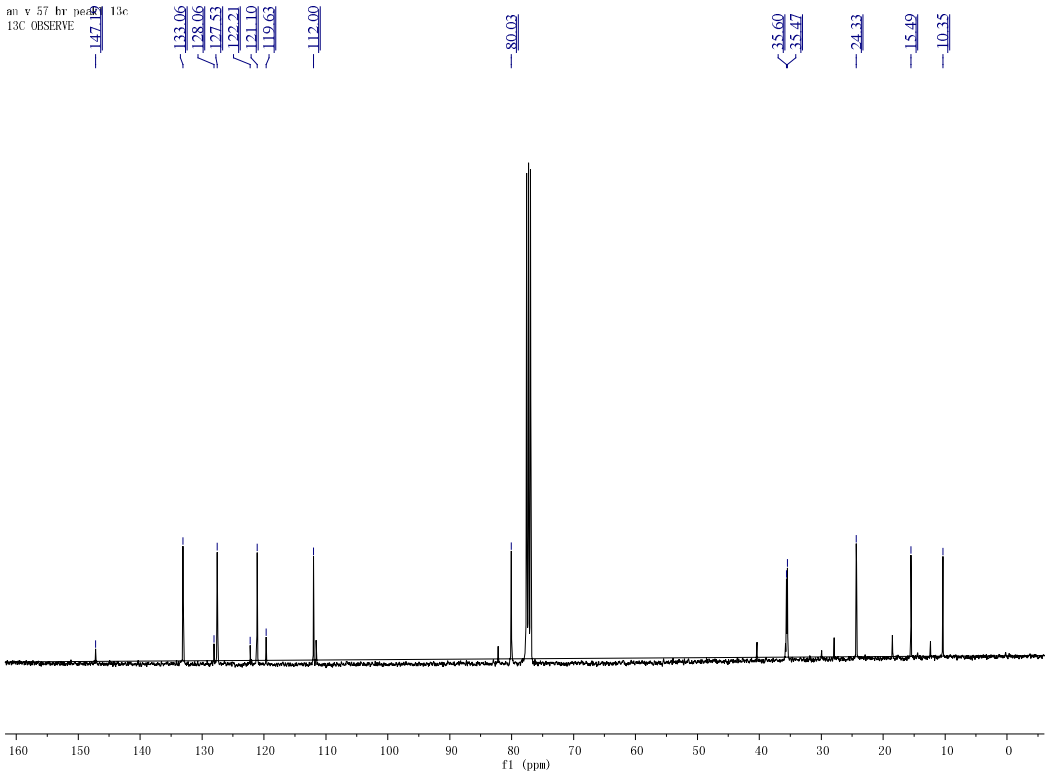

1.11
1.13
0.95
1.76
0.83
1.09
2.27
1.36
3.00
3.59
f1 (ppm)

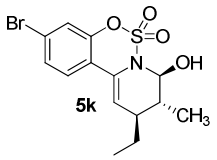

164.29
161.69
148.71
148.59
128.25
126.27
126.17
114.33
114.12
110.29
107.31
107.05
80.05
35.76
35.35
24.42
15.52
10.34
f1 (ppm)

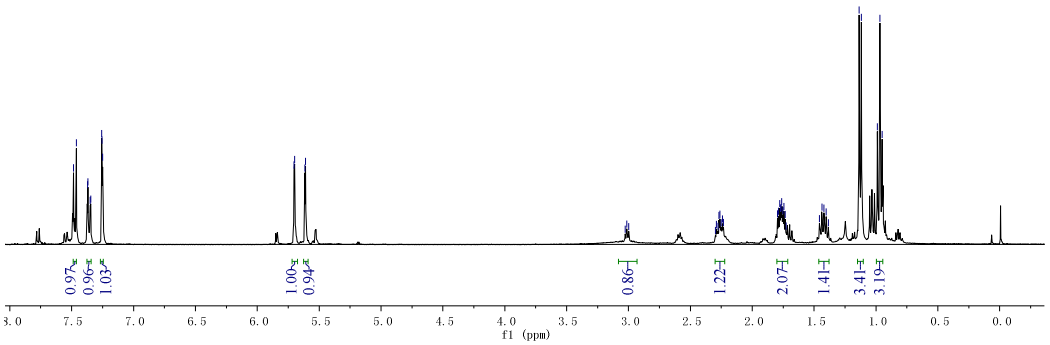

O
O
S
O
N
OH
Br
CH3

5j

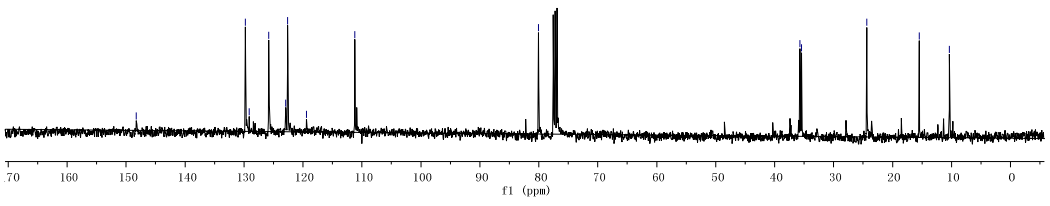

an-v-57-peak1-br
STANDARD 1H OBSERVE
f1 (ppm)

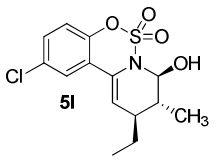

an v 57 br peak1 13c
13C OBSERVE
f1 (ppm)

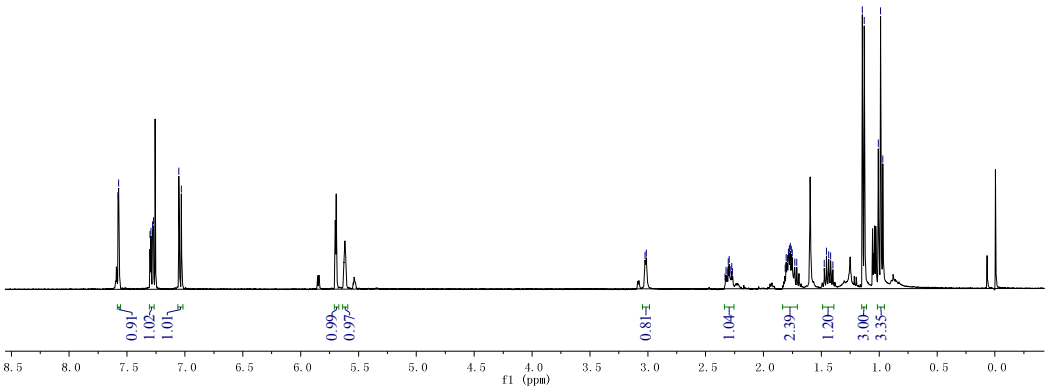

Br
O
O
S
O
N
OH
5k
CH3

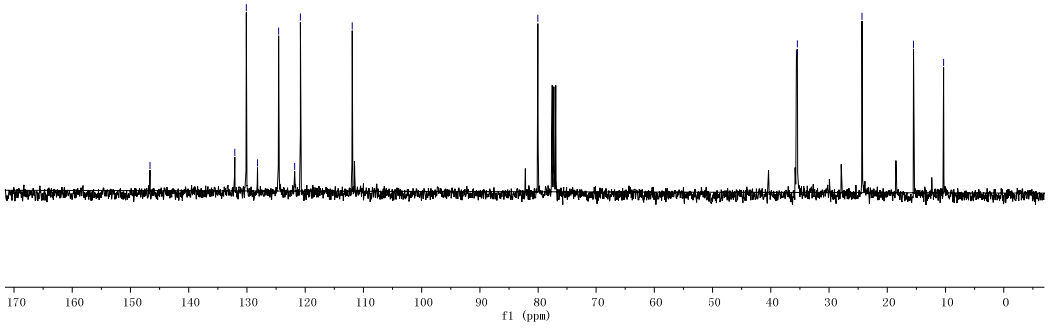

0.97
0.96
1.03
1.00
0.94
0.86
1.22
2.07
1.41
3.41
3.19
f1 (ppm)

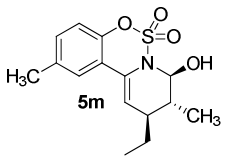

an-v-105-3-13c
13C OBSERVE

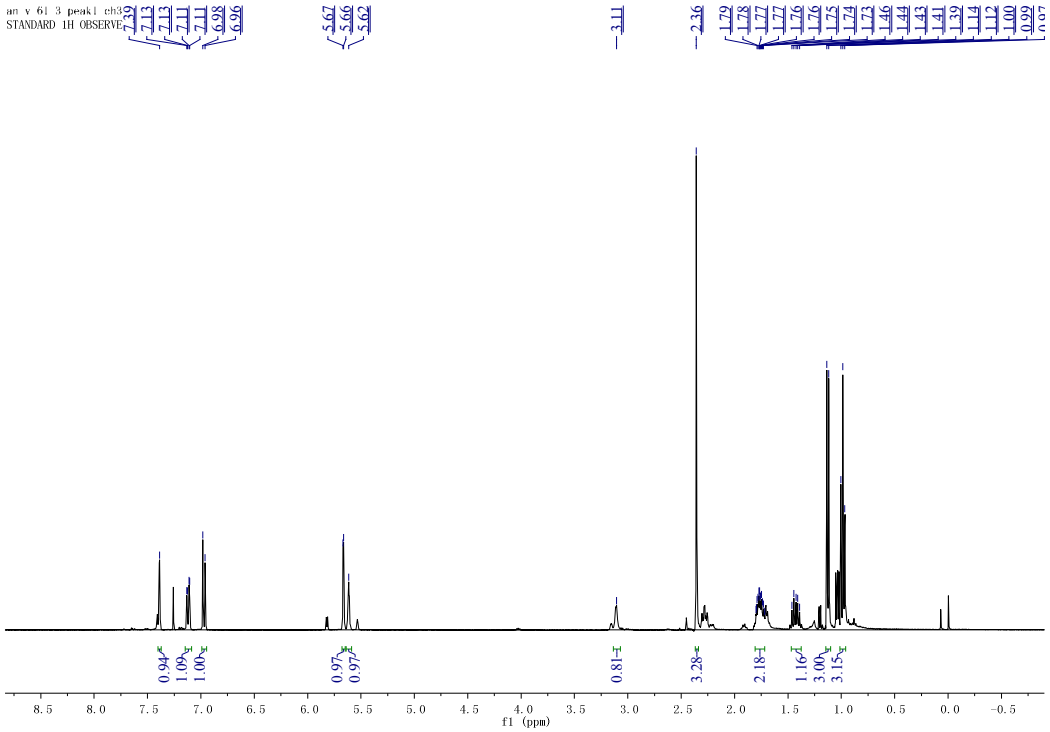

f1 (ppm)

