Supporting Information

Effective synthesis of benzodiazepine sulfonamide and evaluation of anti-tumor activity

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1. General experimental procedures

1.1 Materials

All chemical reagents were obtained from commercial suppliers (Aladdin, Macklin, Energy Chemical, Sinopharm Chemical Reagent Co., Ltd.) and used directly without further purification. Dimethyl sulfoxide (Catalog Number: ST038-100ml) was purchased from Beijing Biotopped Science & Technology Co., Ltd. MEM basal medium (Catalog Number: G4550-500ML) was purchased from Wuhan Cell Biology Co., Ltd. Fetal bovine serum (Catalog Number: 164210-50) was purchased from Wuhan Purela Biotechnology Co., Ltd. Cell counting kit-8 (Catalog Number: C6005) was purchased from New Cell and Molecular Biotechnology Co., Ltd. in China.

1.2 Instrumentation

Proton nuclear magnetic resonance (^{1}H NMR) spectra were recorded on a Bruker 400 (400 MHz) NMR spectrometer at a temperature of 23 °C. Proton chemical shifts are expressed in parts per million (ppm, δ scale) relative to residual deuterium in the NMR solvent ($CHCl_3$, δ 7.26, and DMSO-*d*6, δ 2.50). Data are presented as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, like-t = pseudo-triplet, like-td = pseudo-triplet of doublet, m = multiplet and/or multiple resonance), coupling constants (*J*) in hertz (Hz), and integration. Carbon nuclear magnetic resonance (^{13}C NMR) spectra were recorded on a Bruker 400 (100 MHz) NMR spectrometer at a temperature of 23°C. Carbon chemical shifts are expressed in parts per million (ppm, δ scale) relative to the carbon resonance in the NMR solvent ($CDCl_3$, δ 77.16, and DMSO-*d*6, δ 39.60). Infrared spectra were obtained using an IRAffinity-1s infrared spectrometer. Data are presented as follows: absorption frequency (cm^{-1}) and absorption intensity. Mass spectra were recorded on a Micro Q-TOF mass spectrometer. The purity of all samples was recorded on an Agilent 1200 high-performance liquid chromatograph. The purity of all samples was above 97%. An Agilent 1200 series HPLC with a Discovery C_{18} (4.6 × 250 mm, 5μm particle sizes) reversed-phase column was used for analytical HPLC analyses. The elution buffer was an A/B gradient, where A = 0.1% CF_3COOH in H_2O and B = 0.1% CF_3COOH in MeOH (gradient elution: 0-20 min, 50%B-70%B). Melting points were recorded using a Stuart SMP40 micro melting point apparatus, uncorrected. 96-well plates (Catalog Number: 701001) were purchased from Wuxi Chao Biotechnology Co., Ltd., China. CO_2 incubators (Catalog Number: 3111) and Multiskan™ FC microplate readers (Catalog Number: 1410101) were purchased from Thermo Fisher Scientific, USA.

1.3 Chemistry Experimental Operations

All reactions were carried out in round-bottom flasks that had been dried by a flame and under a nitrogen atmosphere. Unless otherwise specified, liquids sensitive to air and moisture were transferred using syringes. Organic solutions were concentrated by rotary evaporation under conditions not exceeding 40 °C. Anhydrous solvents were obtained through standard procedures unless otherwise indicated. Thin Layer

Chromatography (TLC) was performed on GF_{254} glass plates pre-coated with 0.20-0.25 mm thickness silica gel (Qingdao Marine Chemical Co., Ltd.). 60-F-254 thin layer chromatography silica gel plates (thickness: 0.25 mm), thin layer chromatography preparative plates (thickness: 0.4-0.5 mm), and silica gel (200-300 mesh) were all purchased from Qingdao Marine Chemical Factory. TLC was developed using petroleum ether/ethyl acetate (volume ratio 3:1) as the eluent. Visualization agent: Ninhydrin. TLC plates were visualized under ultraviolet light. Products were dried under vacuum before nuclear magnetic resonance characterization to remove solvents. Unless otherwise specified, all reaction mixtures were temperature-controlled at the temperature of the heating/cooling bath. All steps of cell culture were completed inside a biosafety cabinet, and all materials used in the experiment were sterile.

1.4 Bioactivity Experimental Operations

Six benzosulfonamide compounds were dissolved in DMSO to prepare a solution with a concentration of 100 mg/mL, and then diluted with MEM basal medium to prepare benzosulfonamide compound solutions with concentrations of 100/200/400/600/800/1000 μg/mL. DLD1/A549/MKN45/HepG2 cells from the central laboratory of the Affiliated Hospital of Chengde Medical College were seeded in 96-well plates at 3000 cells per well with MEM medium containing 10% FBS and incubated in a 37 ℃, 5% CO_2 incubator until the cells adhered. We replaced the original medium with 200 μL of basal medium containing different concentrations of benzosulfonamide compounds. After incubation for 24 hours, 10 μL of CCK8 reagent was added to each well of the 96-well plate, and the plate was further incubated for 1 hour before the OD values were read at 450 nm using a microplate reader. We normalized the OD values of the untreated control group cells as a reference. Normalized viability (%) = (OD value of treated cells / OD value of untreated control cells) × 100.

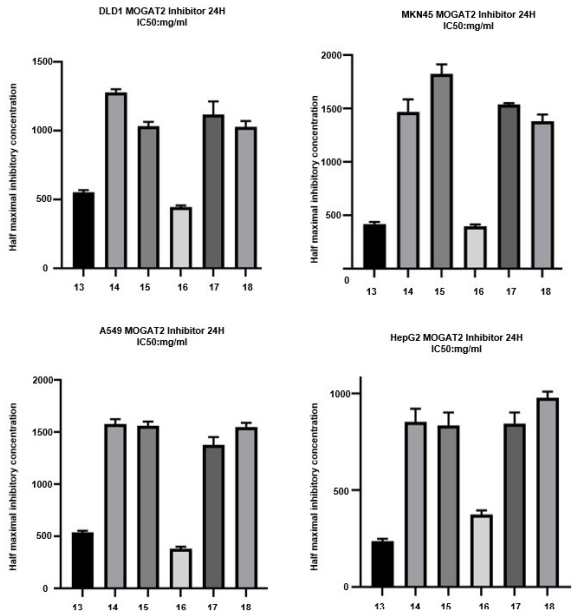
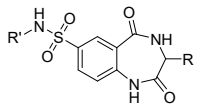


Fig. 1 IC50 values of the synthesized benzodiazepine sulfonande compounds in cancer cells DLDl, A549, MKN45 and HepG2 cells were incubated with a gradient dilution of MGAT2 inhibitors (0-1000 μg/mL) for 24 h, and cell viability was determined by the CCK-8 assay.

Compounds **13** and **16** exhibited significantly lower IC_{50} values than the other inhibitors (Fig. 1). Analysis of the chemical structures of compounds **13-18** revealed that compounds with a benzene ring at the R position showed lower IC_{50} values than those with an alkyl group at the R position.

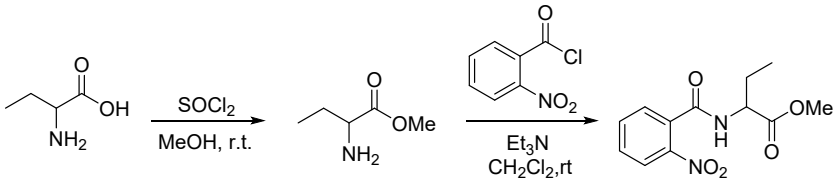
Table 1 Antitumor activity of benzodiazepine sulfonamide compounds **13-18**



Compounds	R	R′	IC_{50}(μg/mL)			
			DLD1	A549	MKN45	HepG2
13	CH_2CH_3	Ph	537.1	521.7	408.7	250.5
14	CH_2CH_3	*n*-propyl	1276	1622	1592	920.8
15	CH_2CH_3	*s*-butyl	1039	1574	1862	896.2
16	$CH_2CH_2CH_3$	Ph	430.1	358	400.2	392.7
17	$CH_2CH_2CH_3$	*n*-propyl	1071	1464	1546	910.6
18	$CH_2CH_2CH_3$	*s*-butyl	1014	1511	1415	1011

1.5 Experimental Procedures

methyl 2-(2-nitrobenzamido)butanoate （**5**）



(**1**) (**3**) (**5**)

At room temperature, DL-2-aminobutyric acid **1** (5.00 g, 0.048 mol) was dissolved in 50 mL of methanol, and $SOCl_2$ (4.21 mL, 0.058 mol) was slowly added dropwise in an ice bath, then the reaction was carried out at room temperature for 3-5 hours until the compound **1** disappeared on TLC. The reaction mixture was evaporated to dryness to obtain the crude product 8.11 g, which was directly used for the next reaction. Rf = 0.7 (EA:MeOH = 1:1 with ninhydrin staining). Compound **3** (1.00 g, 8.54 mmol) was dissolved to 20 mL of dichloromethane, and triethylamine (2.37 mL, 17.08 mmol) was added dropwise, followed by the dropwise addition of 2-nitrobenzoyl chloride (1.02 mL, 7.69 mmol) at 0 °C. Then the reaction mixture was allowed to proceed at room temperature for about 7 hours. Adding 10 mL of water to reaction system and adjusting pH to 8-9 with potassium carbonate saturated solution, then the mixture was extracted with ethyl acetate (30 mL × 3). The organic phase was dried over magnesium sulfate, filtered and concentrated to give yellow solid. The crude product was loaded onto a chromatography column using CH_2Cl_2, and the

product appeared when using a solvent system of petroleum ether: ethyl acetate = 2:1. The final yield of compound **5** (1.77 g, 6.65 mmol)was 78%, White solid, m.p. 137-138℃.

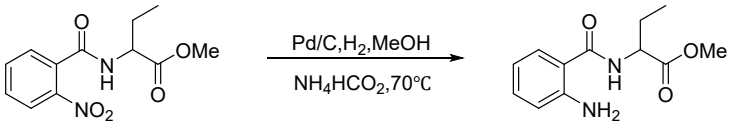
^{1}H NMR (400 MHz, DMSO-d_6) δ 9.08 (d, J = 7.61 Hz, 1 H), 8.05 (dd, J = 8.15, 1.20 Hz, 1 H), 7.82 (td, J = 7.51, 1.22 Hz, 1 H), 7.71 (td, J = 7.79, 1.47 Hz, 1 H), 7.60 (dd, J = 7.54, 1.48 Hz, 1 H), 4.35 (ddd, J = 8.79, 7.62, 5.24 Hz, 1 H), 3.68 (s, 3 H), 1.81 (dtd, J = 15.14, 7.52, 5.44 Hz, 1 H), 1.71 (ddd, J = 13.84, 8.78, 7.32 Hz, 1 H), 0.95 (t, J = 7.41 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 172.47, 166.14, 147.41, 134.10, 132.49, 131.33, 129.72, 124.51, 54.31, 52.38, 24.60, 10.82.

Table 2 Determination of an appropriate catalyst for esterification reactions

Entry	Catalyst	Dose (eq)	Time (h)	Temperature (℃)	Yield (%)
1	H_2SO_4	1	21	25	27
2	H_2SO_4	1.5	15	65	51
3	H_2SO_4	2.0	15	65	55
4	$SOCl_2$	1	9	25	76
5	$SOCl_2$	1.2	4	25	96
6	$SOCl_2$	1.2	4	65	73
7	$SOCl_2$	2	4	25	90

Reaction conditions: DL-2-aminobutyric acid (0.50 g, 4.85 mmol) was dissolved in methanol (5 mL).

methyl 2-(2-aminobenzamido)butanoate (**7**)



(**5**) (**7**)

Compound **5** (2.21 g, 8.30 mmol) was dissolved in 30 mL of methanol, Pd/C (0.09 g, 0.83 mmol) and ammonium formate (4.19 g, 66.40 mmol) was added in the reaction mixture, then reacted at 70 ℃ for 6 hours. After the reaction completed based on the TLC, the Pd/C and remaining salts were filtered out with celite while the mixture was still hot, and the filtrate was evaporated to dryness to obtain a yellow oily crude intermediate **7** (1.92 g, 8.13 mmol).