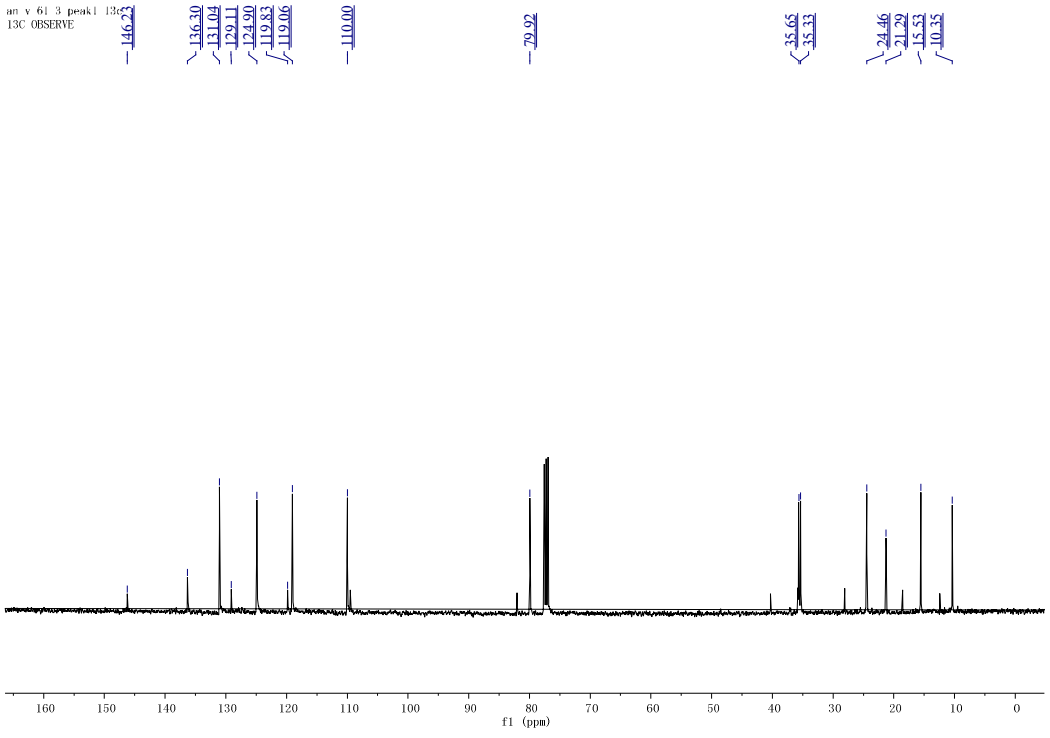

O
O
S
O
N
OH
Cl
5l
CH3

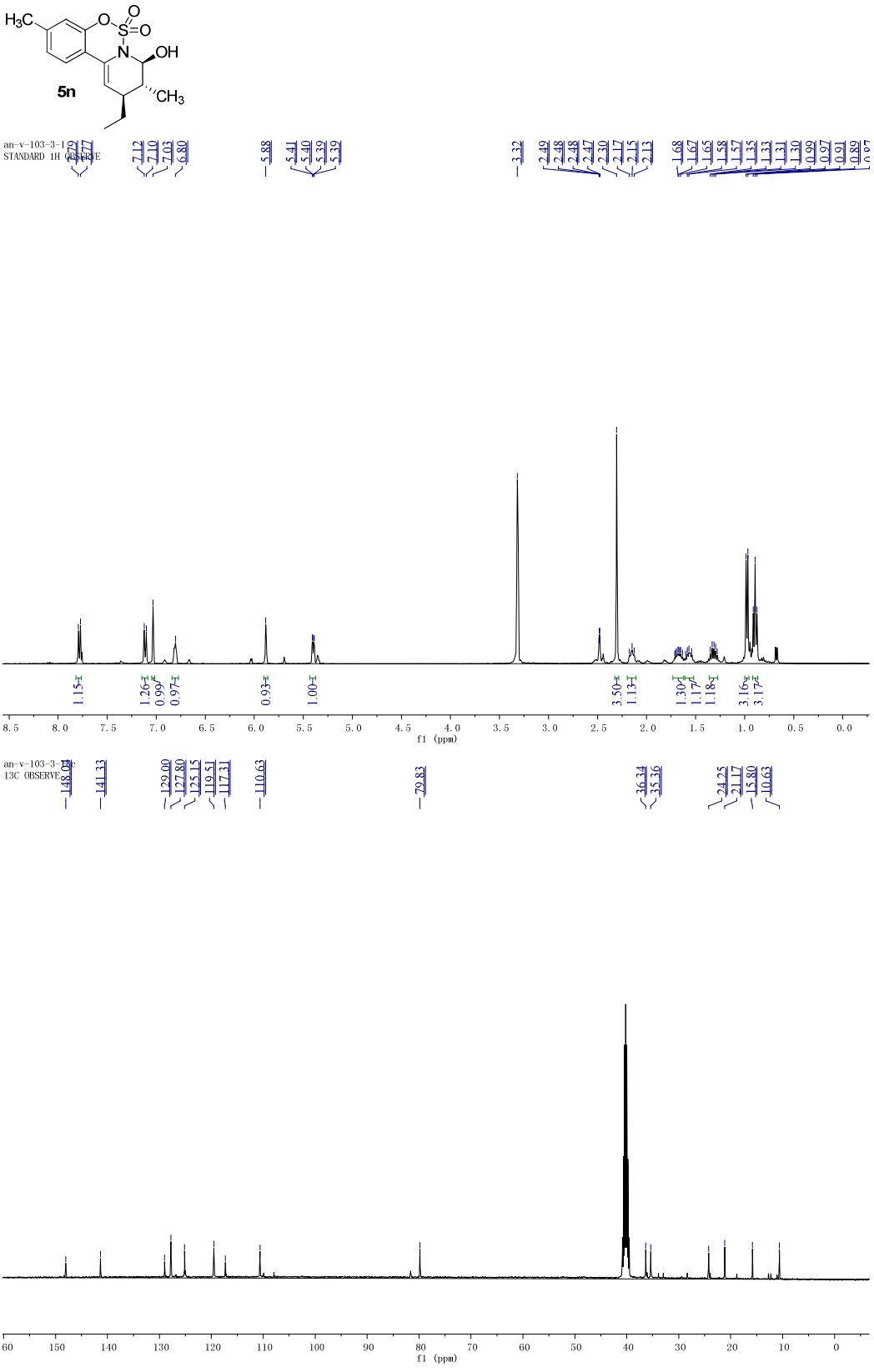

0.91
1.02
1.01
0.99
0.97
0.81
1.04
2.39
1.20
3.00
3.35
f1 (ppm)

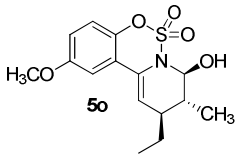

f1 (ppm)


O
O
S
O
N
OH
H3C
5m
CH3


an v 61 3 peak1 ch3
STANDARD 1H OBSERVE
7.39
7.13
7.13
7.11
7.11
6.98
6.96
5.67
5.66
5.62
3.11
2.36
1.79
1.78
1.77
1.77
1.76
1.76
1.75
1.74
1.73
1.46
1.44
1.43
1.41
1.39
1.14
1.12
1.00
0.99
0.94
1.09
1.00
0.97
0.97
0.81
3.28
2.18
1.16
3.00
3.15
f1 (ppm)

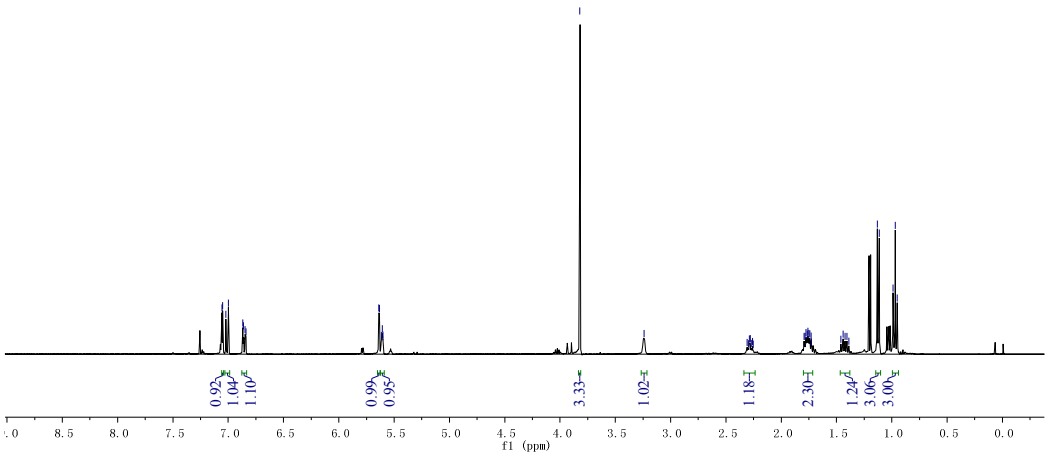

an v 61 3 peak1 13c
13C OBSERVE
146.23
136.30
131.04
129.11
124.90
119.83
119.06
110.00
79.92
35.65
35.33
24.46
21.29
15.53
10.35
f1 (ppm)


5n
an-v-103-3-1
STANDARD 1H OBSERVE
an-v-103-3-2
13C OBSERVE
f1 (ppm)
f1 (ppm)

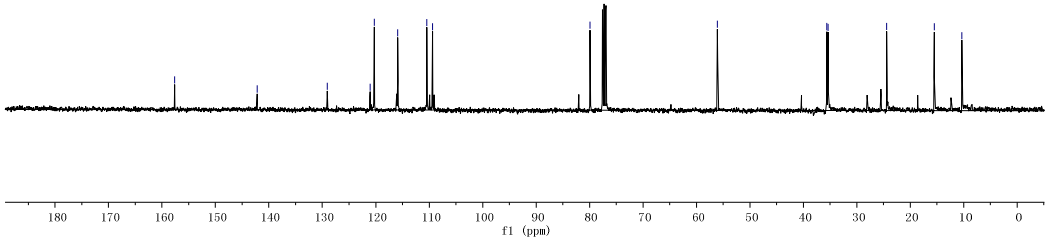

O
O
S
O
N
OH
H3CO
CH3

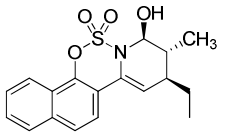
5o


an v 63 och3 peak1 h
STANDARD 1H OBSERVE
7.06
7.05
7.02
7.00
6.87
6.86
6.85
6.84
5.64
5.63
5.62
5.61
5.60
3.82
3.24
2.31
2.30
2.29
2.28
2.27
2.26
2.25
1.79
1.77
1.77
1.76
1.75
1.74
1.73
1.44
1.41
1.13
1.11
0.99
0.97

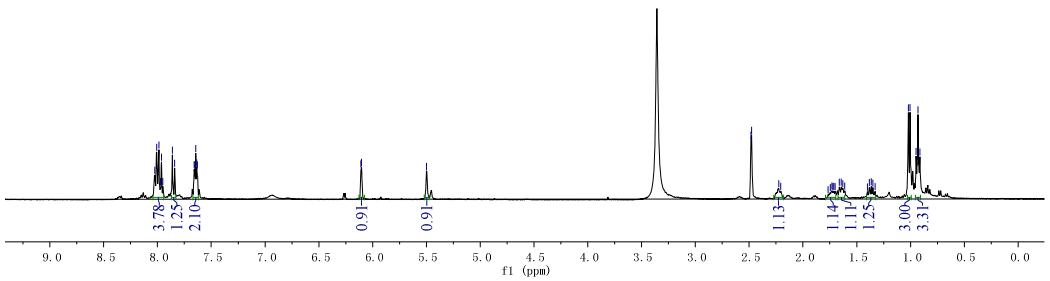

0.92
1.04
1.10
0.99
0.95
3.33
1.02
1.18
2.30
1.24
3.06
3.00
f1 (ppm)

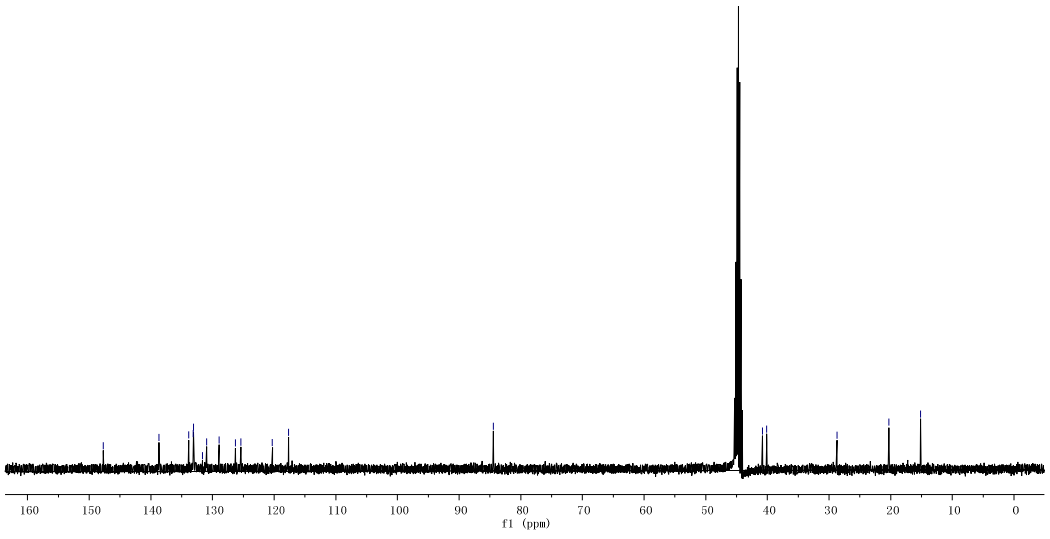

an v 63 3 peak1 och3 13c
13C OBSERVE
157.63
142.21
129.10
121.07
120.25
115.87
110.44
109.40
79.93
56.07
35.63
35.38
24.41
15.53
10.34

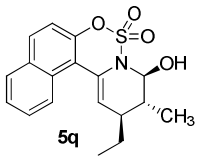

f1 (ppm)



5p

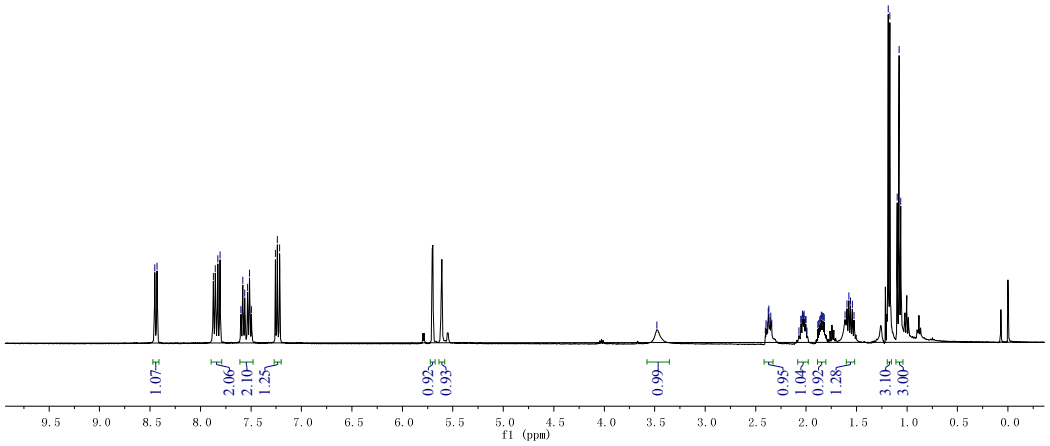




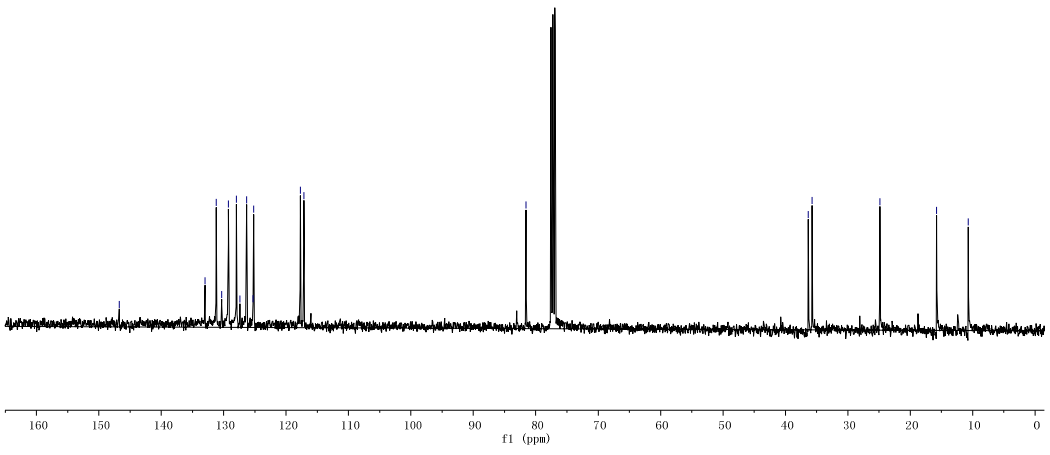

O
O
S
O
N
OH
CH3

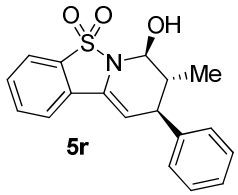
5q


an-v-65-peak1-nai
STANDARD 1H OBSERVE
8.45
8.43
7.87
7.85
7.83
7.81
7.60
7.58
7.56
7.53
7.51
7.50
7.26
7.24
7.22
3.48
2.38
2.37
2.35
2.04
2.03
2.02
1.85
1.84
1.83
1.82
1.61
1.60
1.58
1.56
1.54
1.52
1.19
1.17
1.10
1.08

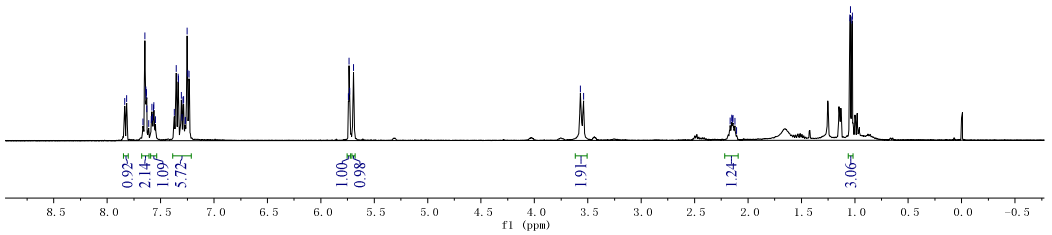

1.07
2.06
2.10
1.25
0.92
0.93
0.99
0.95
1.04
0.92
1.28
3.10
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

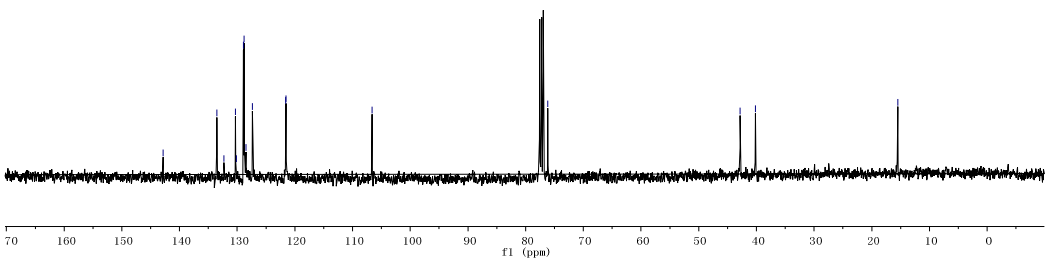

an-v-65-peak1-13c
13C OBSERVE
146.75
133.01
131.19
130.33
129.24
127.96
126.35
125.30
125.18
117.78
117.15
81.55
36.32
35.71
24.87
15.75
10.71

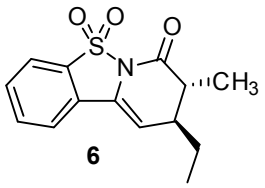

160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



5r







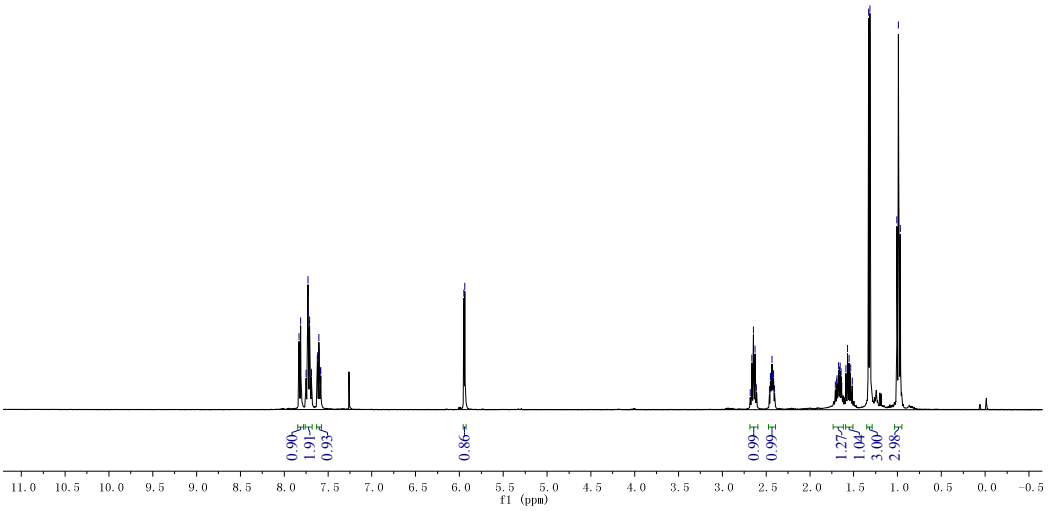
6

an-v-92-2-h-0309
STANDARD 1H OBSERVE

7.83 7.81 7.75 7.73 7.73 7.71 7.71 7.69 7.69 7.62 7.62 7.60 7.60 7.59 7.58 5.95 5.94

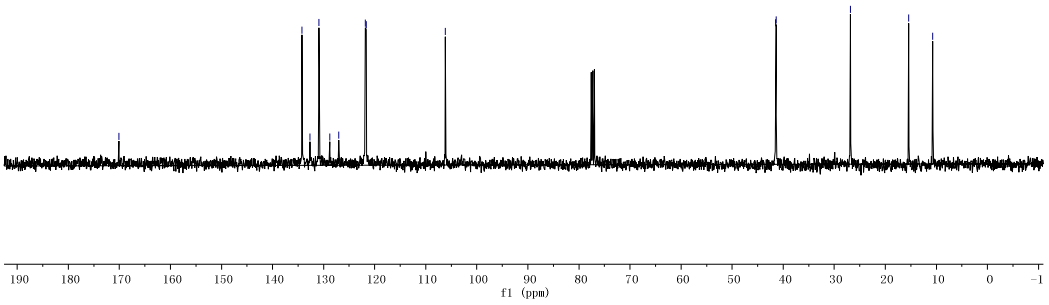
2.68 2.66 2.65 2.63 2.61 2.46 2.45 2.44 2.44 2.43 2.43 2.42 2.42 2.40

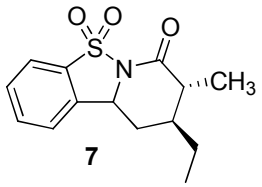
1.67 1.66 1.66 1.64 1.59 1.57 1.55 1.54 1.33 1.31 1.01 0.99



an-v-97-2-13c-0309
13C OBSERVE

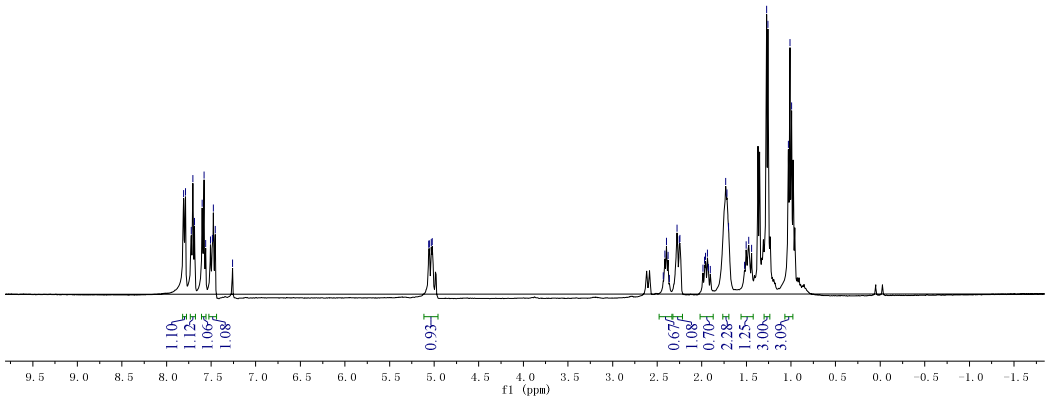
170.07
134.22
132.65
130.92
128.80
127.02
121.85
121.67
106.17
41.47
41.40
26.84
15.44
10.74

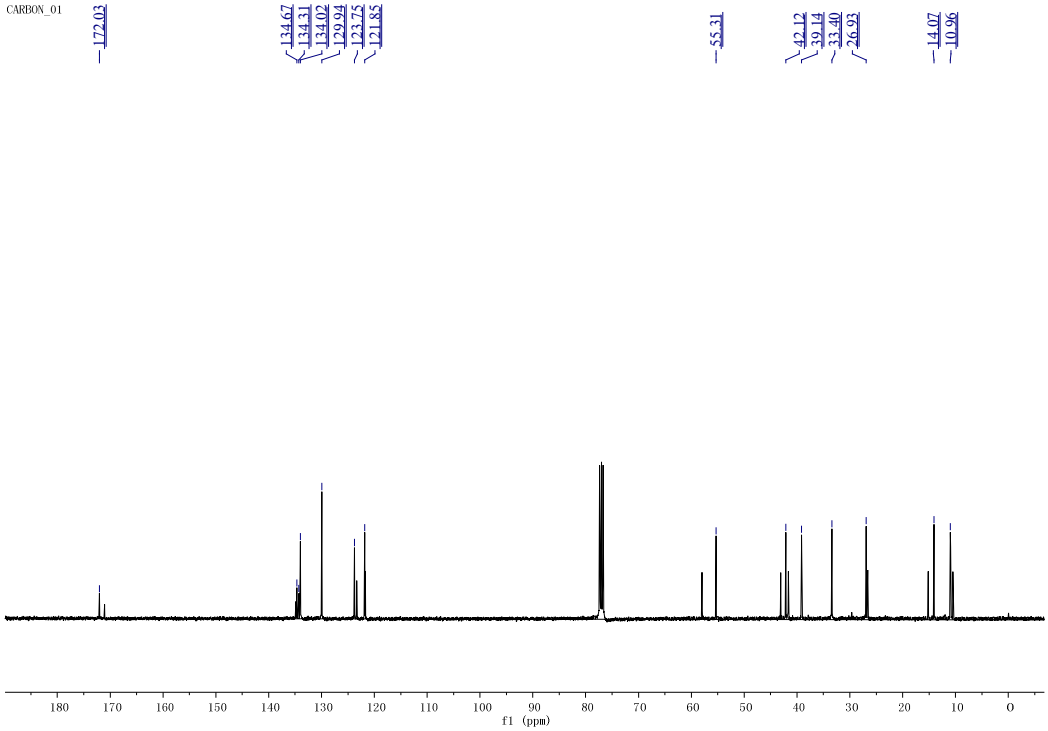


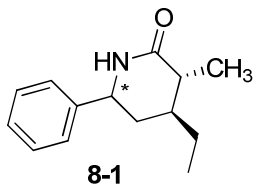

O
O
S
N
O
CH3

7


7.81
7.79
7.72
7.70
7.69
7.60
7.58
7.56
7.51
7.49
7.47
7.45
7.26
5.06
5.05
5.03
5.02
2.43
2.41
2.40
2.38
2.36
2.28
2.25
2.24
1.99
1.97
1.96
1.94
1.92
1.90
1.73
1.72
1.70
1.52
1.50
1.47
1.44
1.27
1.26
1.03
1.01
0.99

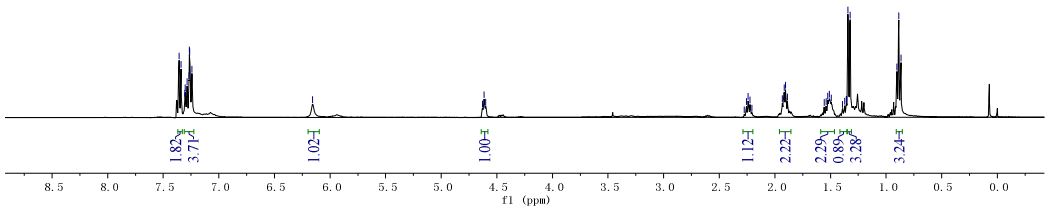

1.10
1.12
1.06
1.08
0.93
0.67
1.08
0.70
2.28
1.25
3.00
3.09
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5
f1 (ppm)


CARBON_01
172.03
134.67
134.31
134.02
129.94
123.75
121.85
55.31
42.12
39.14
33.40
26.93
14.07
10.96
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

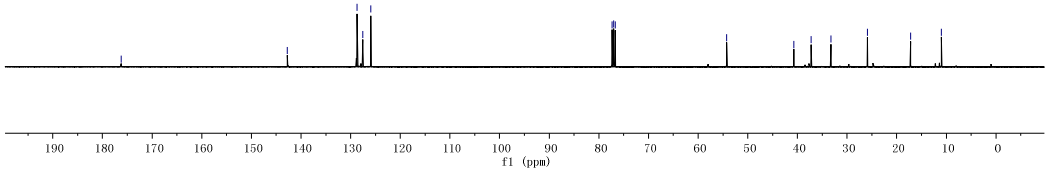

O
HN
*
CH3

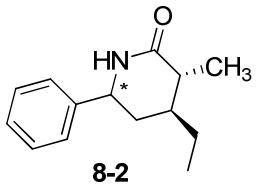
8-1


PROTON_01
7.36
7.34
7.31
7.30
7.29
7.27
7.26
7.26
7.24
6.16
4.63
4.61
4.60
2.27
2.26
2.24
2.22
2.21
1.93
1.92
1.90
1.89
1.51
1.34
1.33
0.88
0.87


1.82
3.71
1.02
1.00
1.12
2.22
2.29
0.89
3.28
3.24
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