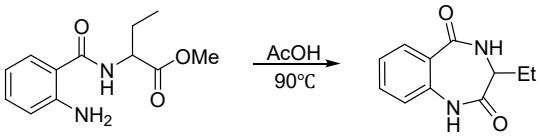
^{1}H NMR (400 MHz, DMSO-d_6) δ 8.41 (d, J = 7.18 Hz, 1 H), 7.59 (dd, J = 8.04, 1.54 Hz, 1 H), 7.15 (ddd, J = 8.33, 6.99, 1.54 Hz, 1 H), 6.69 (dd, J = 8.33, 1.18Hz, 1 H), 6.59 – 6.48 (m, 1 H), 6.37 (s, 2 H), 4.31 – 4.25 (m, 1 H), 3.64 (s, 3 H), 1.84 – 1.75 (m, 2 H), 0.94 (t, J = 7.35 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 178.17, 174.49, 155.00, 137.21, 133.81, 121.51, 119.66, 119.06, 59.14, 56.95, 29.04, 16.06.

Table 3 Assessment of reaction conditions for Pd/C-catalyzed reduction

Entry	Conditions	Yield (%)
1	0.1 eq Pd/C, H_2, 20 ℃	-
2	0.1 eq Pd/C, H_2, 40 ℃	27
3	0.1 eq Pd/C, HCO_2NH_4 (8 eq), H_2, 40 ℃	50
4	0.1 eq Pd/C, HCO_2NH_4 (8 eq), H_2, 70 ℃	98
5	0.1 eq Pd/C, HCO_2NH_4 (6 eq), H_2, 70 ℃	95
6	HCO_2NH_4 (8 eq), 180 ℃	75
7	0.1 eq Pd/C, HCO_2NH_4 (8 eq), 40 ℃	50
8	0.1 eq Pd/C, HCO_2NH_4 (8 eq), 70 ℃	96
9	0.2 eq Pd/C, HCO_2NH_4 (8 eq), 70 ℃	96

Reaction conditions: Compound 5 (0.50 g, 1.88 mmol) was dissolved in anhydrous methanol (10 mL).

3-ethyl-3,4-dihydro-1H-benzo[e][1,4]diazepine-2,5-dione (**9**)

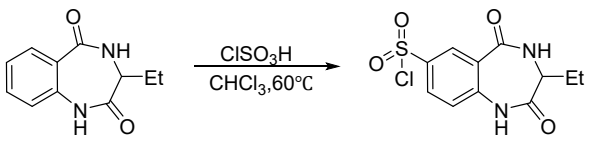


(**7**) (**9**)

Intermediate **7** (1.88 g, 7.96 mmol) was dissolved in 15 mL of glacial acetic acid and the reaction was carried out overnight at 90 ℃. After the reaction, post-treatment was performed by adding 50 mL of water to the reaction mixture, which resulted in the precipitation of a large amount of solid. The final yield of compound **9** (1.14 g, 5.58 mmol) was 69.9%, White solid, m.p. 205-209℃.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.35 (s, 1 H), 8.44 (d, J = 5.73 Hz, 1 H), 7.74 (dd, J = 8.04, 1.65 Hz, 1 H), 7.50 (ddd, J = 8.04, 7.26, 1.65 Hz, 1 H), 7.21 (td, J = 7.26, 1.13 Hz, 1 H), 7.09 (dd, J = 8.04, 1.13 Hz, 1 H), 3.55 – 3.50 (m, 1 H), 1.81 – 1.74 (m, 1 H), 1.68 – 1.51 (m, 1 H), 0.90 (t, J = 7.37 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 172.10, 168.33, 137.22, 132.63, 130.88, 126.84, 124.34, 21.36, 53.89, 21.42, 11.00. IR (KBr, cm^{-1}): 3153.61, 1681.93, 1664.57, 1481.33, 1444.68, 1415.75, 756.10. $C_{11}H_{12}N_2O_2$, HRMS-ESI (m/z): 204.0891 (Theoretical concept: 204.0899).

3-ethyl-2,5-dioxo-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonyl chloride (**11**)



(**9**) (**11**)

Intermediate **9** (0.50 g, 2.45 mmol), chlorosulfonic acid (0.98 mL, 14.70 mmol), and chloroform (15mL) were reacted overnight at 60℃. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of 20ml of water in an ice bath, a solid precipitated out. The final yield of compound **11** (0.71 g, 2.48 mmol)was 96.0%, Brown solid, m.p. 270-271℃.

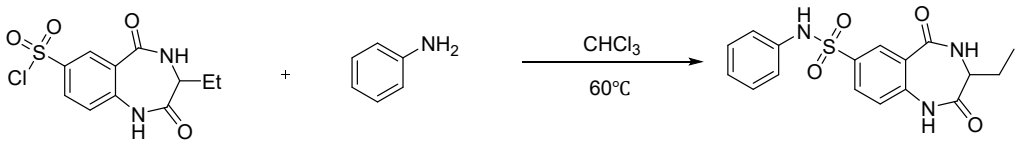
^{1}H NMR (400 MHz, DMSO-d_6) δ 10.40 (s, 1 H), 8.43 (d, J = 5.69 Hz, 1 H), 7.97 (d, J = 2.11 Hz, 1 H), 7.67 (dd, J = 8.31, 2.11 Hz, 1 H), 7.04 (d, J = 8.31 Hz, 1 H), 3.54 (dt, J = 8.31, 5.95 Hz, 1 H), 1.76 (dq, J = 14.22, 7.38 Hz, 1 H), 1.58 (dt, J = 13.75, 7.38 Hz, 1 H), 0.90 (t, J = 7.38 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 172.03, 168.09, 144.42, 137.16, 129.84, 128.18, 125.88, 120.84, 53.98, 21.42, 10.96.

Table 4 Assessment of conditions for the condensation reaction of sulfuryl chloride (**11**) with aniline

Entry	Conditions	Yield (%)
1	Aniline (3 eq), THF, 66 ℃, 10 h	45
2	Aniline (3 eq), CH_3CN, 82 ℃, 12 h	55
3	Aniline (3 eq), DMSO, 100 ℃, 12 h	36
4	Aniline (3 eq), DMF, 100 ℃, 12 h	40
5	Aniline (3 eq), CH_2Cl_2, 40 ℃, 10 h	68
6	Aniline (3 eq), $CHCl_3$, 70 ℃, 9 h	78
7	Aniline (3 eq), $CHCl_3$, 80 ℃, 9 h	78
8	Aniline (3 eq), $CHCl_3$, 40 ℃, 9 h	35
9	Aniline (3 eq), $CHCl_3$, 60 ℃, 5 h	55
10	Aniline (3 eq), $CHCl_3$, 60 ℃, 11 h	67
11	Aniline (1 eq), $CHCl_3$, 60 ℃, 15 h	53
12	Aniline (5 eq), $CHCl_3$, 60 ℃, 8 h	78

Reaction conditions: sulfuryl chloride (**11**) (0.5 g, 1.65 mmol); the reaction system was protected by nitrogen. The reaction was considered complete when no further conversion of the starting material was observed in TLC.

3-ethyl-2,5-dioxo-N-phenyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**13**)

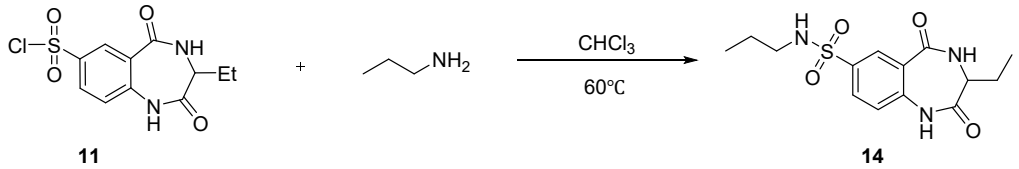


11 **13**

Compound **11** (0.50 g, 1.65 mmol) was dissolved in 25 mL of chloroform, and aniline (0.45 mL, 4.95 mmol) was slowly added at room temperature. The reaction was carried out at 60 ℃ for 9 hours. After TLC analysis confirmed the disappearance of the starting material, the reaction was terminated. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of a 2:1 ethanol:water mixture (20 mL), a solid precipitated out. The final yield of compound **13** (0.463 g, 1.22 mmol)was 78%, White solid, m.p. 150-152℃. The purity was 97%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.70 (s, 1 H), 10.35 (s, 1 H), 8.63 (d, J = 5.58 Hz, 1 H), 8.15 (d, J = 2.32 Hz, 1 H), 7.82 (dd, J = 8.59, 2.32 Hz, 1 H), 7.29 – 7.21 (m, 2 H), 7.19 (d, J = 8.59 Hz, 1 H), 7.14 – 7.07 (m, 2 H), 7.07 – 7.00 (m, 1 H), 3.61 – 3.56 (m, 1 H), 1.81 – 1.70 (m, 1 H), 1.62 – 1.51 (m, 1 H), 0.89 (t, J = 7.37 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.82, 166.96, 140.76, 137.97, 135.01, 130.56, 130.24, 129.71, 129.37, 126.68, 124.68, 122.13, 120.58, 53.74, 21.39, 10.84. $C_{17}H_{17}N_3O_4S$, HRMS-ESI (m/z): 359.0932 (Theoretical concept: 359.0940).

3-ethyl-2,5-dioxo-N-propyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**14**)

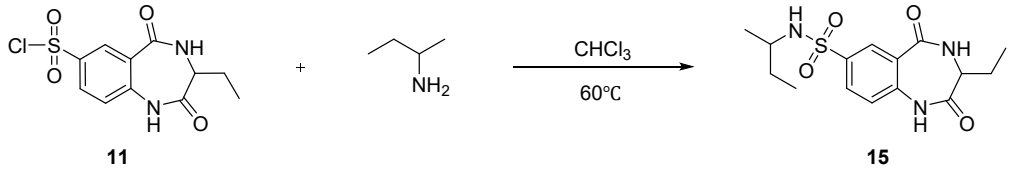


11 **14**

Compound **11** (0.10 g, 0.33 mmol) was dissolved in 10 mL of chloroform, and n-propylamine (0.08 mL, 0.99 mmol) was slowly added at room temperature. The reaction was carried out at 60 ℃ for 9 hours. The reaction was stopped after the disappearance of the starting material was confirmed by TLC. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of a 2:1 ethanol:water mixture (20 mL) in an ice bath, a solid precipitated out. The final yield of compound **14** (0.0891 g, 0.27 mmol) was 83%, White solid, m.p. 185-186℃. The purity was 98%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.71 (s, 1 H), 8.64 (d, J = 5.60 Hz, 1 H), 8.14 (d, J = 2.31 Hz, 1 H), 7.87 (dd, J = 8.54, 2.31 Hz, 1 H), 7.66 (t, J = 5.60 Hz, 1 H), 7.25 (d, J = 8.54 Hz, 1 H), 3.64 (dt, J = 8.19, 5.96 Hz, 1 H), 2.71 (td, J = 7.09, 5.96 Hz, 2 H), 1.86 – 1.75 (m, 1 H), 1.67 – 1.56 (m, 1 H), 1.45 – 1.36 (m, 2 H), 0.92 (t, J = 7.40 Hz, 3 H), 0.80 (t, J = 7.4 0Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.66, 171.99, 145.03, 140.90, 135.21, 134.61, 131.43, 126.88, 58.51, 27.64, 26.17, 16.36, 15.64. $C_{14}H_{19}N_3O_4S$, HRMS-ESI (m/z): 325.1093 (theoretical concept: 325.1096).