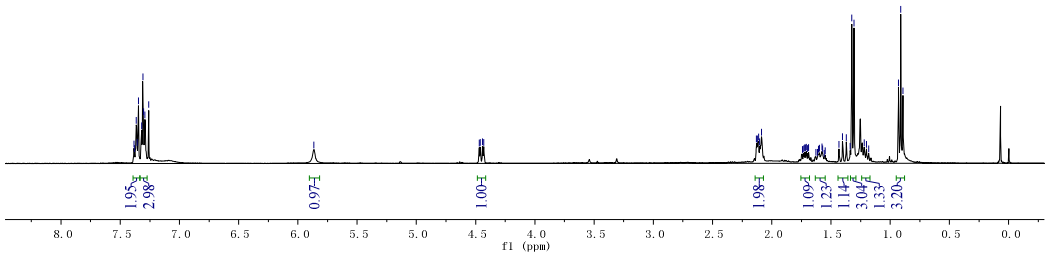

CARBON_01
176.25
142.75
128.69
127.58
125.94
77.33
77.02
76.70
54.24
40.71
37.25
33.23
25.90
17.18
10.99


190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

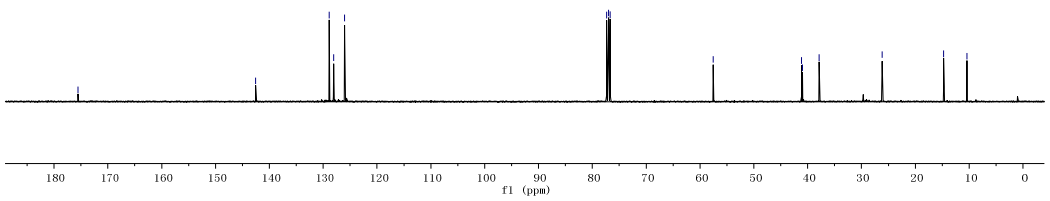

O
HN
*
CH3

8-2

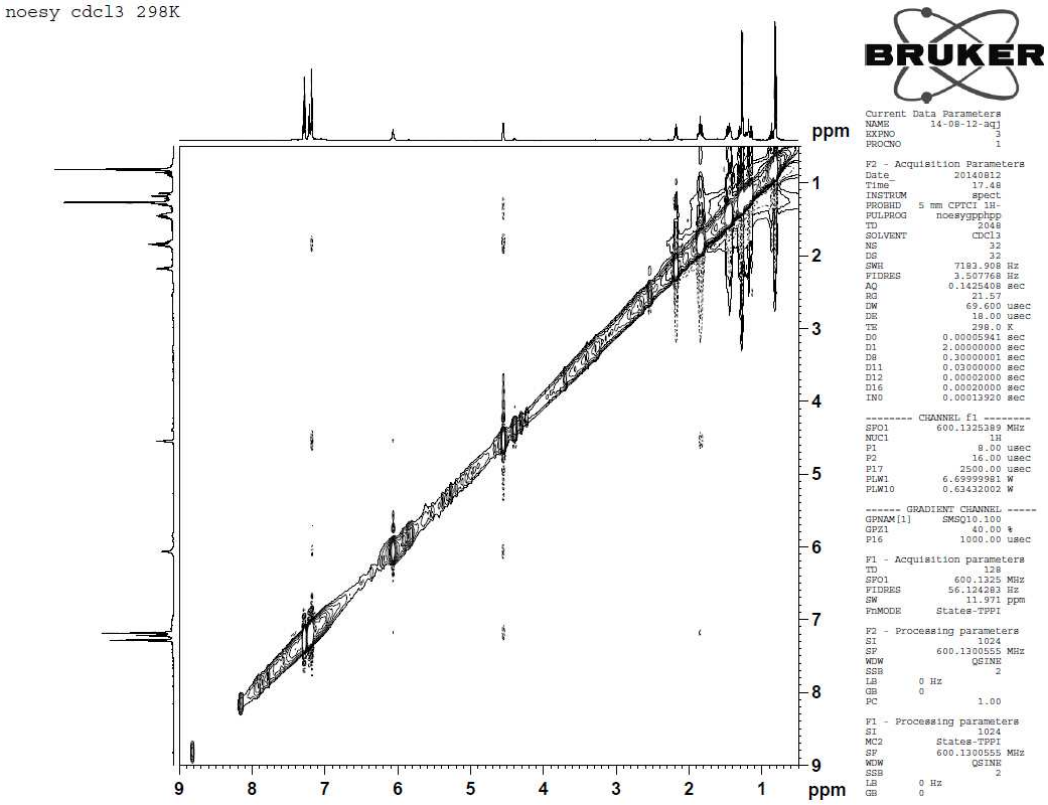

PROTON_01
7.38
7.38
7.36
7.36
7.35
7.32
7.31
7.30
7.29
7.26
5.87
4.47
4.46
4.44
4.43
2.13
2.12
2.11
2.10
2.09
1.71
1.69
1.58
1.43
1.40
1.37
1.34
1.32
1.31
1.22
1.20
0.93
0.91


1.95
2.98
0.97
1.00
1.98
1.09
1.23
1.14
3.04
1.33
3.20
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

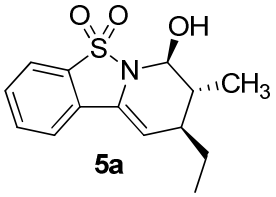

CARBON_01
175.53
142.53
128.88
128.07
126.02
77.32
77.00
76.68
57.53
41.16
40.99
37.87
26.16
14.73
10.42


180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

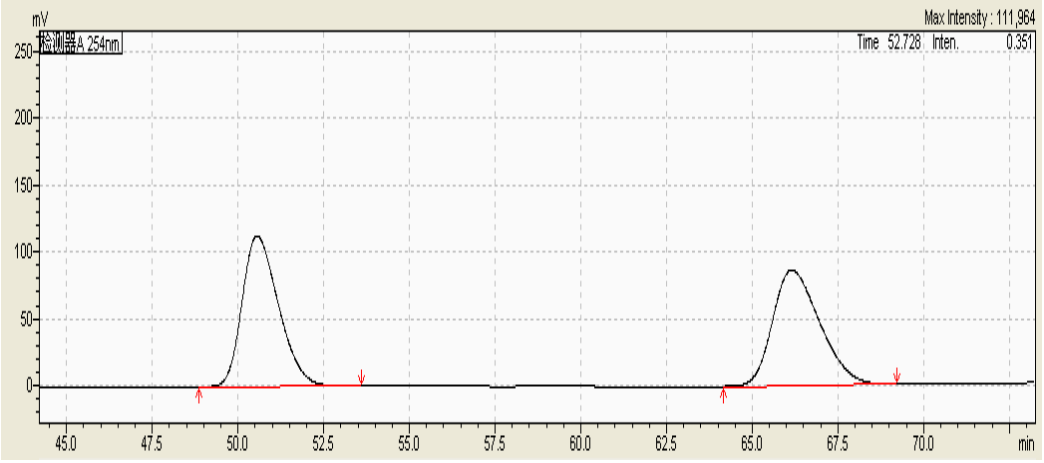
NOESY of **8-1**


noesy cdcl3 298K
ppm
1
2
3
4
5
6
7
8
9
ppm
9
8
7
6
5
4
3
2
1
BRUKER
Current Data Parameters
NAME 14-08-12-aqj
EXPNO 3
PROCNO 1
F2 - Acquisition Parameters
Date_ 20140812
Time 17.48
INSTRUM spect
PROBHD 5 mm CPTCI 1H-
PULPROG noesygpphpp
TD 2048
SOLVENT CDCl3
NS 32
DS 32
SWH 7183.908 Hz
FIDRES 3.507768 Hz
AQ 0.1425408 sec
RG 21.57
DW 69.600 usec
DE 18.00 usec
TE 298.0 K
D0 0.00005941 sec
D1 2.00000000 sec
D8 0.30000001 sec
D11 0.03000000 sec
D12 0.00002000 sec
D16 0.00020000 sec
IN0 0.00013920 sec
-------- CHANNEL f1 --------
SFO1 600.1325389 MHz
NUC1 1H
P1 8.00 usec
P2 16.00 usec
P17 2500.00 usec
PLW1 6.69999981 W
PLW10 0.63432002 W
------ GRADIENT CHANNEL -----
GPNAM[1] SMSQ10.100
GPZ1 40.00 %
P16 1000.00 usec
F1 - Acquisition parameters
TD 128
SFO1 600.1325 MHz
FIDRES 56.124283 Hz
SW 11.971 ppm
FnMODE States-TPPI
F2 - Processing parameters
SI 1024
SF 600.1300555 MHz
WDW QSINE
SSB 2
LB 0 Hz
GB 0
PC 1.00
F1 - Processing parameters
SI 1024
MC2 States-TPPI
SF 600.1300555 MHz
WDW QSINE
SSB 2
LB 0 Hz
GB 0

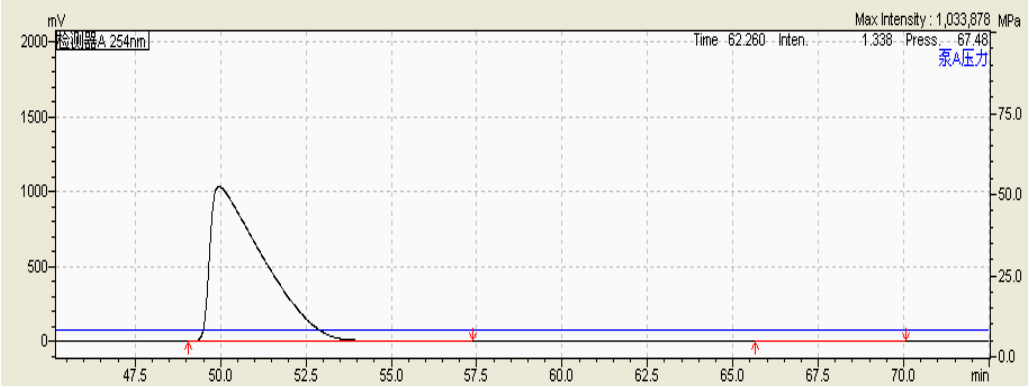
9. HPLC Spectra



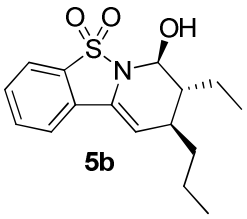
5a



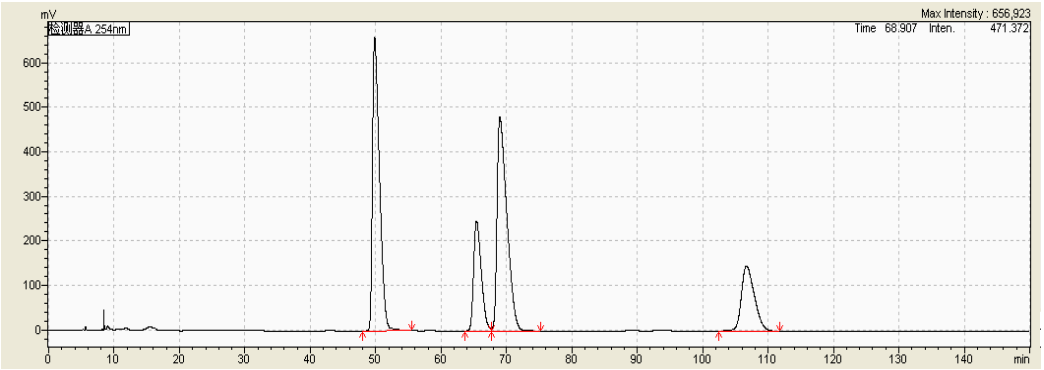
Peak	Retention time	Area (%)
1	50.559	50.215
2	66.160	49.785



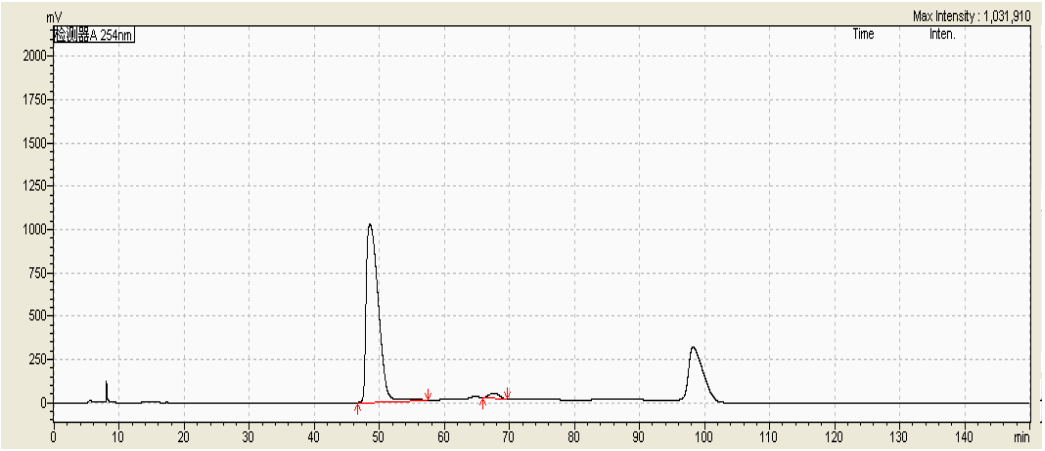
Peak	Retention time	Area (%)
1	49.952	99.625
2	67.817	0.375



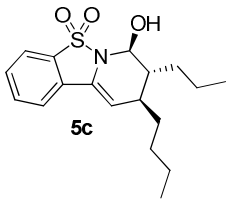
5b



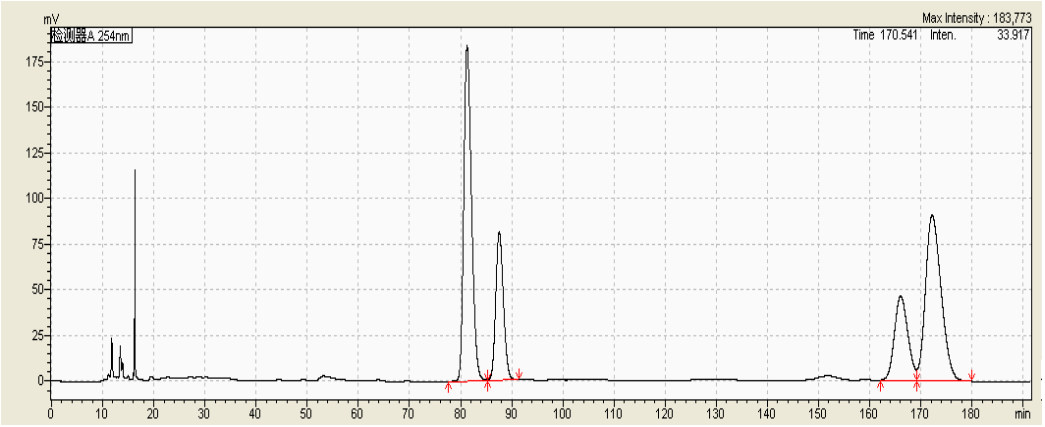
Peak	Retention time	Area (%)
1	49.846	35.417
2	65.423	14.470
3	68.997	35.735
4	106.704	14.379



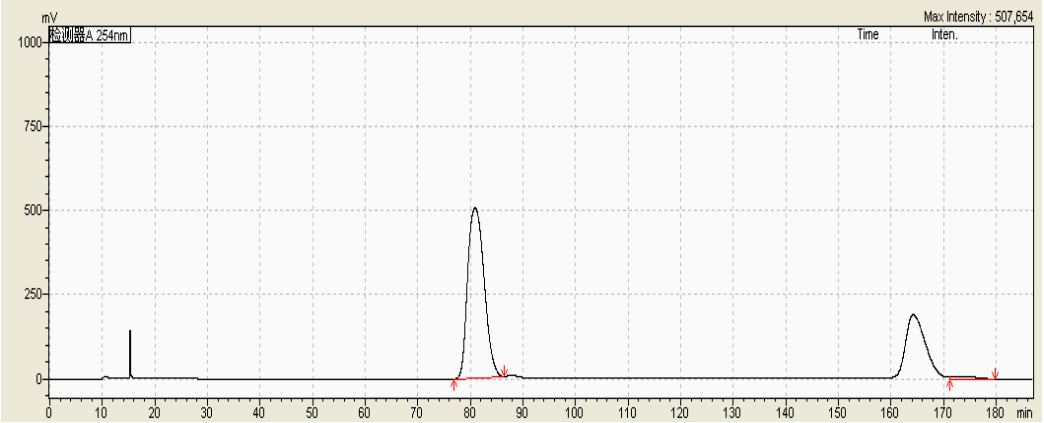
Peak	Retention time	Area (%)
1	48.532	96.855
2	67.560	3.145