N-(sec-butyl)-3-ethyl-2,5-dioxo-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**15**)

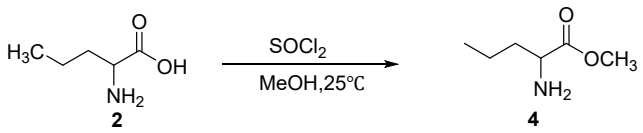


11 **15**

Compound **11** (0.50 g, 1.65 mmol) was dissolved in 25 mL of chloroform, and sec-butylamine (0.50 mL, 4.95 mmol) was slowly added at room temperature. The reaction was carried out at 60 ℃ for 9 hours. The reaction was terminated after the disappearance of the starting material was confirmed by TLC. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of a 2:1 ethanol:water mixture (20 mL) in an ice bath, a solid precipitated out. The final yield of compound **15** (0.448 g, 1.32 mmol) was 80%, White solid, m.p. 252-254℃. The purity was 98.6%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.70 (s, 1 H), 8.64 (d, J = 5.62 Hz, 1 H), 8.16 (d, J = 2.28 Hz, 1 H), 7.88 (dd, J = 8.53, 2.28 Hz, 1 H), 7.61 (t, J = 7.34 Hz, 1 H), 7.24 (d, J = 8.53 Hz, 1 H), 3.61 (dt, J = 8.22, 5.93 Hz, 1 H), 3.06 (m, 1 H), 1.84 – 1.73 (m, 1 H), 1.65 – 1.54 (m, 1 H), 1.36 – 1.28 (m, 2 H), 0.91 (td, J = 7.07, 6.61, 2.59 Hz, 6 H), 0.72 (td, J = 7.34, 5.44 Hz, 3 H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.66, 171.99, 144.85, 142.39, 135.09, 134.47, 131.33, 126.80, 58.64, 55.97, 34.81, 26.17, 25.86, 15.65, 15.25. $C_{15}H_{21}N_3O_4S$, HRMS-ESI (m/z): 339.1249 (Theoretical concept: 339.1253).

methyl 2-aminopentanoate (**4**)

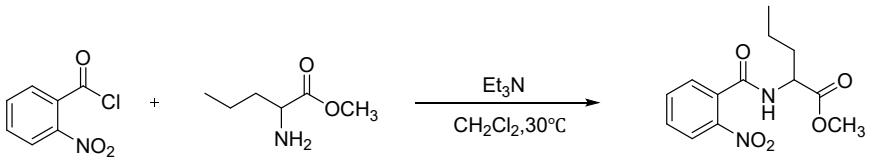


2 4

L-valine (0.50 g, 4.27 mmol) was dissolved in 10 mL of methanol with stirring. Then, $SOCl_2$ (0.37 mL, 5.12 mmol) was slowly added in an ice bath, and the reaction was carried out at T = 25 ℃ for 5.5 hours. After the reaction was confirmed to be stable by TLC, the methanol was removed by rotary evaporation to obtain a colorless oily substance, which was then dried under vacuum using an oil pump to yield a white solid. The final yield of compound **4** (0.50 g, 3.81 mmol), White solid, m.p. 63-65℃.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.66 (s, 2 H), 3.97 (t, J = 6.32 Hz, 1 H), 3.74 (s, 3 H), 1.77 (ddd, J = 8.56, 7.63, 6.33 Hz, 2 H), 1.51 – 1.22 (m, 2 H), 0.88 (t, J = 7.34 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 169.98, 52.67, 51.67, 31.99, 17.62, 13.42. IR (KBr, cm^{-1}): 1753.29, 1514.12, 1259.52, 1118.71, 532.53.

methyl 2-(2-nitrobenzamido)pentanoate(**6**)

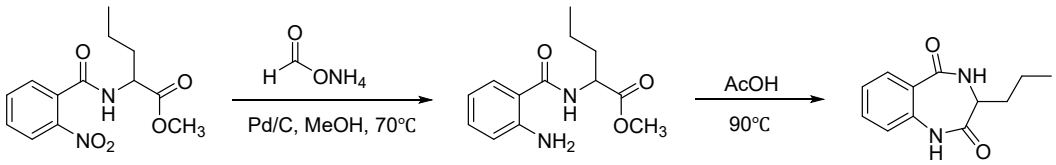


4 6

Compound **4** (0.50 g, 3.81 mmol) was stirred with 10 mL of CH_2Cl_2 until the compound was dissolved. Then, introduce 2-nitrobenzoyl chloride (0.45 mL, 3.43 mmol), followed by the slow addition of Et_3N (2.12 mL, 15.24 mmol) in an ice bath. Allow the reaction to proceed at room temperature for 4 hours. Once the reaction is complete as confirmed by TLC, halt the reaction. Filter out the white solid and extract the filtrate with ethyl acetate three times. Rinse with water once, dry with anhydrous sodium sulfate, and evaporate the organic phase to a yellow oily substance. The final yield of compound **6** (0.9 g, 3.21 mmol), White solid, m.p. 53-55℃, yield 85%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 9.08 (d, J = 7.59 Hz, 1 H), 8.05 (dd, J = 8.10, 1.23 Hz, 1 H), 7.81 (td, J = 7.56, 1.23 Hz, 1 H), 7.71 (td, J = 7.56, 1.47 Hz, 1 H), 7.59 (dd, J = 7.56, 1.47 Hz, 1 H), 4.42 (ddd, J = 8.96, 7.56, 5.39 Hz, 1 H), 3.68 (s, 3 H), 1.81 – 1.62 (m, 2 H), 1.48 – 1.26 (m, 2 H), 0.90 (t, J = 7.30 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 172.19, 165.58, 146.92, 133.59, 131.97, 130.84, 129.20, 124.01, 52.01, 51.90, 32.66, 18.56, 18.32, 13.36. IR (KBr, cm^{-1}): 3238.48, 3078.39, 2958.80, 2873.94, 1749.44, 1643.35, 1558.48, 1533.41, 1354.03, 786.96. $C_{13}H_{16}N_2O_5$, HRMS-ESI (m/z): 280.1055 (Theoretical concept 280.1059).

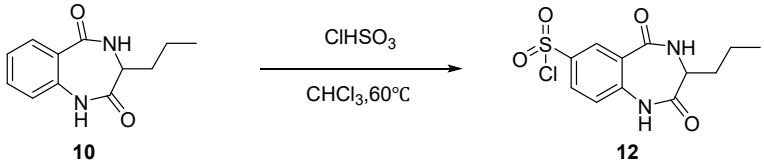
3-propyl-3,4-dihydro-1H-benzo[e][1,4]diazepine-2,5-dione (**10**)



At room temperature, compound **6** (0.90 g, 3.21 mmol) was dissolved in 10 mL of methanol. Pd/C (0.03 g, 0.32 mmol) and ammonium formate (1.62 g, 25.68 mmol) were then added and heated with stirring. React under reflux at T = 70°C for 6 hours. After the reaction is complete as determined by TLC, remove the Pd/C, and evaporate the filtrate to dryness to obtain a yellow oily crude product, 0.19g. Crude compound **8** was dissolved in 5 mL of glacial acetic acid and slowly heated to initiate the reaction. The reaction was carried out at T = 70 °C for 22 h. After completion of the reaction as determined by TLC, the reaction mixture was cooled to room temperature. To the reaction solution 10 ml of water was added and stirred for 10 min, then filtered to give a gray-yellow solid (0.55 g, 2.52 mmol), yield 78%, White solid, m.p. 228-230℃.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.35 (s, 1 H), 8.43 (d, J = 5.76 Hz, 1 H), 7.73 (dd, J = 7.90, 1.66 Hz, 1 H), 7.55 – 7.46 (m, 1 H), 7.21 (td, J = 7.55, 1.15 Hz, 1 H), 7.09 (dd, J = 8.40, 1.15 Hz, 1 H), 3.58 (dt, J = 8.40, 5.76 Hz, 1 H), 1.75 – 1.69 (m, 1 H), 1.60 – 1.55 (m, 1 H), 1.47 – 1.21 (m, 2 H), 0.84 (t, J = 7.33 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.60, 167.74, 136.70, 132.13, 130.36, 126.29, 123.84, 120.85, 51.70, 29.66, 18.59, 13.72. IR (KBr, cm^{-1}): 3178.69, 3066.82, 2968.45, 2937.59, 1668.43, 1481.33, 1442.75, 1413.82, 1230.58, 754.17. $C_{12}H_{14}N_2O_2$, HRMS-ESI (m/z): 218.1050 (Theoretical concept 218.1055).

2,5-dioxo-3-propyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonyl chloride (**12**)



Compound **10** (0.50 g, 2.29 mmol), chlorosulfonic acid (0.91 mL, 13.74 mmol), and chloroform (15 mL) were reacted overnight at 60 °C. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of 20 mL of water in an ice bath, a solid precipitated out. The final yield of compound **12** (0.70 g, 2.21 mmol), yield 96%, White solid, m.p. 213-215℃.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.39 (s, 1 H), 8.42 (d, J = 5.71 Hz, 1 H), 7.96 (d, J = 2.09 Hz, 1 H), 7.67 (dd, J = 8.34, 2.09 Hz, 1 H), 7.03 (d, J = 8.34 Hz, 1 H), 3.60 (dt, J = 8.34, 5.87 Hz, 1 H), 1.75 – 1.66 (m, 1 H), 1.61 – 1.52 (m, 1 H), 1.43 – 1.24 (m, 2 H), 0.84 (t, J = 7.35 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.54, 167.52, 143.95, 136.63, 129.37, 127.66, 125.30, 120.32, 51.72, 29.65, 18.56, 13.69. IR (KBr, cm^{-1}): 3066.82, 2972.31, 1697.36, 1664.57, 1435.04, 1371.39, 1180.44, 582.50, 563.21. Compound **12** is readily hydrolyzed to 2,5-dioxo-3-propyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonic acid $C_{12}H_{14}N_2O_5S$, HRMS-ESI (m/z): 298.0627 (Theoretical concept: 298.0623).

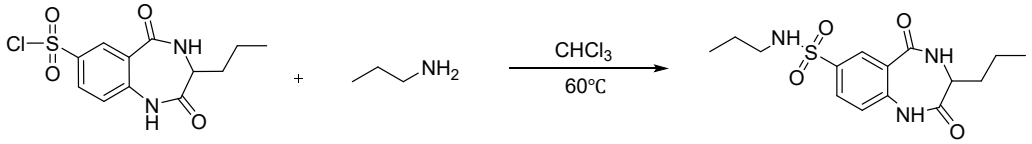
2,5-dioxo-N-phenyl-3-propyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**16**)

12 **16**

Compound **12** (0.10 g, 0.32 mmol) was dissolved in 5 mL of dichloromethane, and aniline (0.09 mL, 0.96 mmol) was slowly added at room temperature. The reaction was carried out at 60°C for 9 hours. The reaction was terminated after the disappearance of the starting material was confirmed by TLC. Post-treatment: The reaction mixture was evaporated to dryness, and upon the addition of a 2:1 ethanol:water mixture (21 mL) in an ice bath, a white solid precipitated. The final yield of compound **16** (0.094g, 0.25 mmol), yield 79%, White solid, m.p. 135-140 ℃. The purity was 98.6%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.71 (s, 1 H), 10.34 (s, 1 H), 8.62 (d, J = 5.57 Hz, 1 H), 8.14 (d, J = 2.36 Hz, 1 H), 7.82 (dd, J = 8.49, 2.36 Hz, 1 H), 7.22 (m, 3 H), 7.10 (d, J = 7.34 Hz, 2 H), 7.04 (t, J = 7.34 Hz, 1 H), 3.67 – 3.62 (m, 1 H), 1.73 – 1.64 (m, 1 H), 1.58 – 1.49 (m, 1 H), 1.41 – 1.23 (m, 2 H), 0.83 (t, J = 7.32 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.37, 166.41, 140.26, 137.46, 134.48, 130.07, 129.74, 129.19, 129.00, 126.12, 124.21, 121.64, 120.16, 115.93, 51.62, 29.60, 18.47, 13.67. IR (KBr, cm^{-1}): 3242.34, 2962.66, 1693.50, 1651.07, 1485.19, 1163.08, 696.30. $C_{18}H_{19}N_3O_4S$, HRMS-ESI (m/z): 373.1093 (Theoretical concept 373.1096).

2,5-dioxo-N,3-dipropyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**17**)

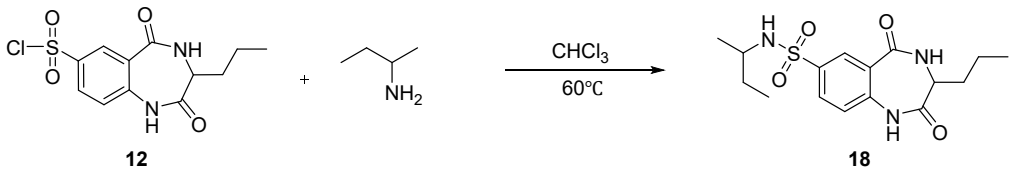


12 **17**

Compound **12** (0.10 g, 0.32 mmol) was dissolved in 5 mL of dichloromethane, and n-propylamine (0.08 mL, 0.96 mmol) was slowly added at room temperature. The reaction was carried out at 60°C for 14 hours. The reaction was terminated after the disappearance of the starting material was confirmed by TLC. Post-treatment: Water was added to the flask, and the mixture was filtered. The solid was rinsed with a 2:1 ethanol:water mixture (21 mL), the final yield of compound **17** (0.0915 g, 0.27 mmol), yield 85%, White solid, m.p. 210-212℃. The purity was 98.6%.