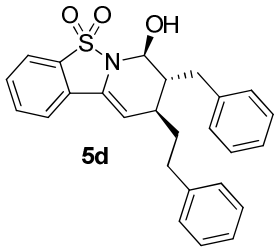
5c



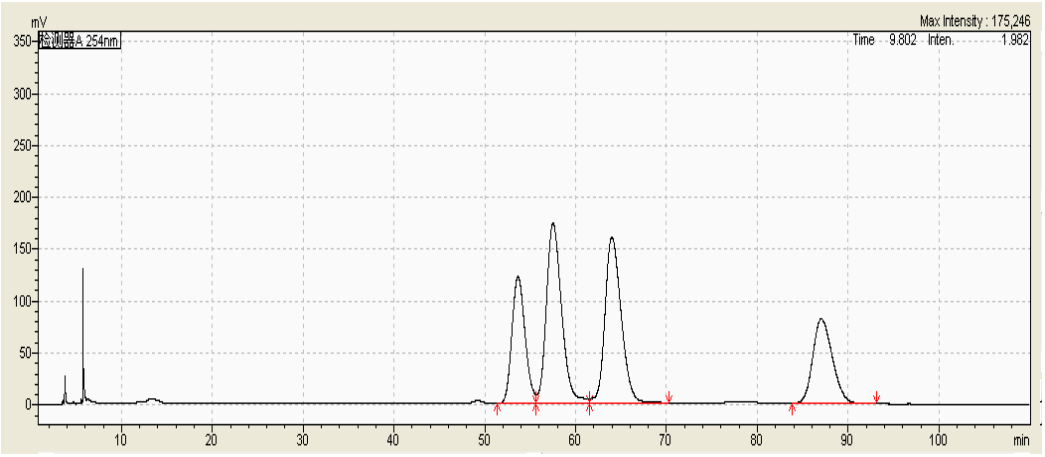
Peak	Retention time	Area (%)
1	81.252	34.891
2	87.546	15.237
3	166.054	15.124
4	172.199	34.747



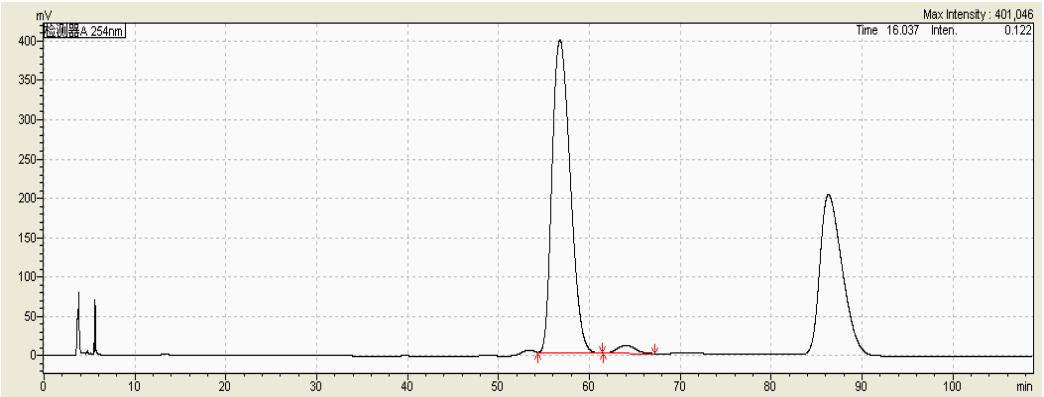
Peak	Retention time	Area (%)
1	80.890	98.020
2	173.707	1.980



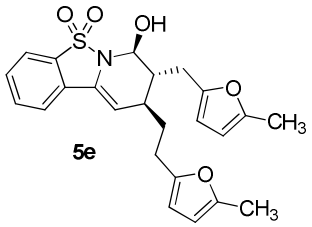
5d



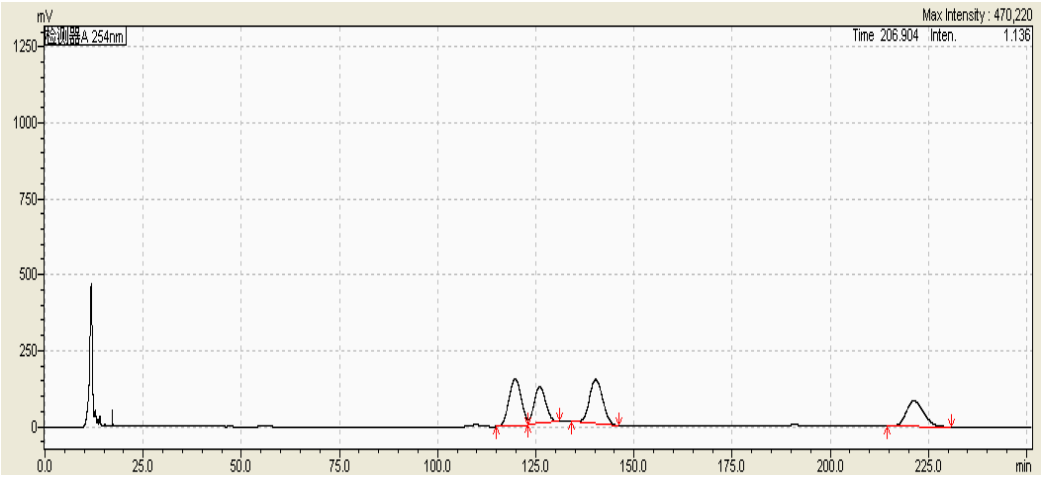
Peak	Retention time	Area (%)
1	53.655	18.727
2	57.510	31.975
3	63.989	31.177
4	87.052	18.121



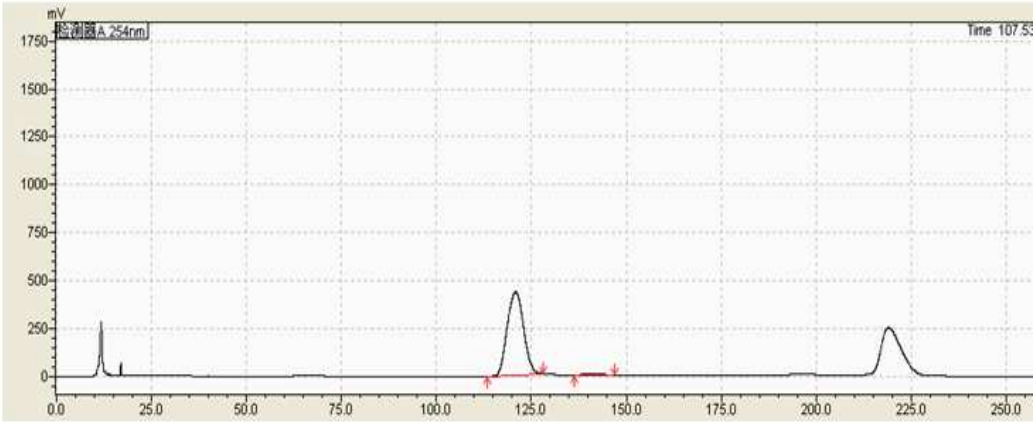
Peak	Retention time	Area (%)
1	56.765	97.555
2	64.045	2.445



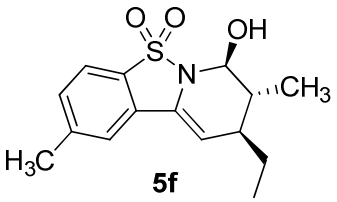
5e



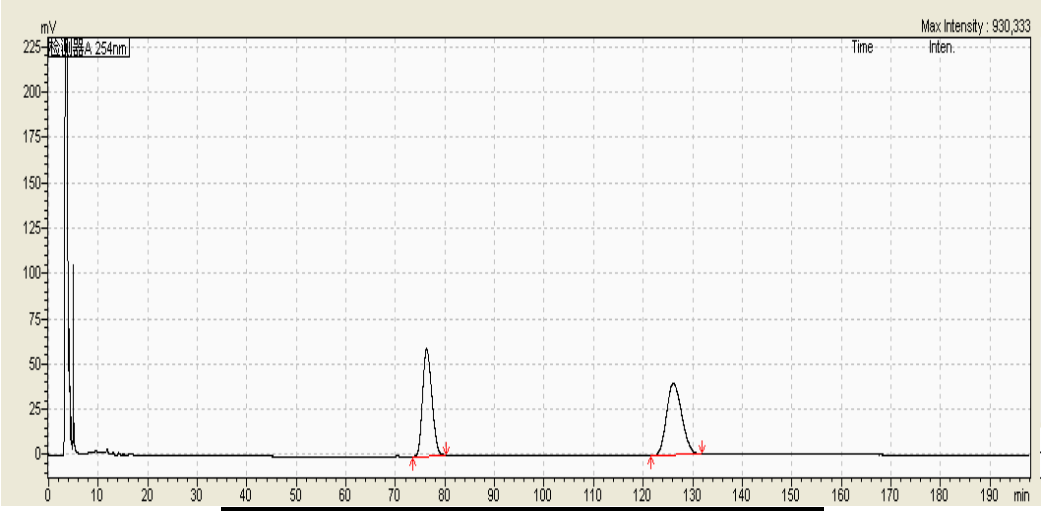
Peak	Retention time	Area (%)
1	119.732	28.517
2	125.981	21.143
3	140.218	28.786
4	221.291	21.554



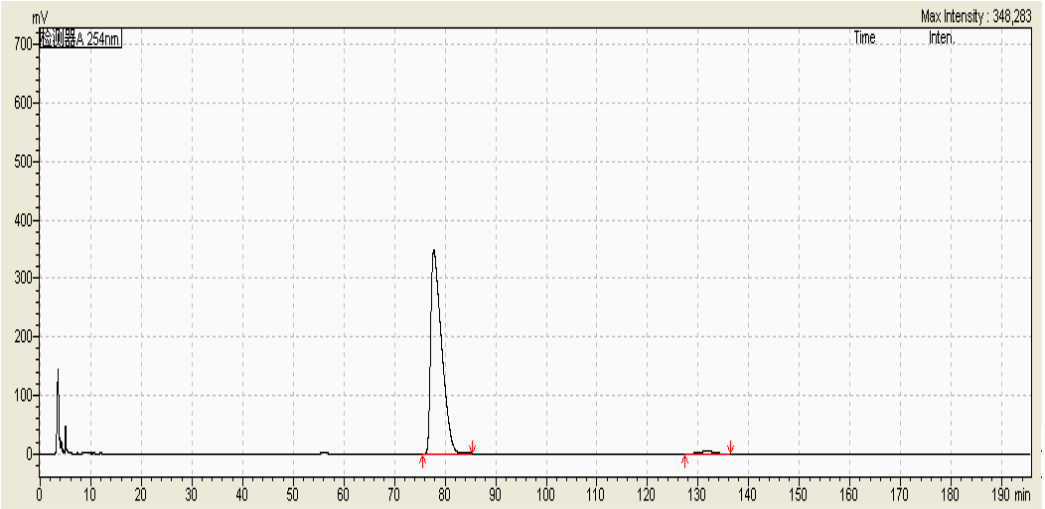
Peak	Retention time	Area (%)
1	120.891	98.335
2	141.790	1.665