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.70 (s, 1 H), 8.64 (d, J = 5.59 Hz, 1 H), 8.15 (d, J = 2.27 Hz, 1 H), 7.87 (dd, J = 8.46, 2.27 Hz, 1 H), 7.66 (t, J = 5.59 Hz, 1 H), 7.26 (d, J = 8.46 Hz, 1 H), 3.70 (dt, J = 8.25, 5.83 Hz, 1 H), 2.73 – 2.69 (m, 2 H), 1.78 – 1.69 (m, 1 H), 1.62 – 1.53 (m, 1 H), 1.44 – 1.26 (m, 4 H), 0.85 (t, J = 7.32 Hz, 3H), 0.79 (t, J = 7.32 Hz, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.44, 166.68, 139.79, 135.68, 129.97, 129.36, 126.13, 121.63, 51.64, 44.31, 29.66, 22.38, 18.53, 13.72, 11.10. IR (KBr, cm^{-1}): 3269.34, 2962.66, 1693.50, 1670.35, 1436.97, 1166.93, 831.32. $C_{15}H_{21}N_3O_4S$, HRMS-ESI (m/z): 339.1249 (Theoretical concept: 339.1253).

N-(sec-butyl)-2,5-dioxo-3-propyl-2,3,4,5-tetrahydro-1H-benzo[e][1,4]diazepine-7-sulfonamide (**18**)



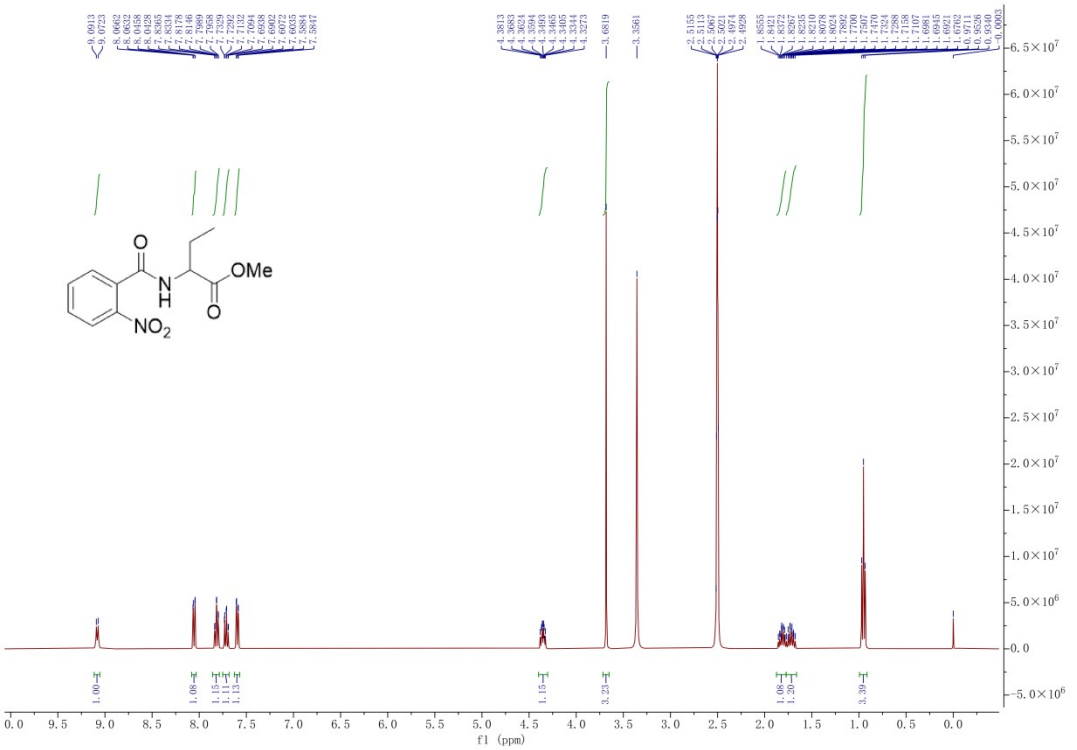
12 18

Compound 12 (0.10 g, 0.32 mmol) was dissolved in 5 mL of dichloromethane, and sec-butylamine (0.09 mL, 0.96 mmol) was slowly added at room temperature. The reaction was carried out at 60°C for 14 hours. The reaction was terminated after the disappearance of the starting material was confirmed by TLC. Post-treatment: 10 ml of water was added to the flask and a solid was precipitated, which was filtered to give compound **18**. The final yield of compound **18** (0.0938g, 0.27 mmol), yield 83%, White solid, m.p. 200-203℃. The purity was 98.9%.

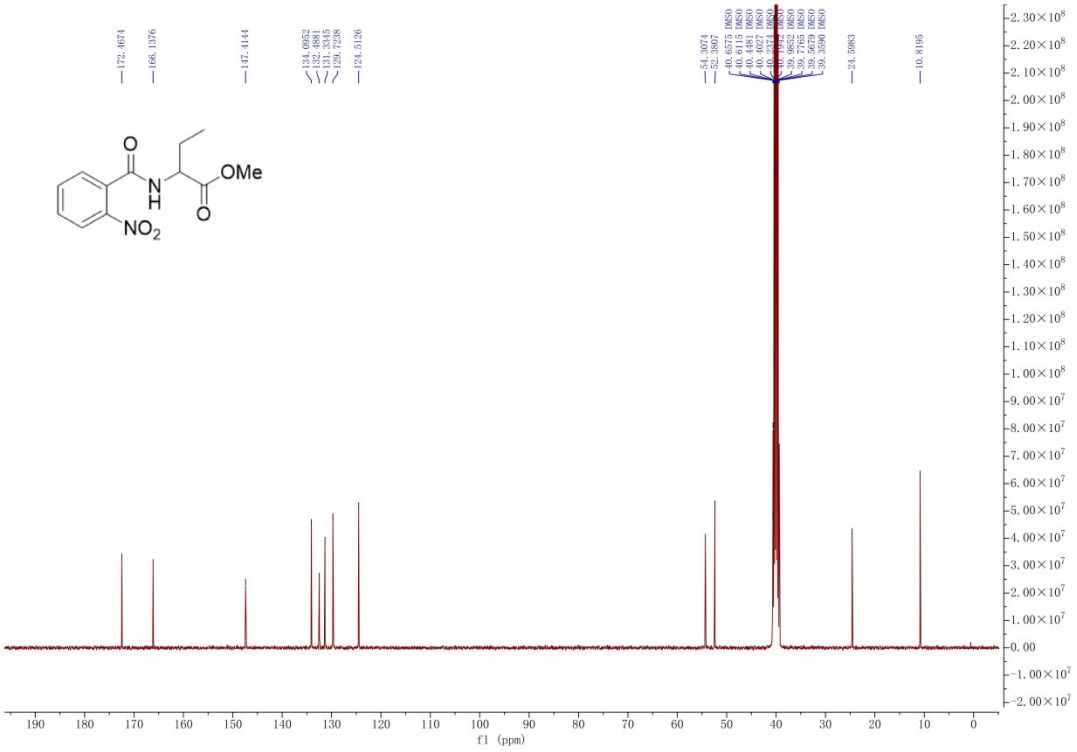
^{1}H NMR (400 MHz, DMSO-d_6) δ 10.71 (s, 1 H), 8.64 (d, J = 5.67 Hz, 1 H), 8.16 (d, J = 2.27 Hz, 1 H), 7.88 (dd, J = 8.50, 2.27 Hz, 1 H), 7.66 – 7.55 (m, 1 H), 7.25 (d, J = 8.50 Hz, 1 H), 3.67 (dt, J = 8.34, 5.83 Hz, 1 H), 3.12 – 3.00 (m, 1 H), 1.76 – 1.67 (m, 1 H), 1.62 – 1.52 (m, 1 H), 1.43 – 1.24 (m, 4 H), 0.95 – 0.80 (m, 6 H), 0.71 (q, J = 7.2 Hz, 3 H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 171.46, 166.68, 139.60, 137.14, 137.11, 129.86, 129.21, 126.07, 126.05, 121.54, 51.76, 50.73, 29.62, 29.55, 29.48, 20.70, 20.62, 18.51, 13.63, 10.02, 9.99. IR (KBr, cm^{-1}): 3265.49, 298.45, 1693.50, 1660.71, 1172.72, 619.15. $C_{16}H_{23}N_3O_4S$, HRMS-ESI (m/z): 353.1408 (Theoretical concept 353.1409).

2. Compound （5）

2.1 ^{1}H NMR spectra of crude compound （**5**）

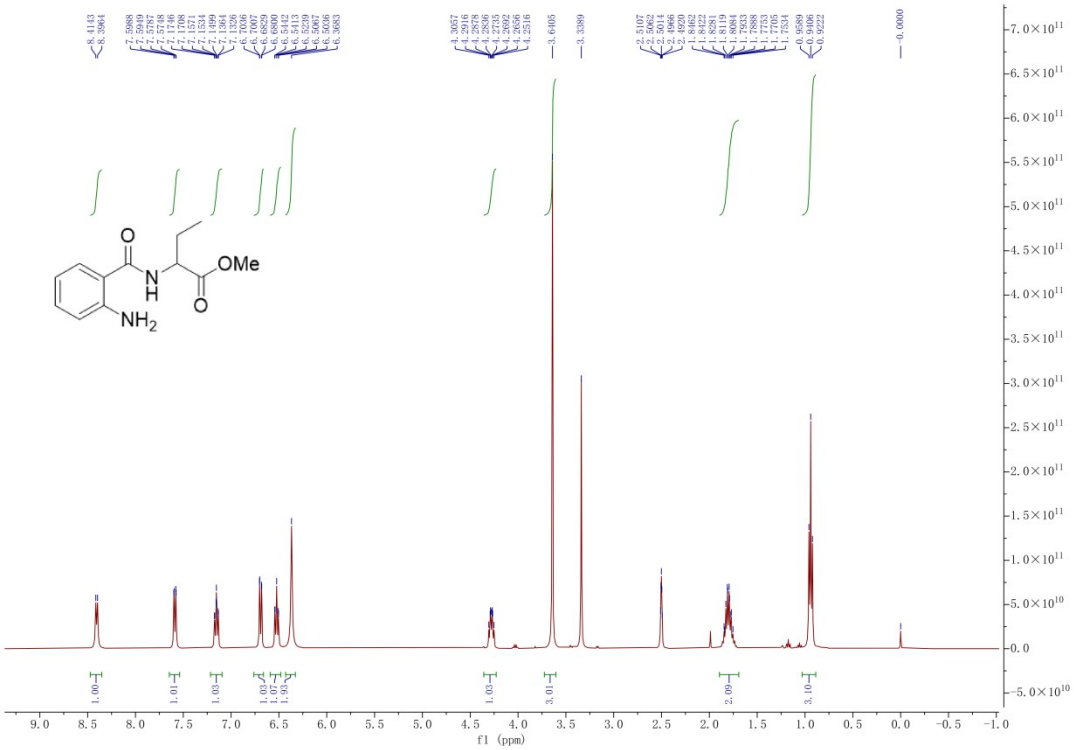


2.2 ^{13}C NMR spectra of crude compound (**5**)