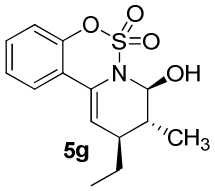
5f

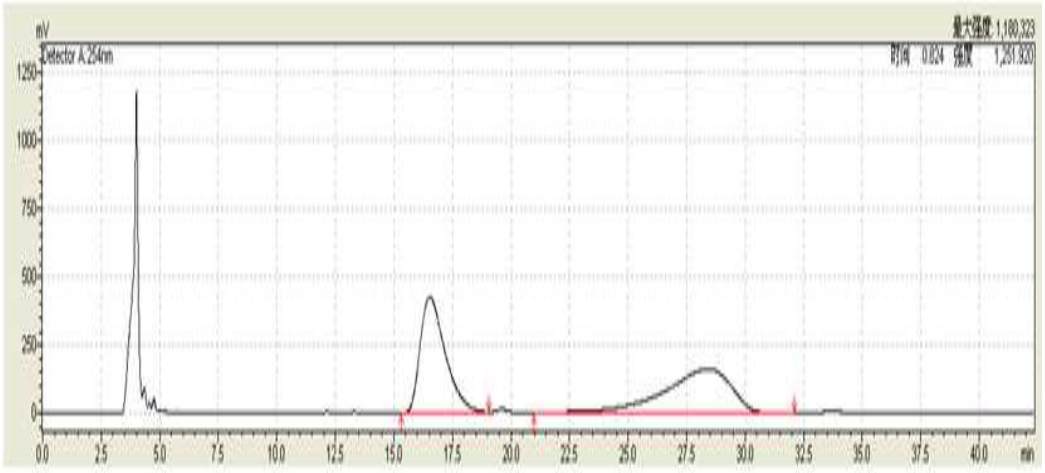


Peak	Retention time	Area (%)
1	76.303	50.428
2	126.088	49.572

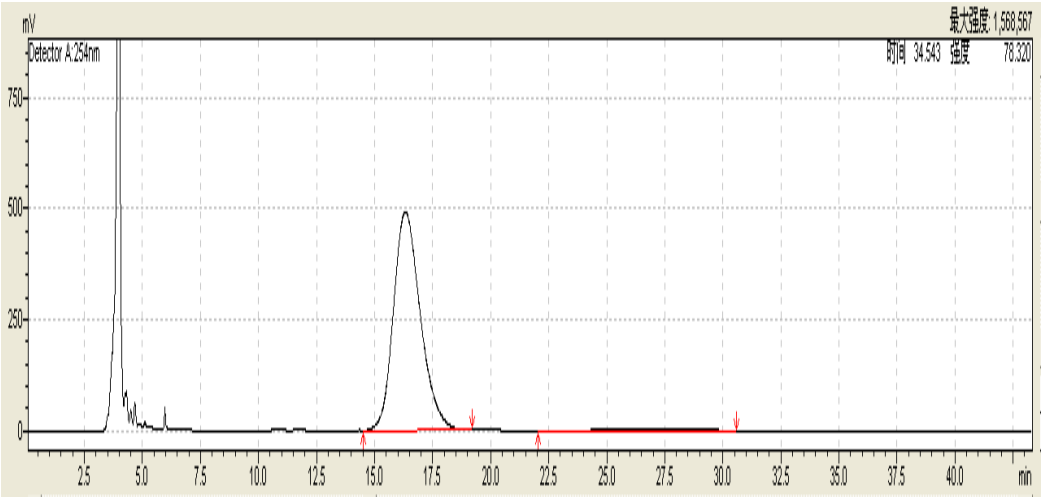


Peak	Retention time	Area (%)
1	77.775	98.087
2	131.782	1.913

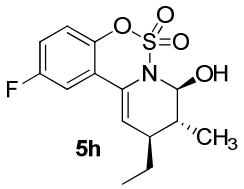




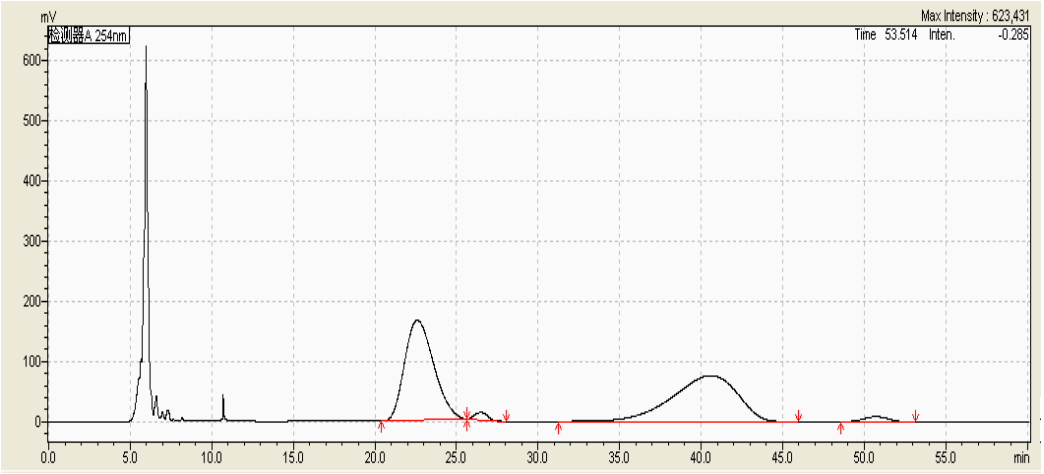
Peak	Retention time	Area (%)
1	16.529	49.951
2	28.365	50.049



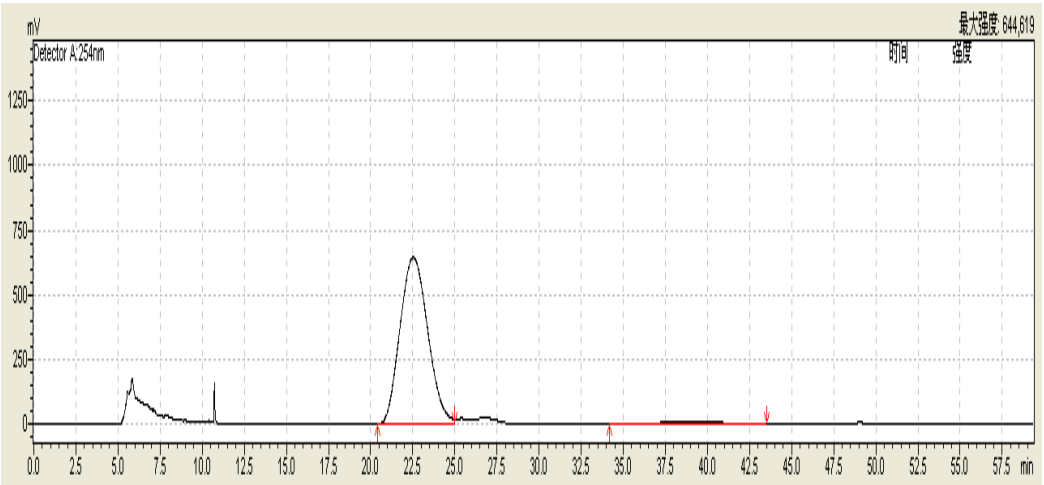
Peak	Retention time	Area (%)
1	16.319	97.537
2	27.845	2.463



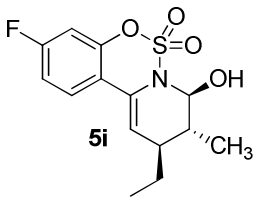
5h



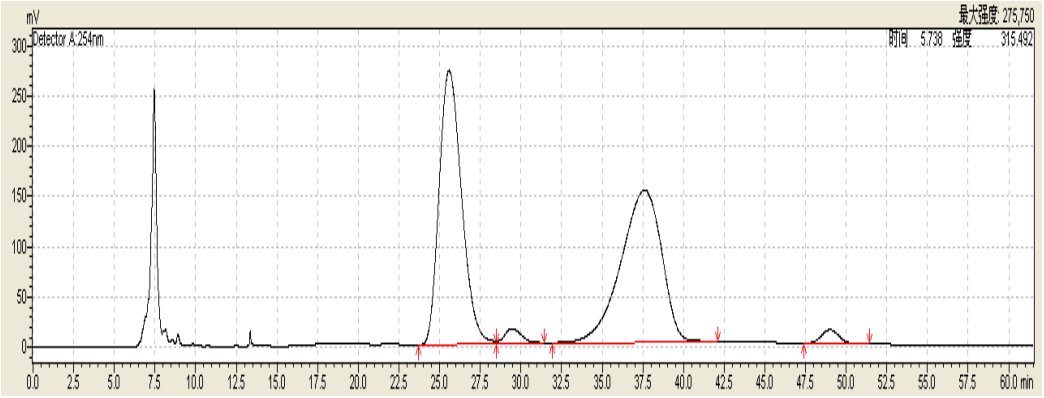
Peak	Retention time	Area (%)
1	22.608	48.038
2	26.515	2.059
3	40.597	47.950
4	50.738	1.953



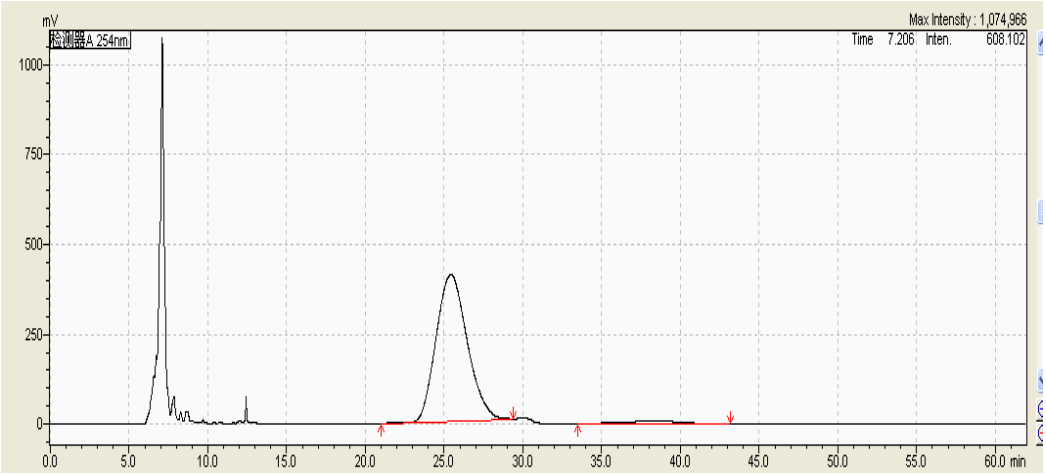
Peak	Retention time	Area (%)
1	22.535	97.406
2	39.280	2.594



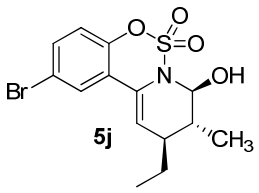
5i



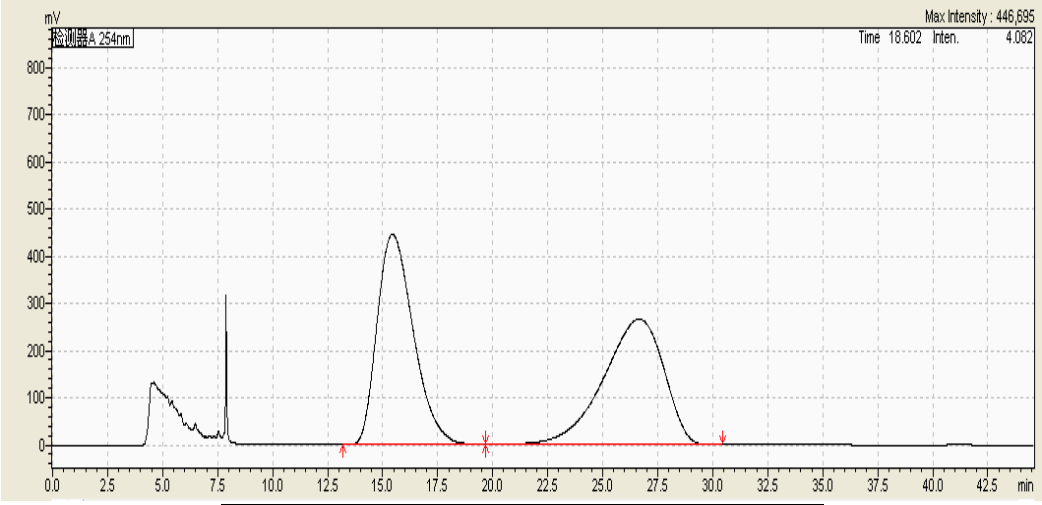
Peak	Retention time	Area (%)
1	25.890	48.259
2	30.247	1.760
3	38.237	48.123
4	50.506	1.857



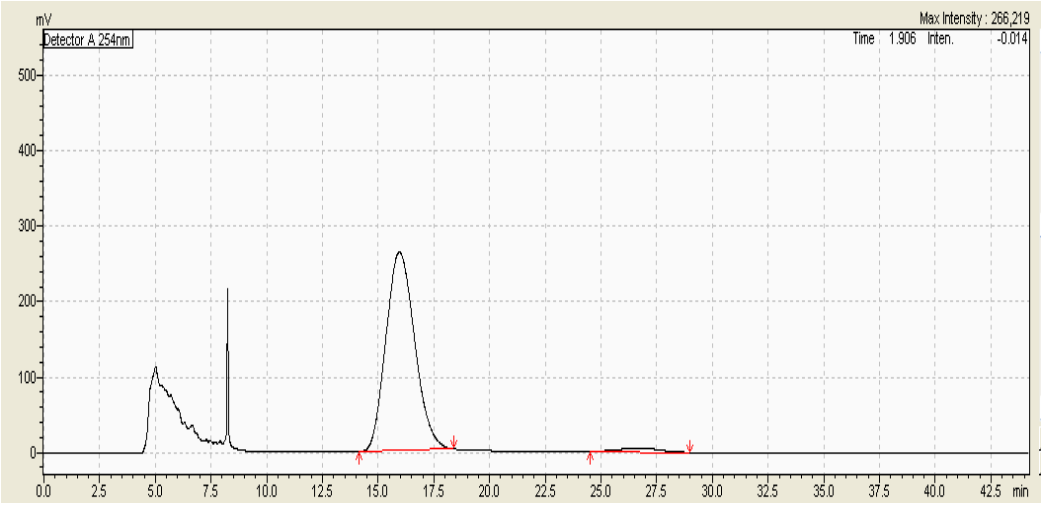
Peak	Retention time	Area (%)
1	25.419	97.182
2	38.361	2.818



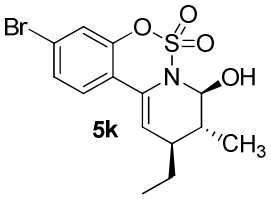
5j

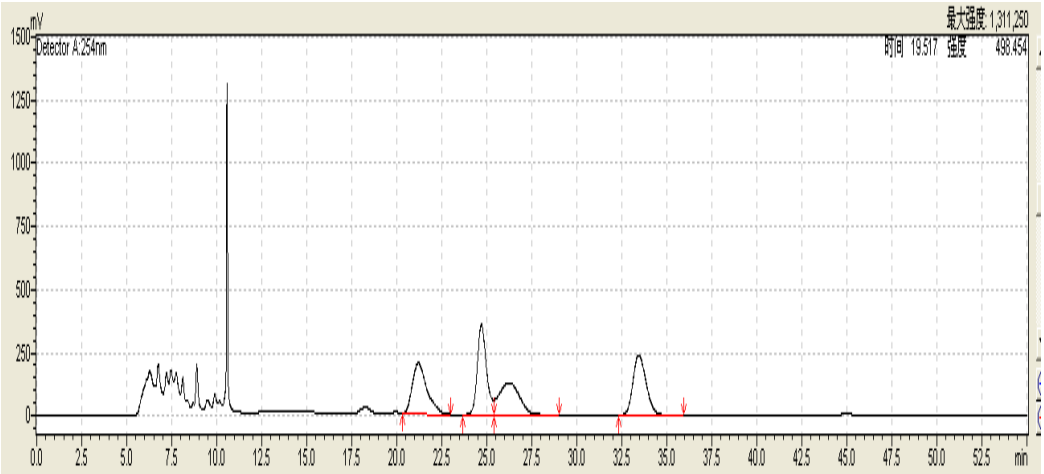


Peak	Retention time	Area (%)
1	15.442	50.062
2	26.656	49.938

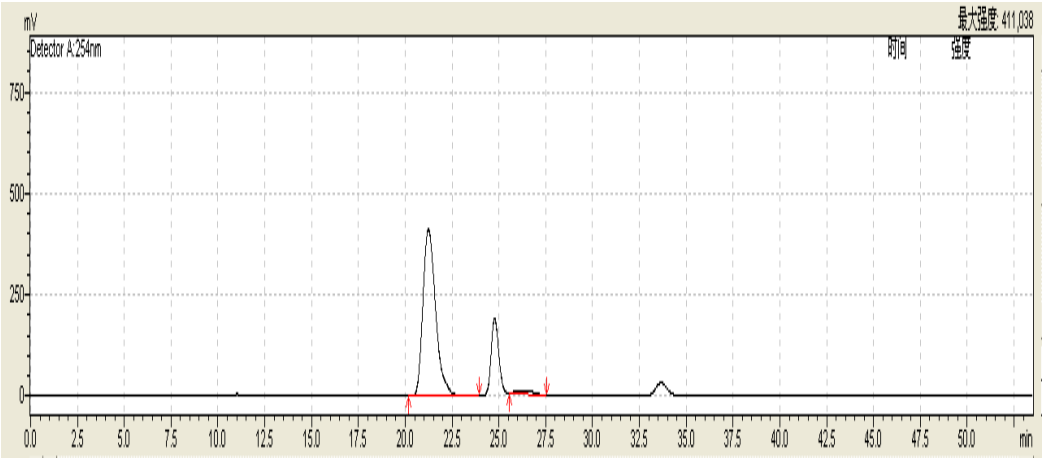


Peak	Retention time	Area (%)
1	15.949	97.593
2	28.786	2.407

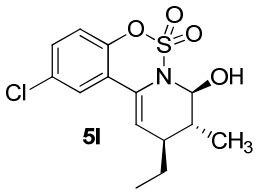




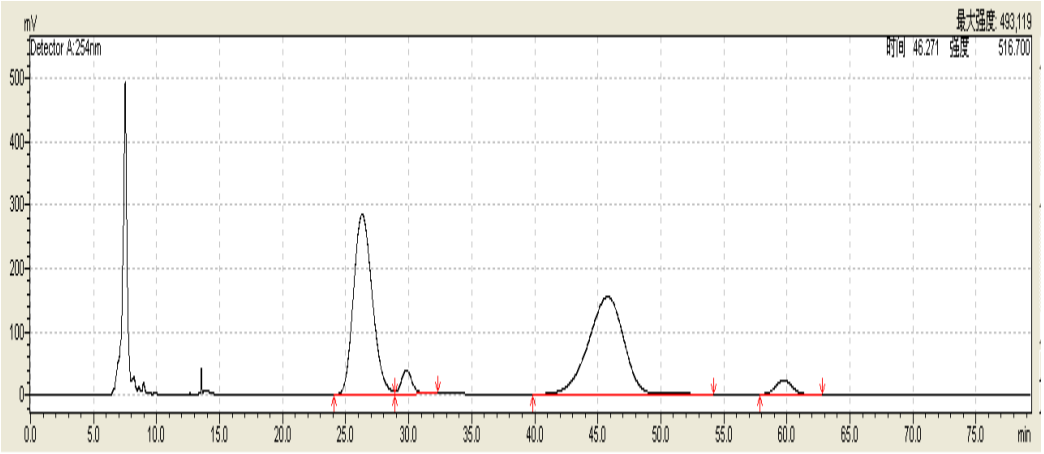
Peak	Retention time	Area (%)
1	21.203	24.261
2	24.703	27.678
3	26.253	22.011
4	33.446	26.050



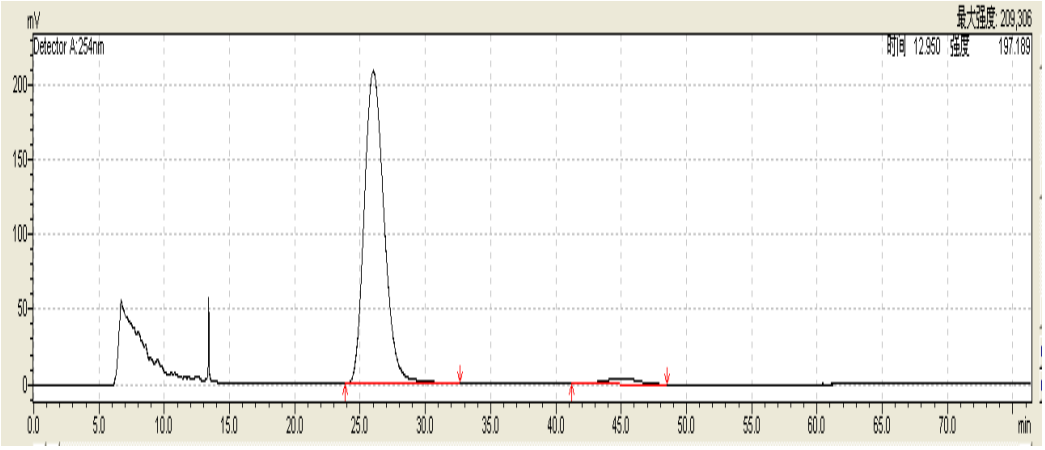
Peak	Retention time	Area (%)
1	21.235	97.213
2	26.324	2.787



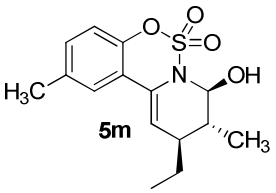
5l

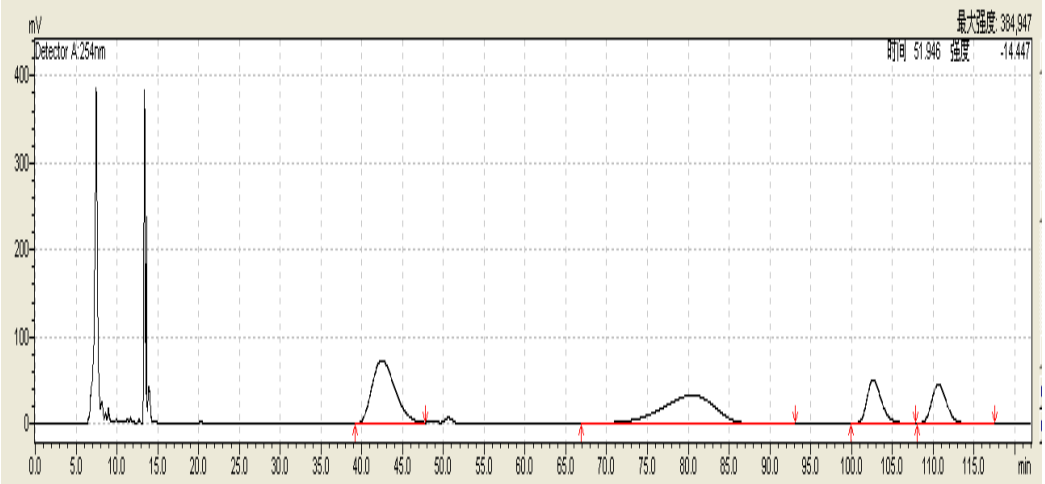


Peak	Retention time	Area (%)
1	26.298	46.508
2	29.811	3.454
3	45.763	46.819
4	59.736	3.220

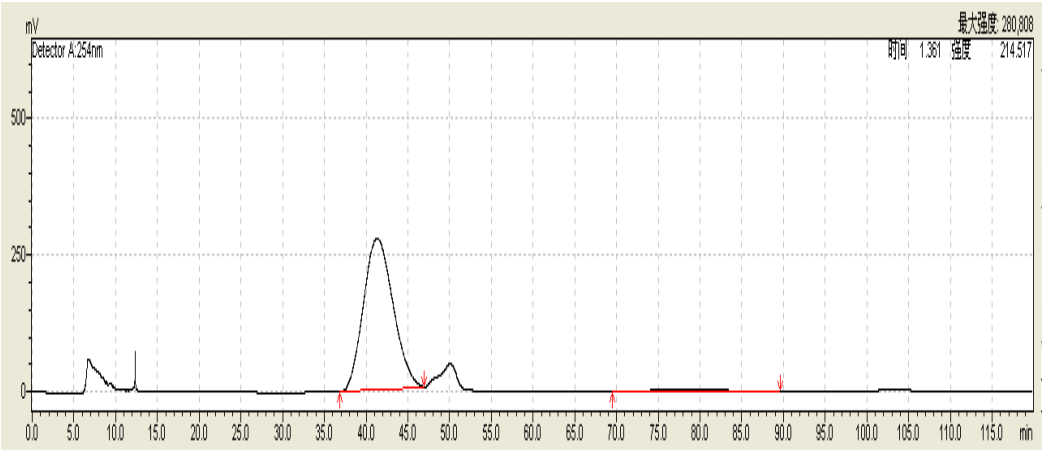


Peak	Retention time	Area (%)
1	26.006	96.891
2	45.008	3.119

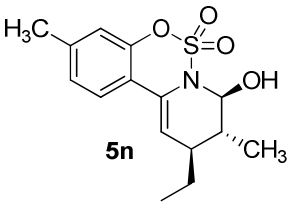




Peak	Retention time	Area (%)
1	42.472	35.049
2	80.439	35.469
3	102.652	14.948
4	110.629	14.534



Peak	Retention time	Area (%)
1	41.316	96.027
2	79.561	3.973



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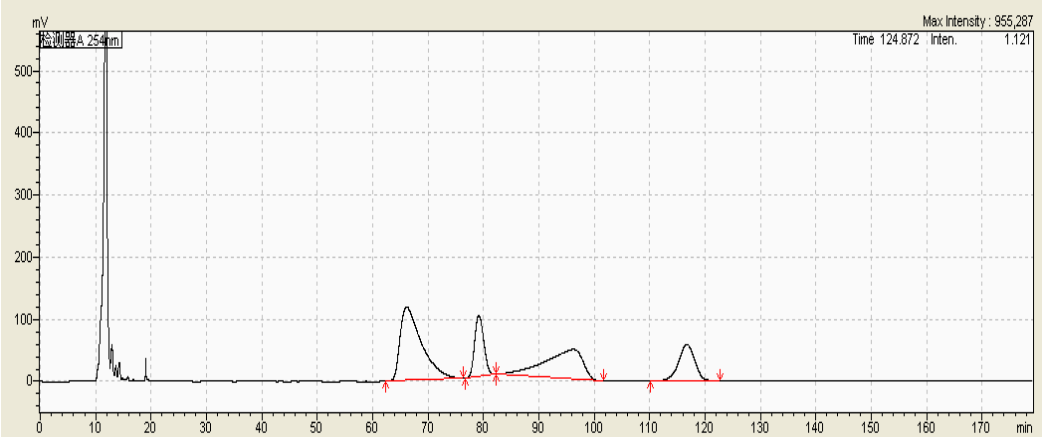
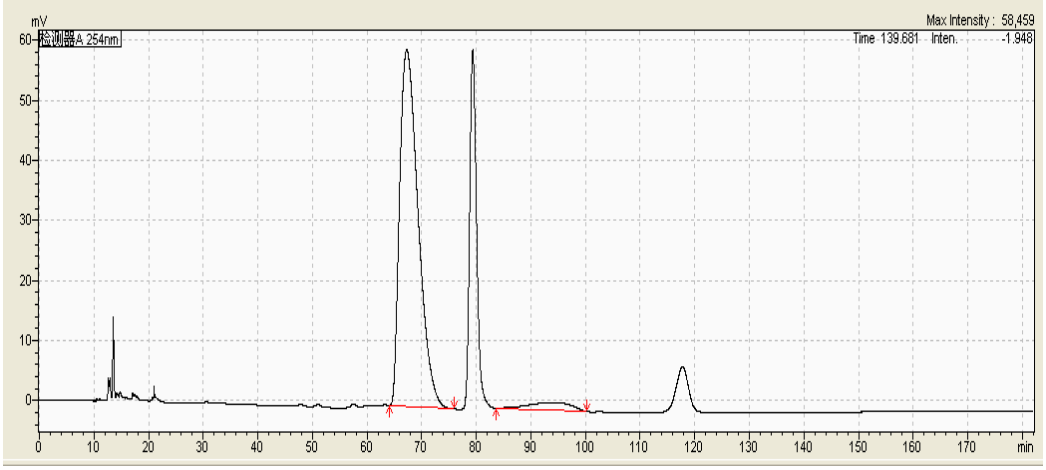
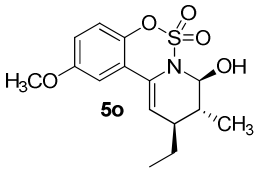
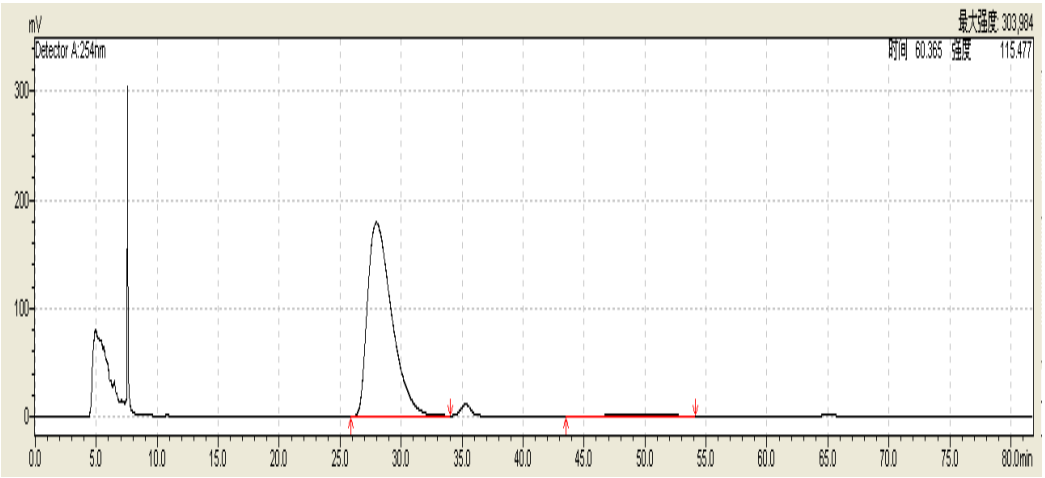


Peak	Retention time	Area (%)
1	66.147	36.447
2	79.165	13.446
3	96.240	35.842
4	116.728	14.266