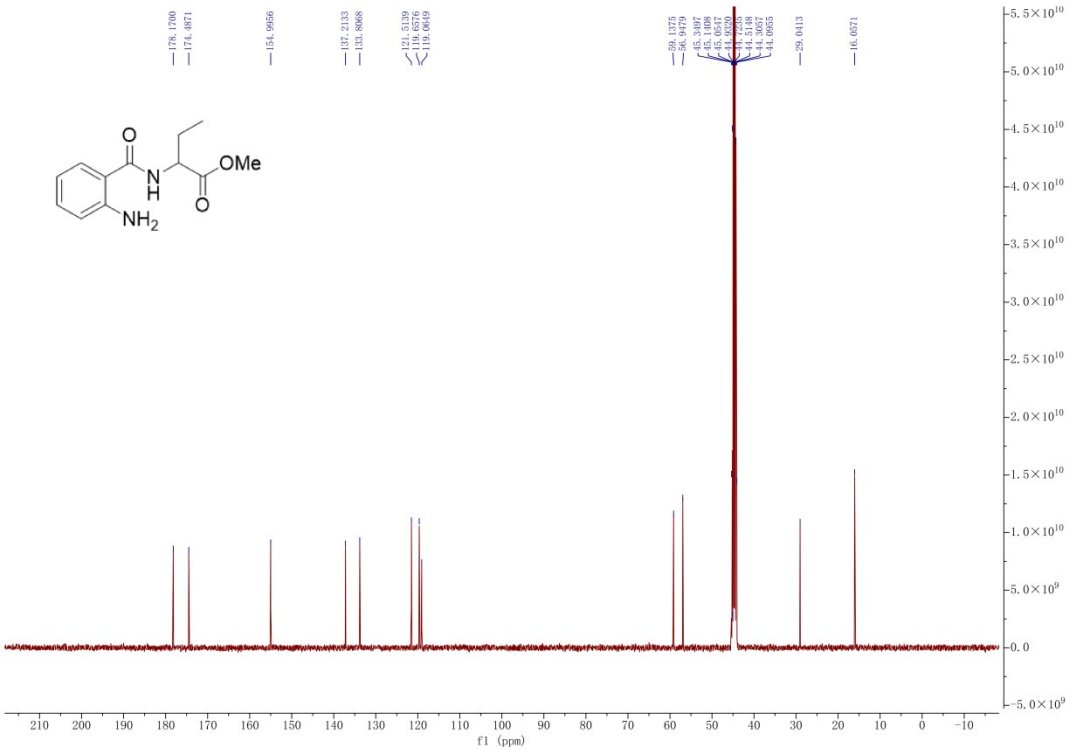


3. Compound （7）

3.1 ^{1}H NMR spectra of compound (**7**)

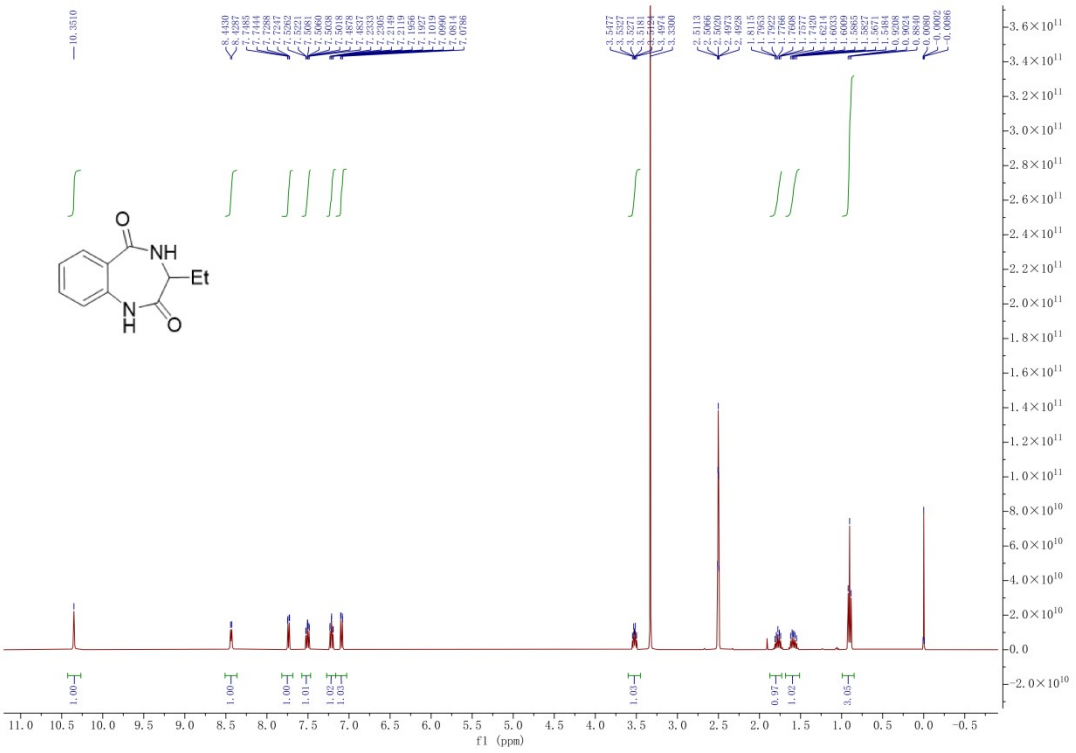


3.2 ^{13}C NMR spectra of compound (**7**)

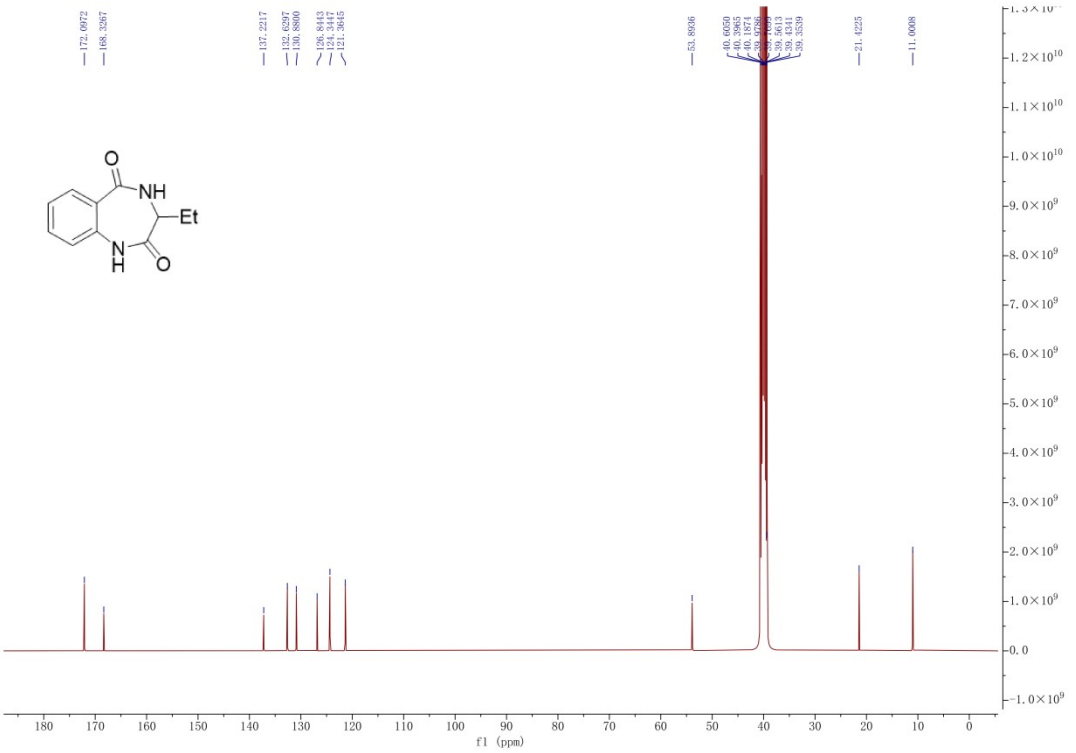


4. Compound （9）

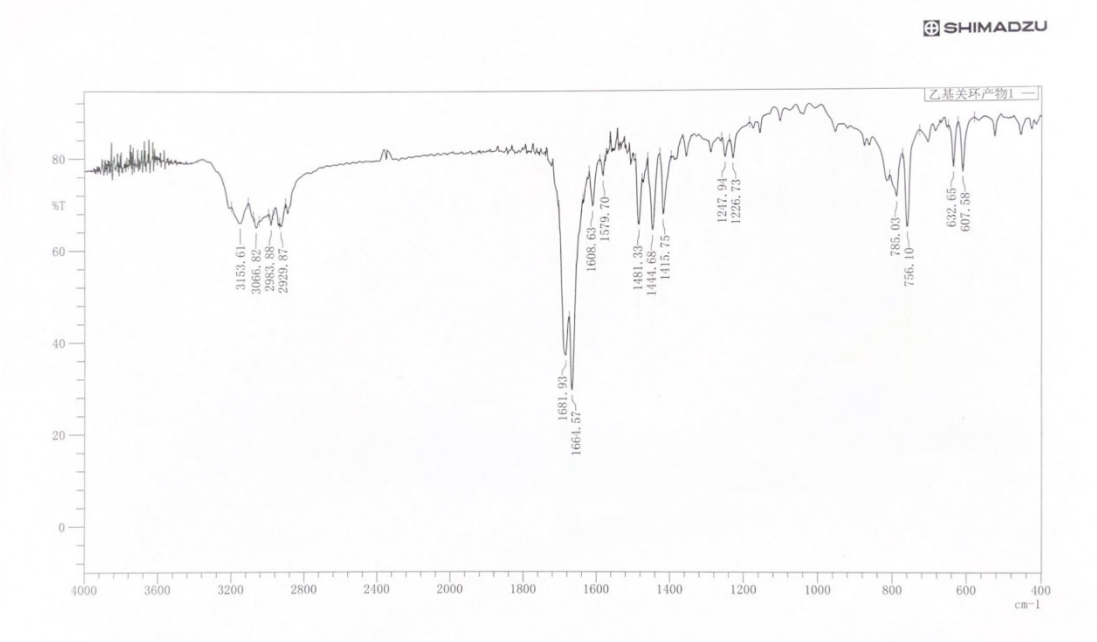
4.1 ^{1}H NMR spectra of compound (**9**)



4.2 ^{13}C NMR spectra of compound (**9**)



4.3 IR spectra of compound (**9**)



4.4 HRMS spectra of compound (**9**)

Qualitative Analysis Report

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Sample Type	Sample	**Position**	P1-A4
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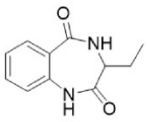
Acq Method	test.m	**Acquired Time**	12/22/2023 11:11:00 AM
IRM Calibration Status	Some Ions Missed	**DA Method**	Default.m
Comment			

Sample Group **Info.**



Chemical Formula: $C_{11}H_{12}N_2O_2$
Exact Mass: 204.0899

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
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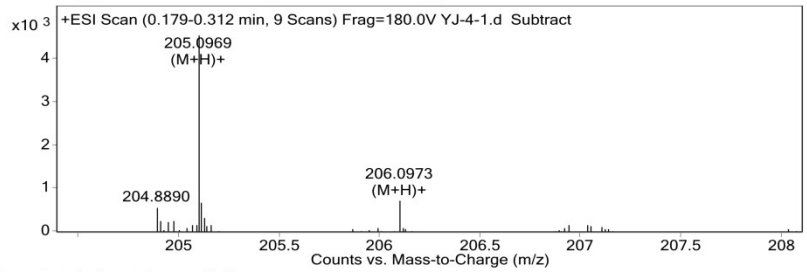

Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	30
S	0	5

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
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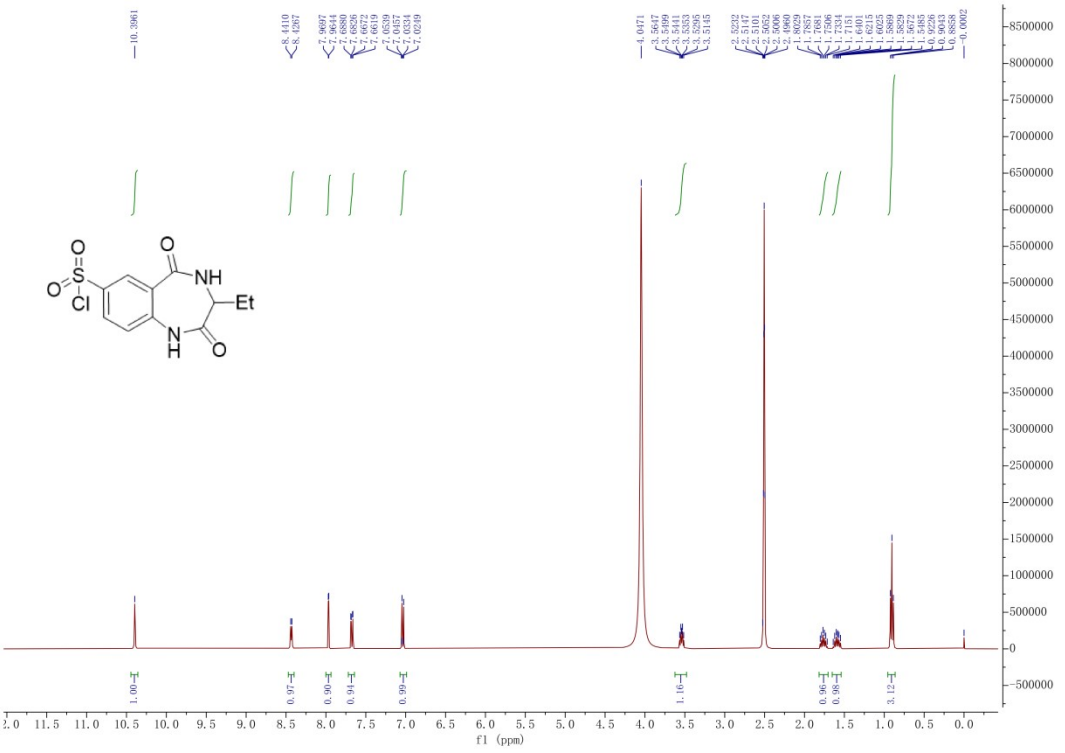
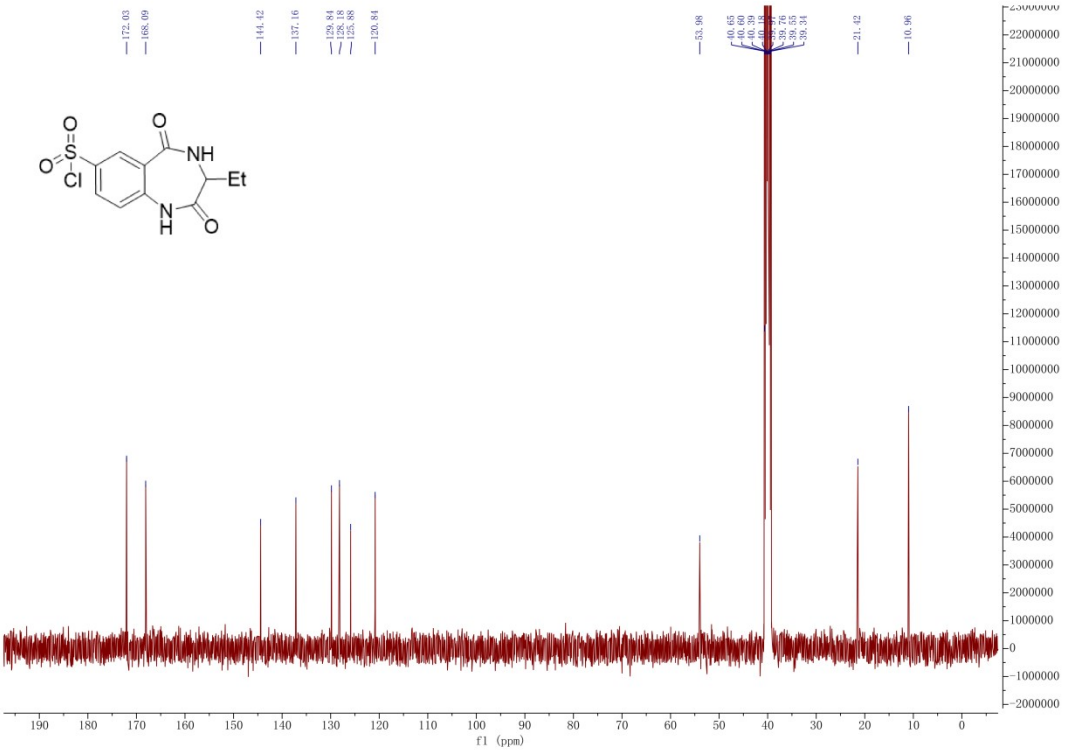
--- End Of Report ---

5. Compound （11）

5.1 ^{1}H NMR spectra of crude compound (**11**)

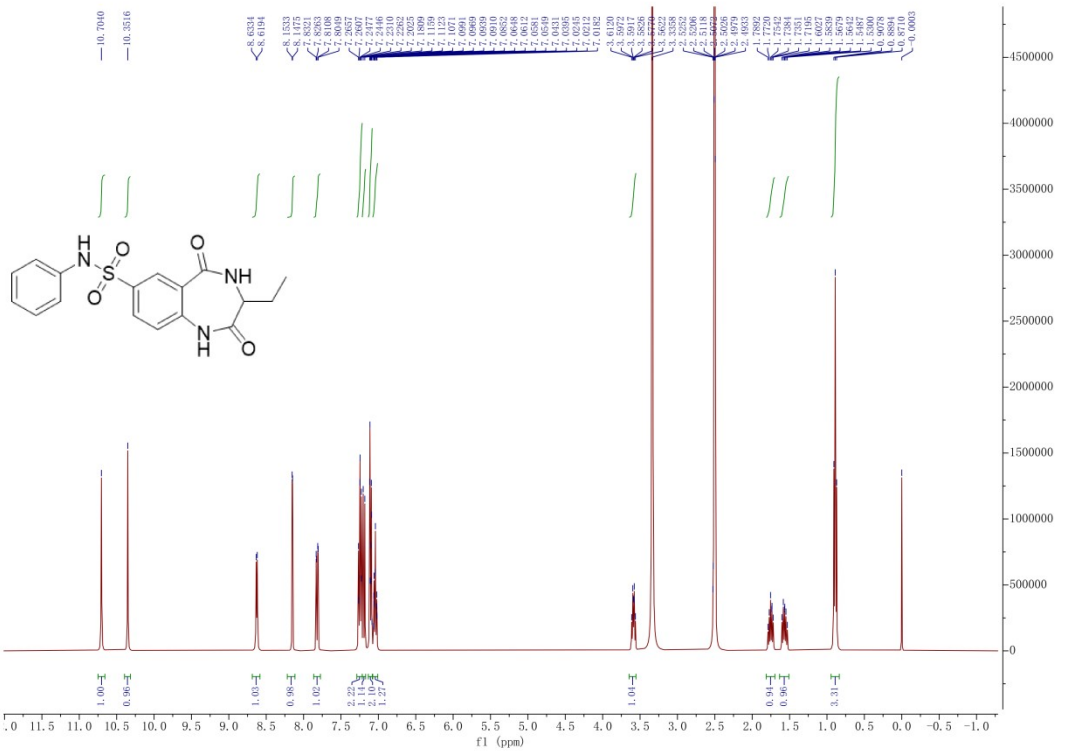


5.2 ^{13}C NMR spectra of crude compound (**11**)

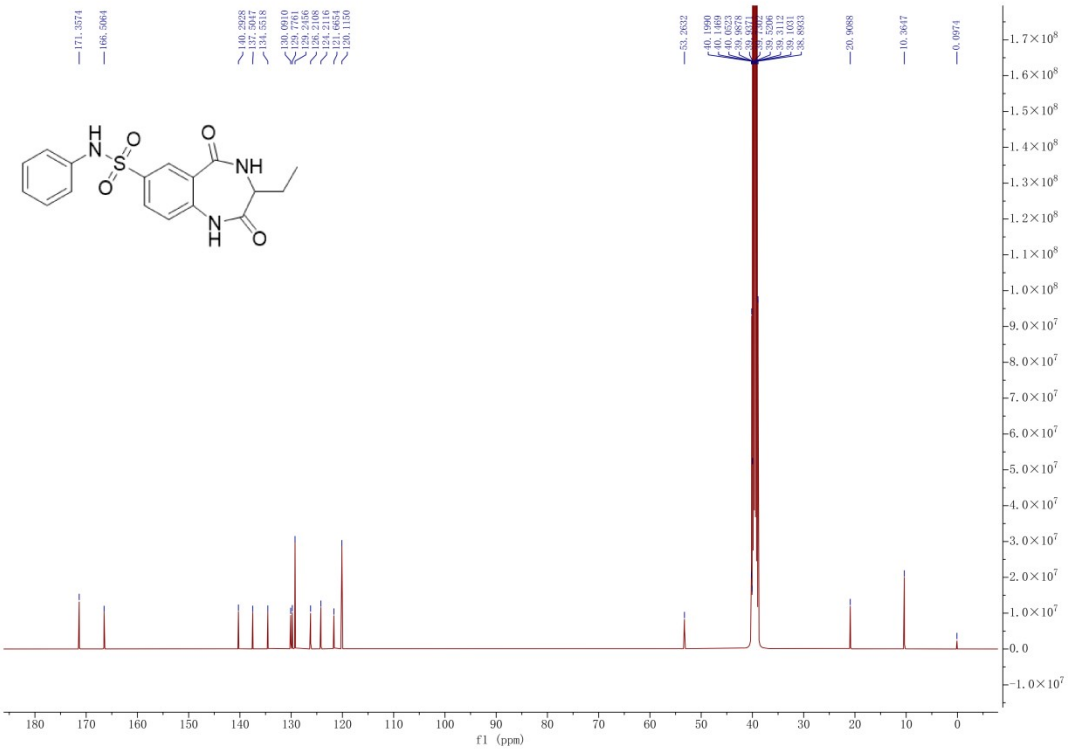


6. Compound （13）

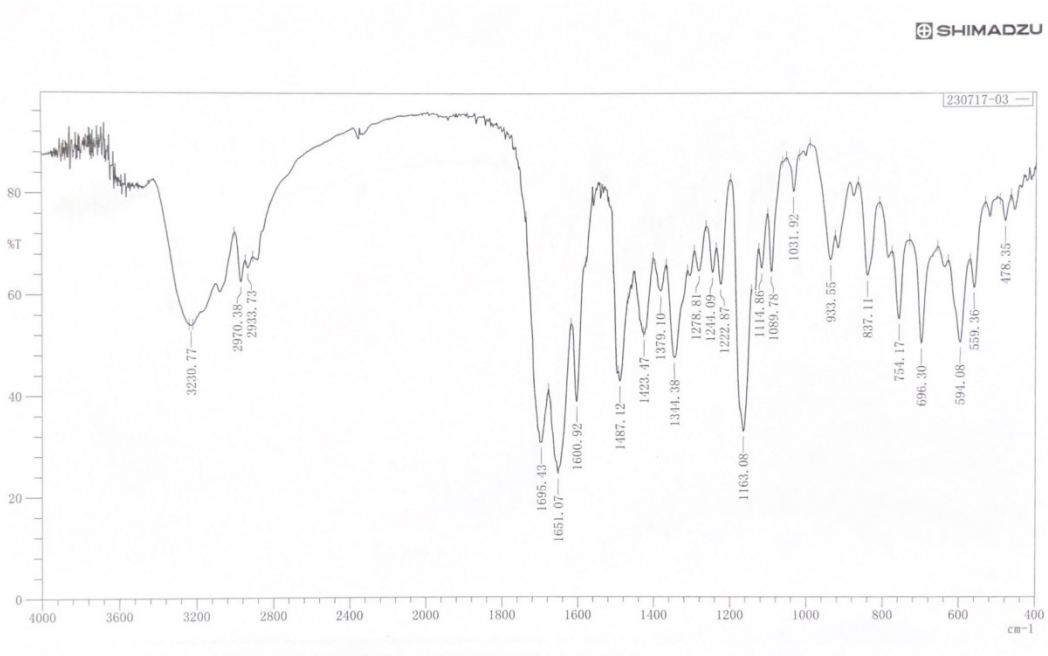
6.1 ^{1}H NMR spectra of crude compound (**13**)



6.2 ^{13}C NMR spectra of crude compound (**13**)



6.3 IR spectra of compound (**13**)



6.4 HRMS spectra of compound (**13**)

Qualitative Analysis Report

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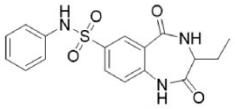
Sample Type	Sample	**Position**	P1-A2
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	12/22/2023 11:08:29 AM
IRM Calibration Status	Some Ions Missed	**DA Method**	Default.m
Comment			
Sample Group	**Info.**		



Chemical Formula: $C_{17}H_{17}N_3O_4S$
Exact Mass: 359.0940

苯卓磺胺2

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
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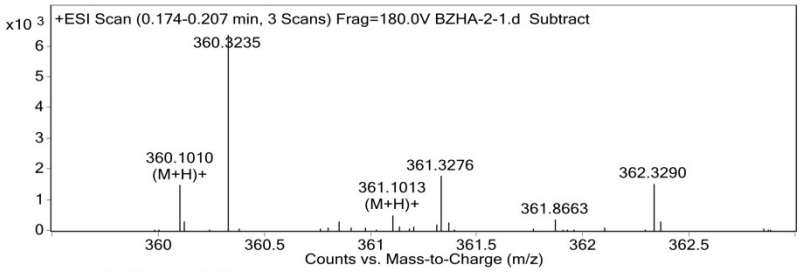