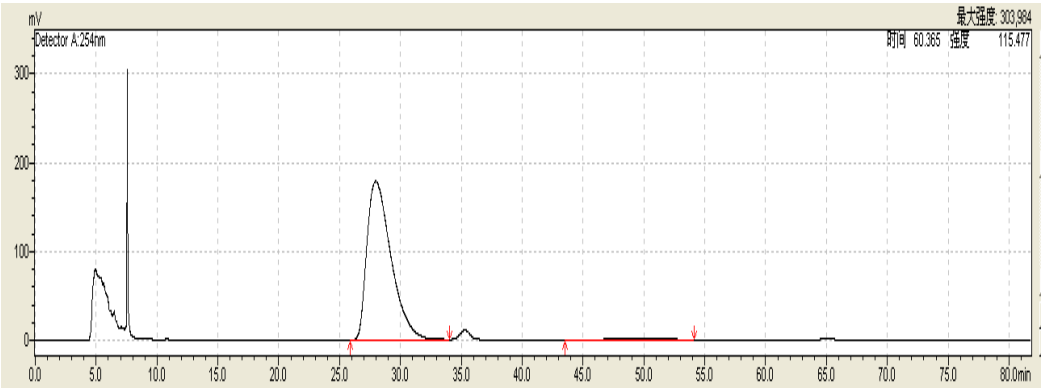


Peak	Retention time	Area (%)
1	67.272	94.967
2	94.004	5.033

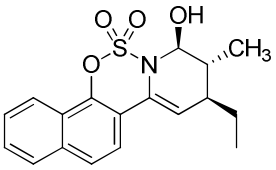




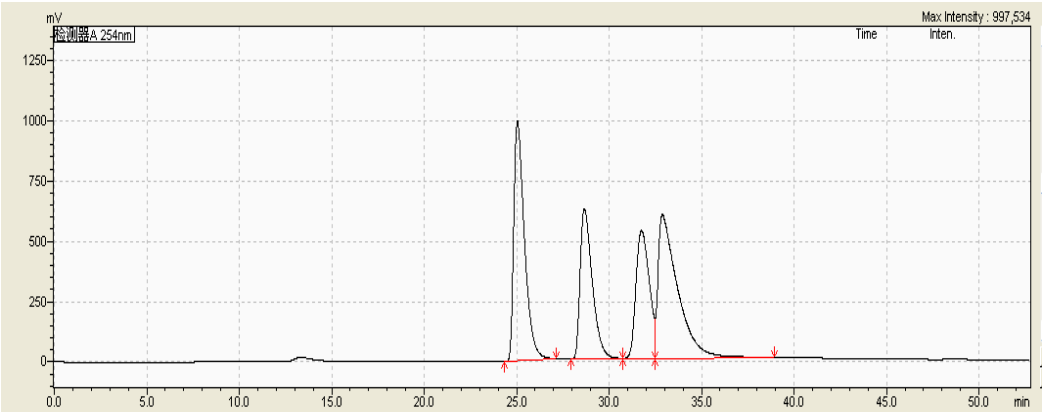
Peak	Retention time	Area (%)
1	28.784	48.978
2	36.074	1.105
3	50.608	48.798
4	66.115	1.120



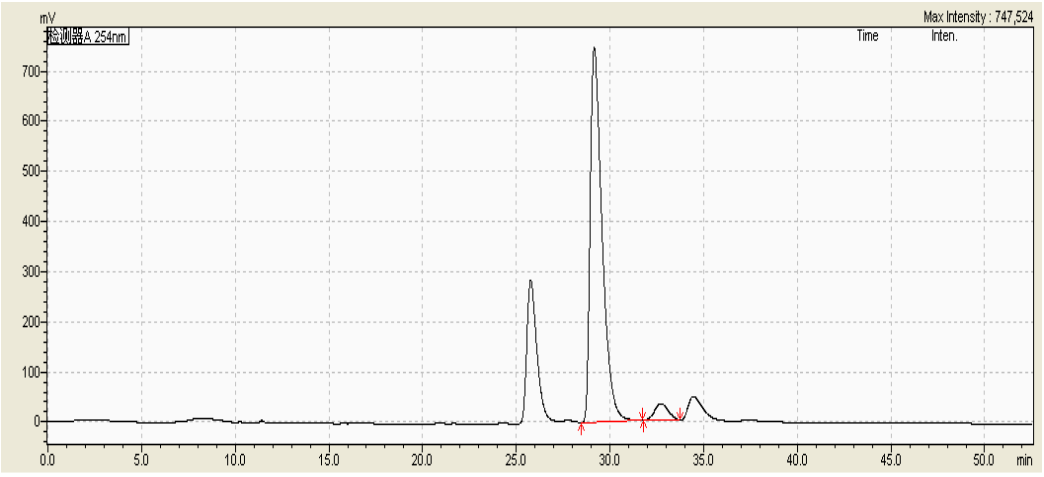
Peak	Retention time	Area (%)
1	27.963	98.068
2	50.620	1.932



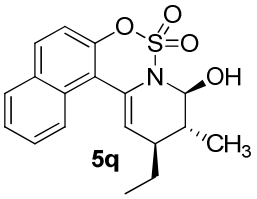
5p

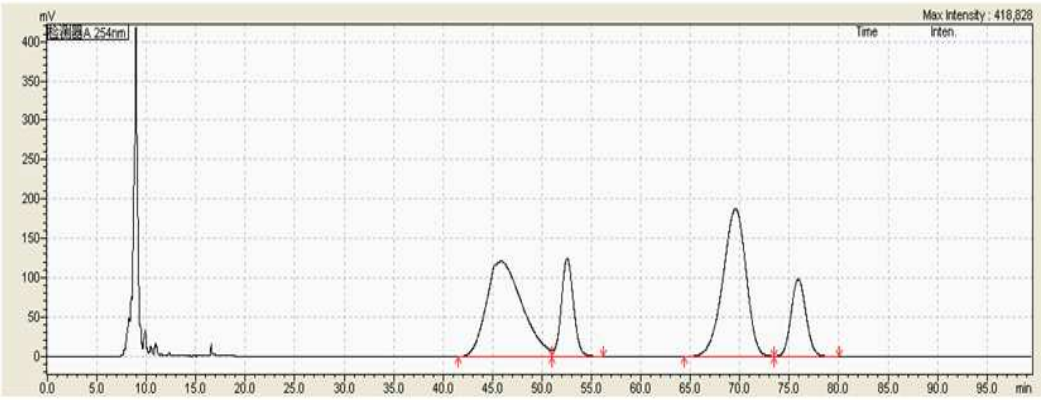


Peak	Retention time	Area (%)
1	25.045	28.813
2	28.668	20.531
3	31.753	19.098
4	32.881	31.558

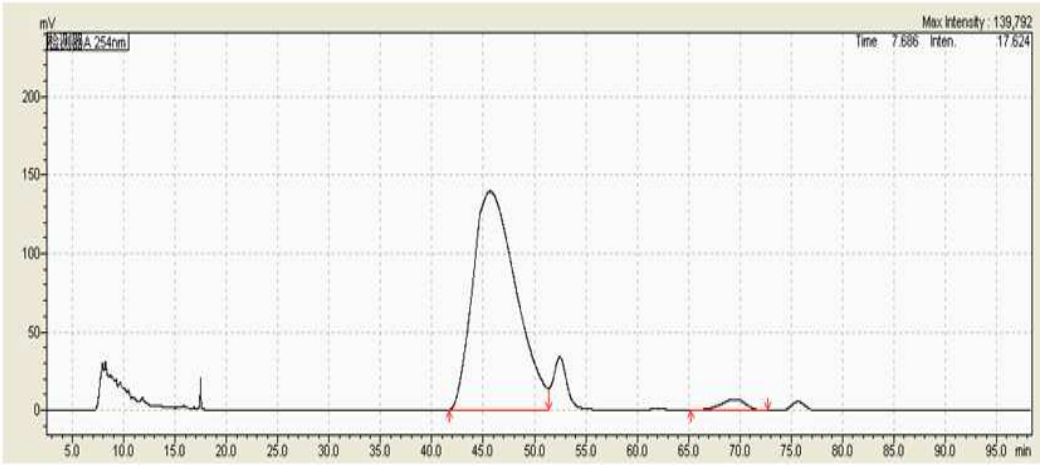


Peak	Retention time	Area (%)
1	29.168	94.952
2	32.729	5.048

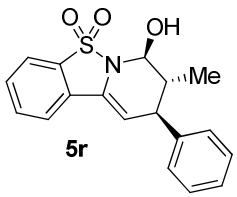




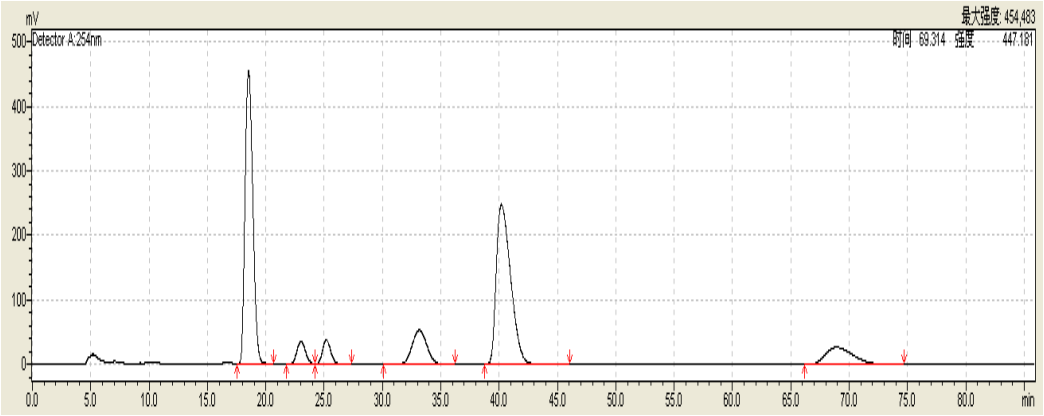
Peak	Retention time	Area (%)
1	45.834	37.041
2	52.541	12.968
3	69.572	37.387
4	75.912	12.603



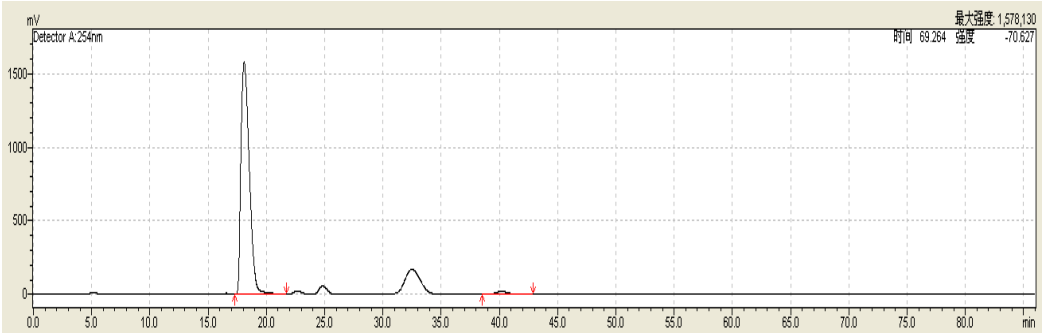
Peak	Retention time	Area (%)
1	45.693	97.109
2	69.550	2.891



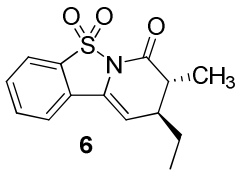
5r



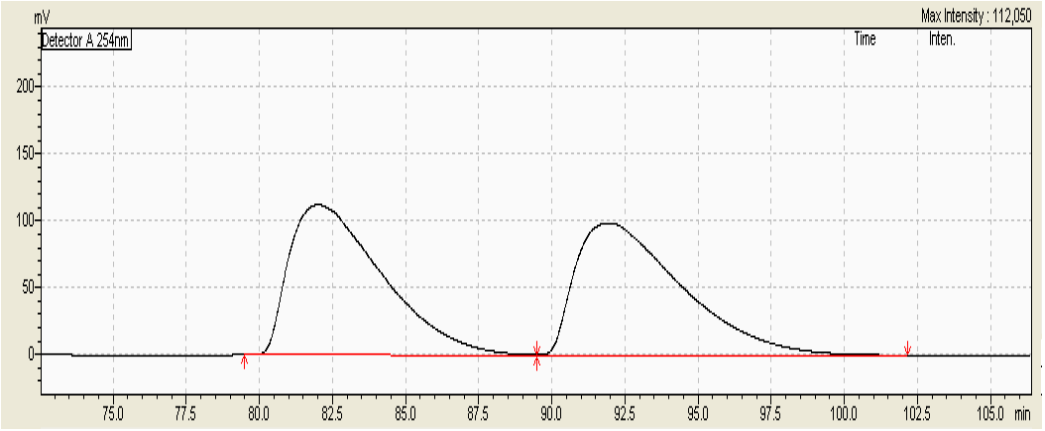
Peak	Retention time	Area (%)
1	18.523	38.169
2	23.016	3.379
3	25.187	3.374
4	33.166	8.481
5	40.195	38.449
6	68.917	8.147



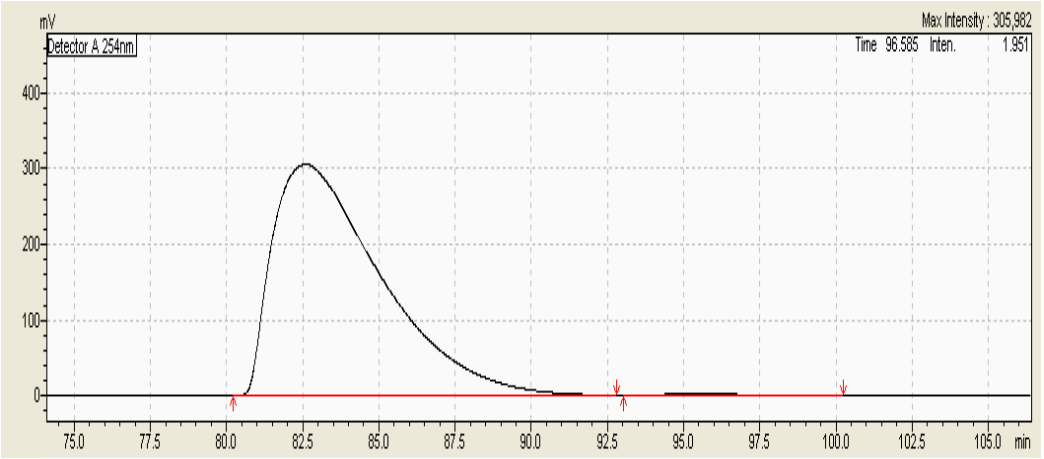
Peak	Retention time	Area (%)
1	18.087	98.024
2	40.183	1.976



6



Peak	Retention time	Area (%)
1	82.003	50.009
2	91.908	49.991



Peak	Retention time	Area (%)
1	82.606	99.560
2	95.556	0.440