Formula Calculator Element Limits

Element	Min	Max
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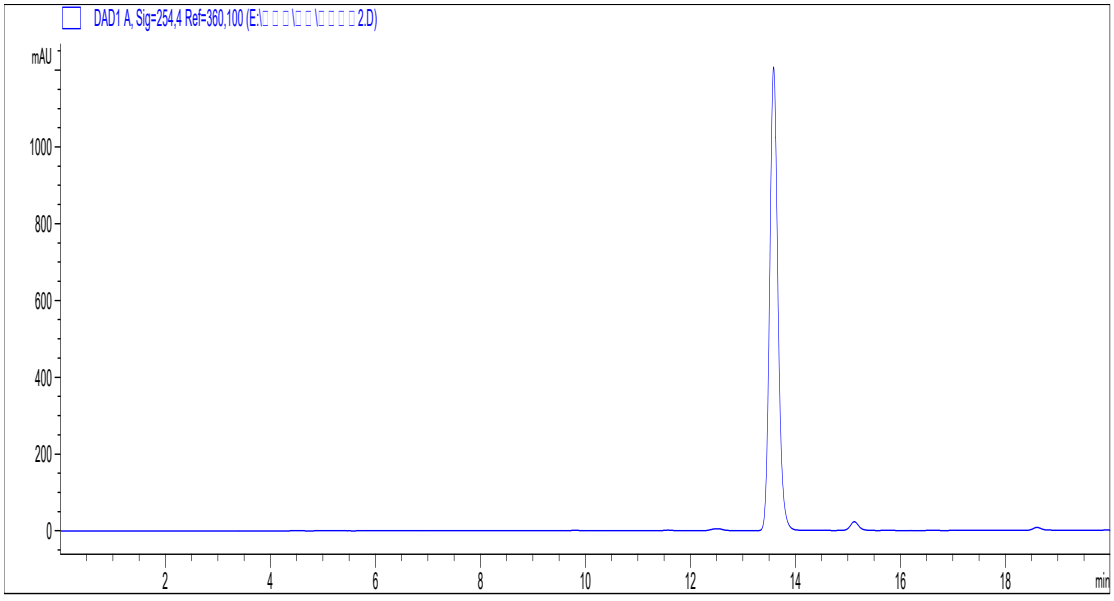
H	0	120
O	0	30
N	0	30
S	1	5

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C17 H17 N3 O4 S	TRUE	359.0936	359.094	1.04	C17 H18 N3 O4 S	67.7
C18 H13 N7 S		359.0936	359.0953	4.71	C18 H14 N7 S	65.9
C13 H13 N9 O2 S		359.0936	359.0913	-6.55	C13 H14 N9 O2 S	55.91
C13 H21 N5 O S3		359.0936	359.0908	-7.83	C13 H22 N5 O S3	50.79
C14 H21 N3 O4 S2		359.0936	359.0973	10.39	C14 H22 N3 O4 S2	40.39

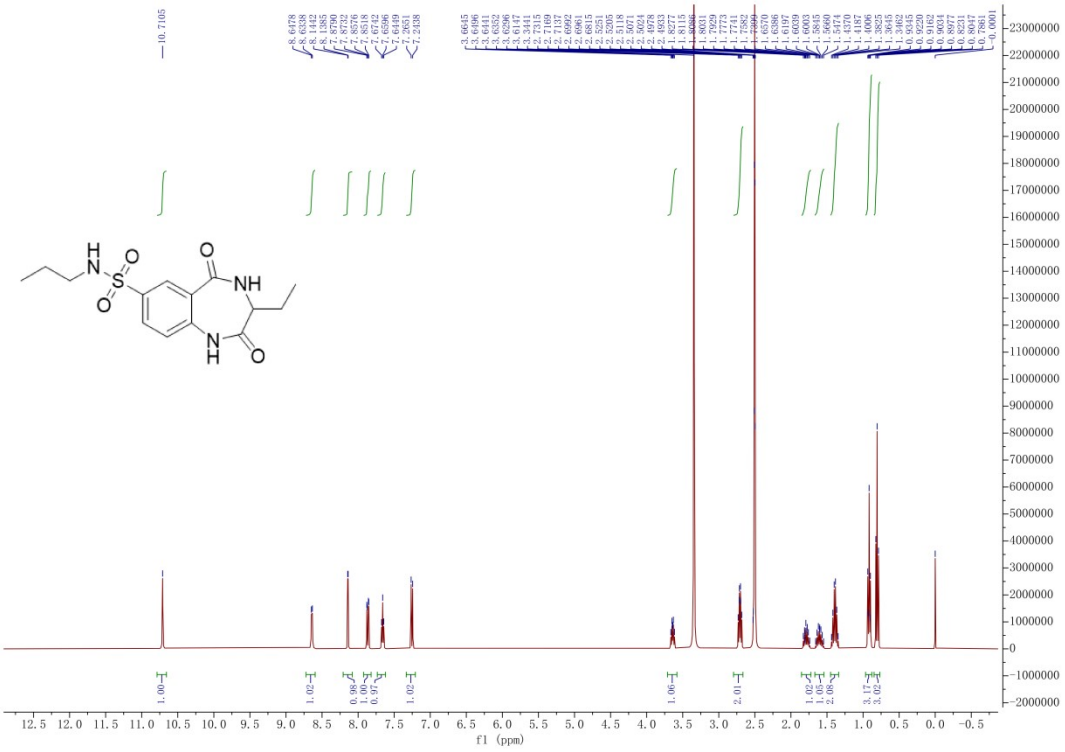
--- End Of Report ---

6.5 HPLC spectra of compound (**13**)

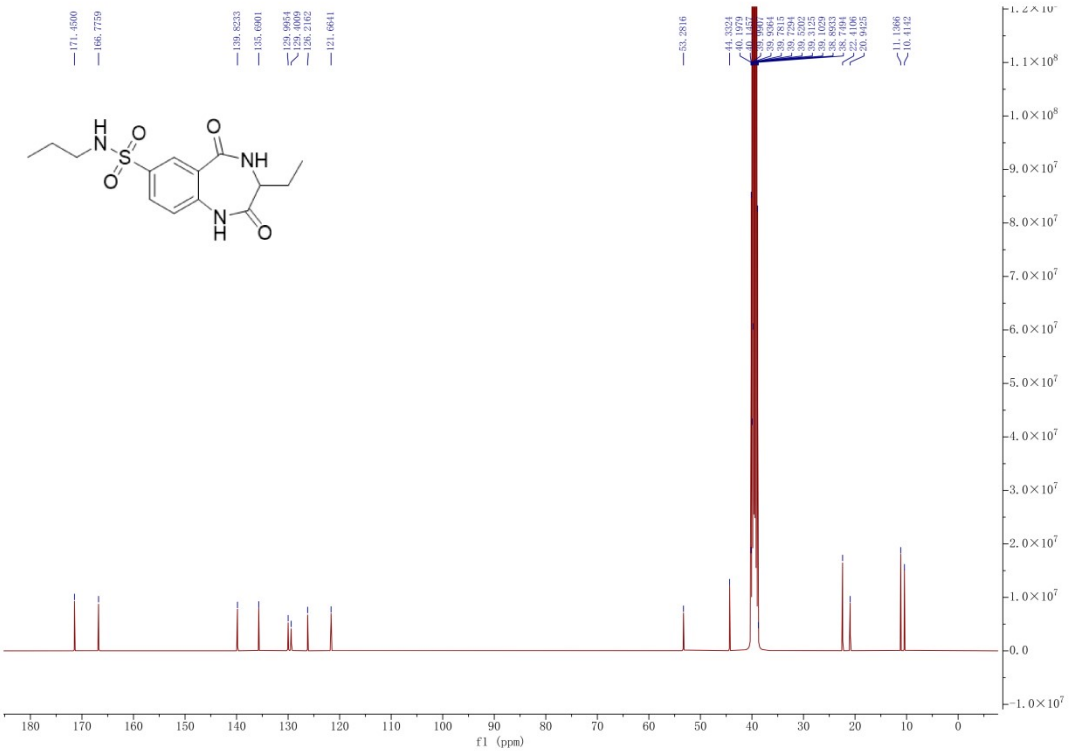


7. Compound （14）

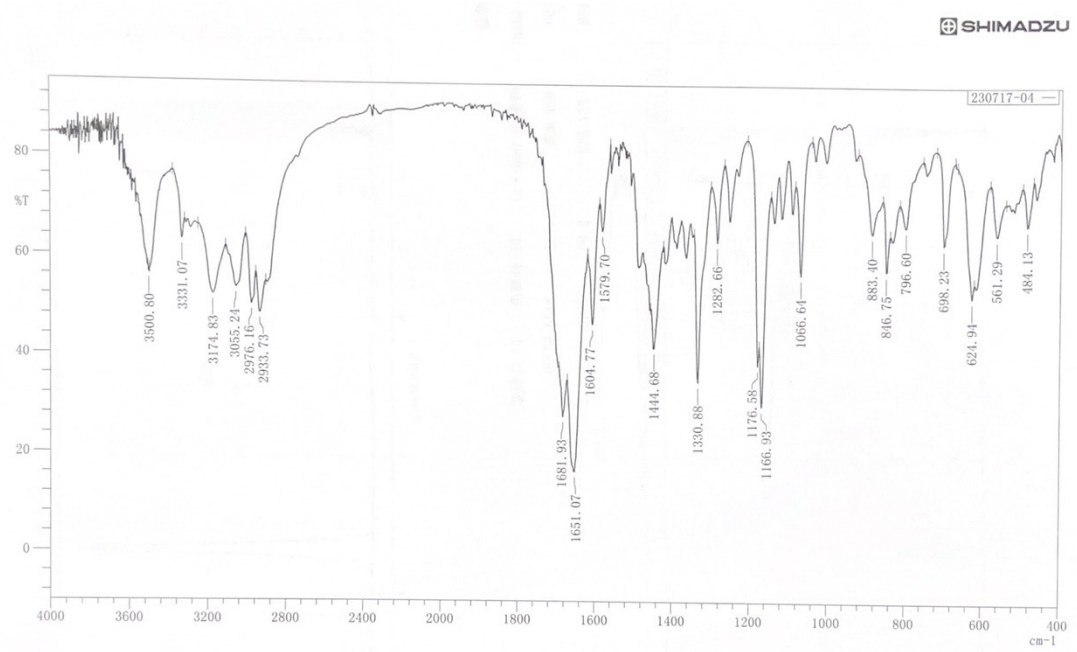
7.1 ^{1}H NMR spectra of crude compound (**14**)



7.2 ^{13}C NMR spectra of crude compound (**14**)



7.3 IR spectra of compound (**14**)

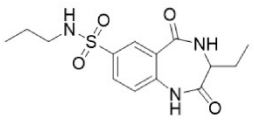


7.4 HRMS spectra of compound (**14**)

Qualitative Analysis Report

Data Filename	BZHA-3-1.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-A3
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	12/22/2023 11:09:44 AM
IRM Calibration Status	Some Ions Missed	**DA Method**	Default.m
Comment			

Sample Group **Info.**

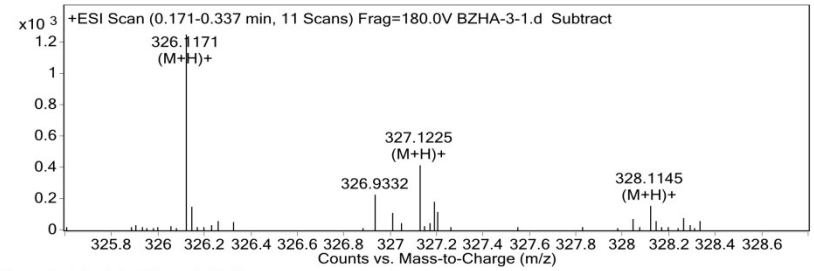


Chemical Formula: $C_{14}H_{19}N_3O_4S$
Exact Mass: 325.1096

苯卓磺胺3

User Spectra

Fragmentor Voltage 180 **Collision Energy** 0 **Ionization Mode** ESI



Formula Calculator Element Limits

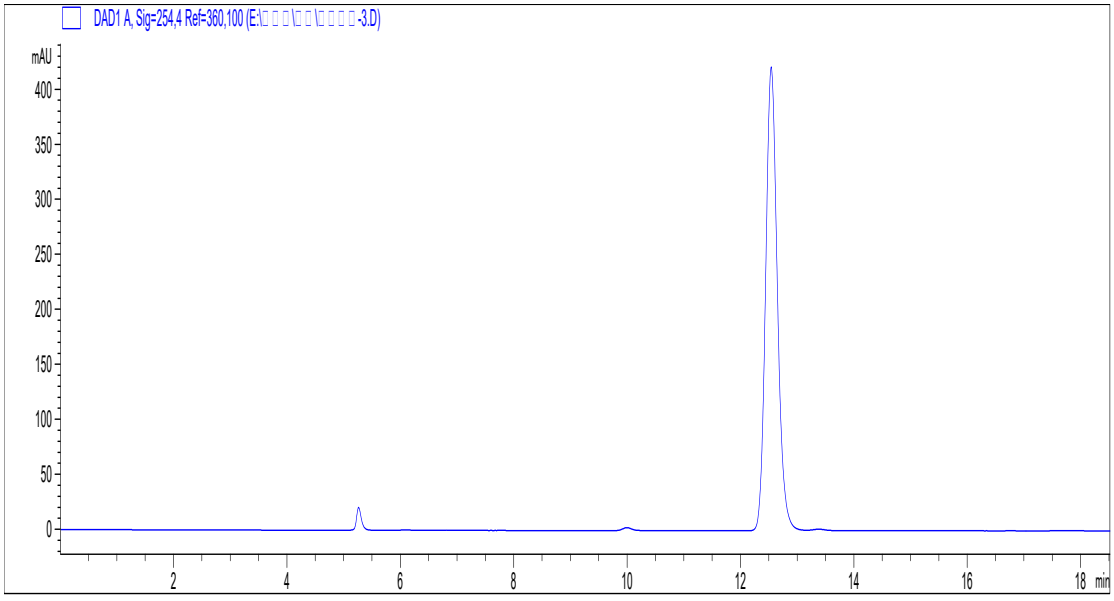
Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	30
S	1	5
Cl	0	3

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C14 H19 N3 O4 S	TRUE	325.1099	325.1096	-0.9	C14 H20 N3 O4 S	69.7
C15 H15 N7 S		325.1099	325.111	3.16	C15 H16 N7 S	69.11
C19 H19 N O2 S		325.1099	325.1136	11.51	C19 H20 N O2 S	46.99

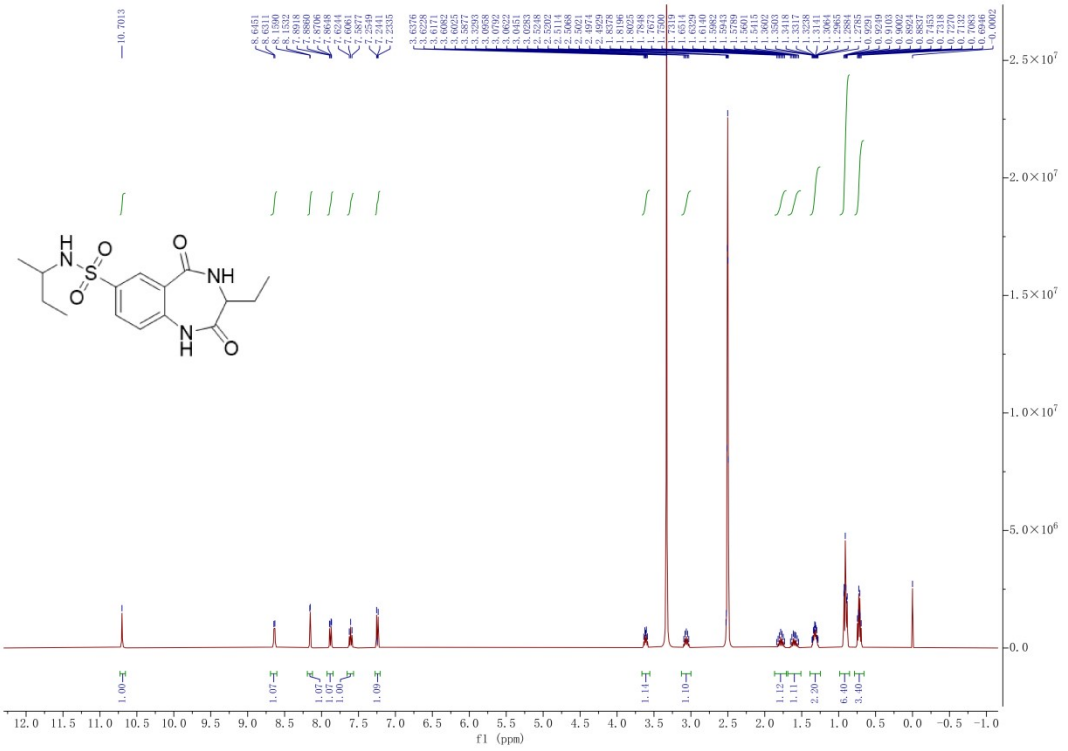
--- End Of Report ---

7.5 HPLC spectra of compound (**14**)

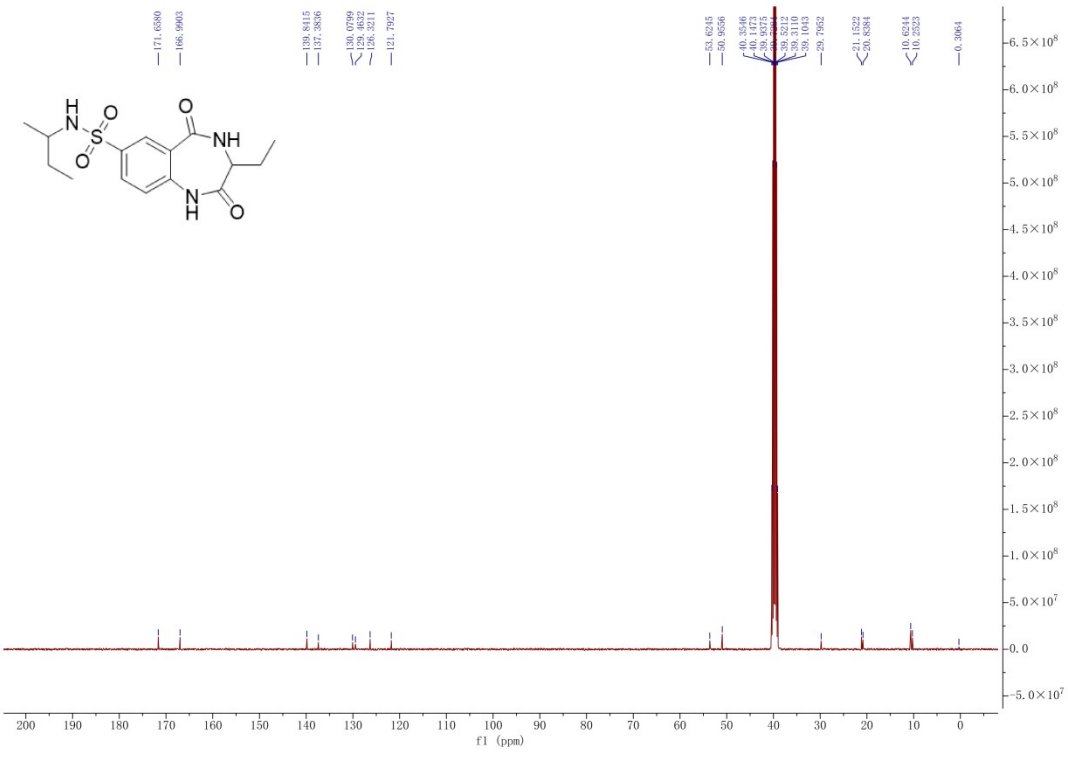


8. Compound （15）

8.1 ^{1}H NMR spectra of crude compound (**15**)



8.2 ^{13}C NMR spectra of crude compound (**15**)

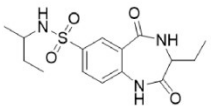


8.3 IR spectra of compound (**15**)

8.4 HRMS spectra of compound (**15**)

Qualitative Analysis Report

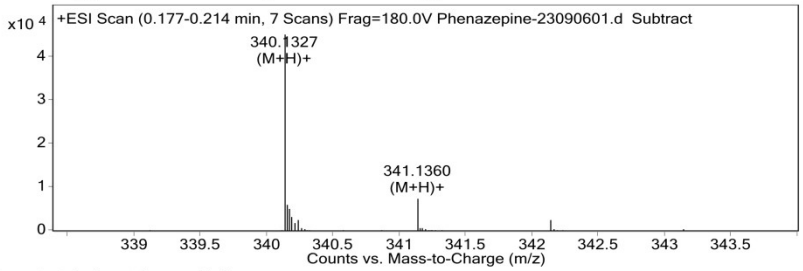
Data Filename	Phenazepine-23090601.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-A2
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	9/14/2023 6:14:47 PM
IRM Calibration Status	All Ions Missed	**DA Method**	Default.m
Comment			
Sample Group	**Info.**		



Chemical Formula: $C_{15}H_{21}N_3O_4S$
Exact Mass: 339.1253

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

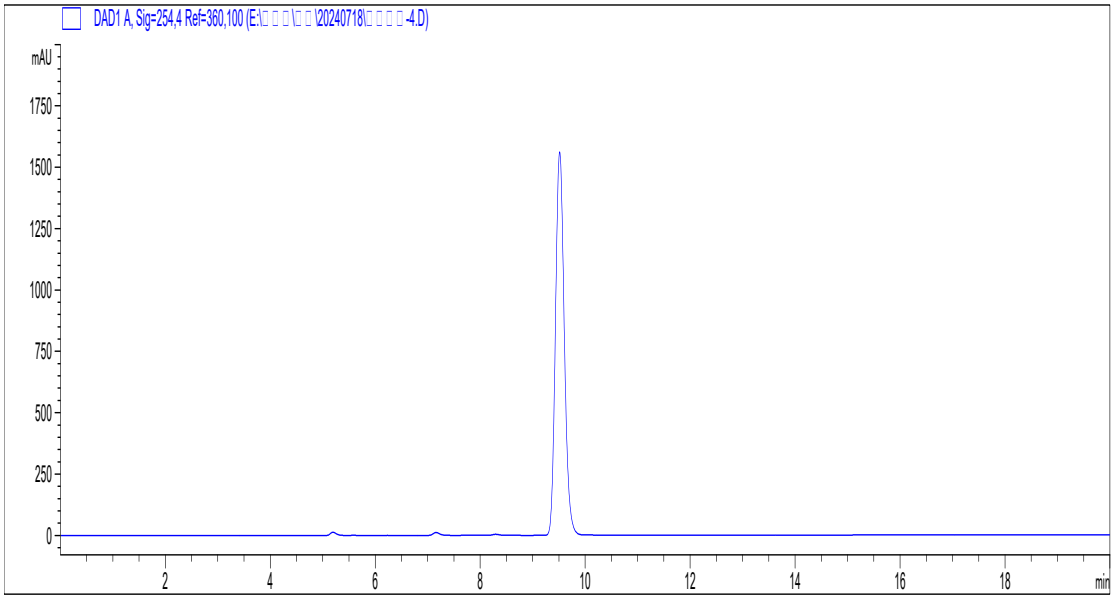
Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	30
S	0	5
Cl	0	3

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C15 H21 N3 O4 S	TRUE	339.1254	339.1253	-0.3	C15 H22 N3 O4 S	98.57
C16 H17 N7 S		339.1254	339.1266	3.64	C16 H18 N7 S	90.81
C8 H21 N9 O2 S2		339.1254	339.126	1.7	C8 H22 N9 O2 S2	85.56
C23 H17 N O2		339.1254	339.1259	1.63	C23 H18 N O2	78.72
C11 H17 N9 O2 S		339.1254	339.1226	-8.23	C11 H18 N9 O2 S	78.09
C11 H21 N3 O9		339.1254	339.1278	7.08	C11 H22 N3 O9	76.94
C19 H13 N7		339.1254	339.1232	-6.3	C19 H14 N7	70.79
C12 H25 N3 O4 S2		339.1254	339.1286	9.64	C12 H26 N3 O4 S2	66.93
C12 H17 N7 O5		339.1254	339.1291	11.02	C12 H18 N7 O5	63.39
C18 H17 N3 O4		339.1254	339.1219	-10.23	C18 H18 N3 O4	62.21

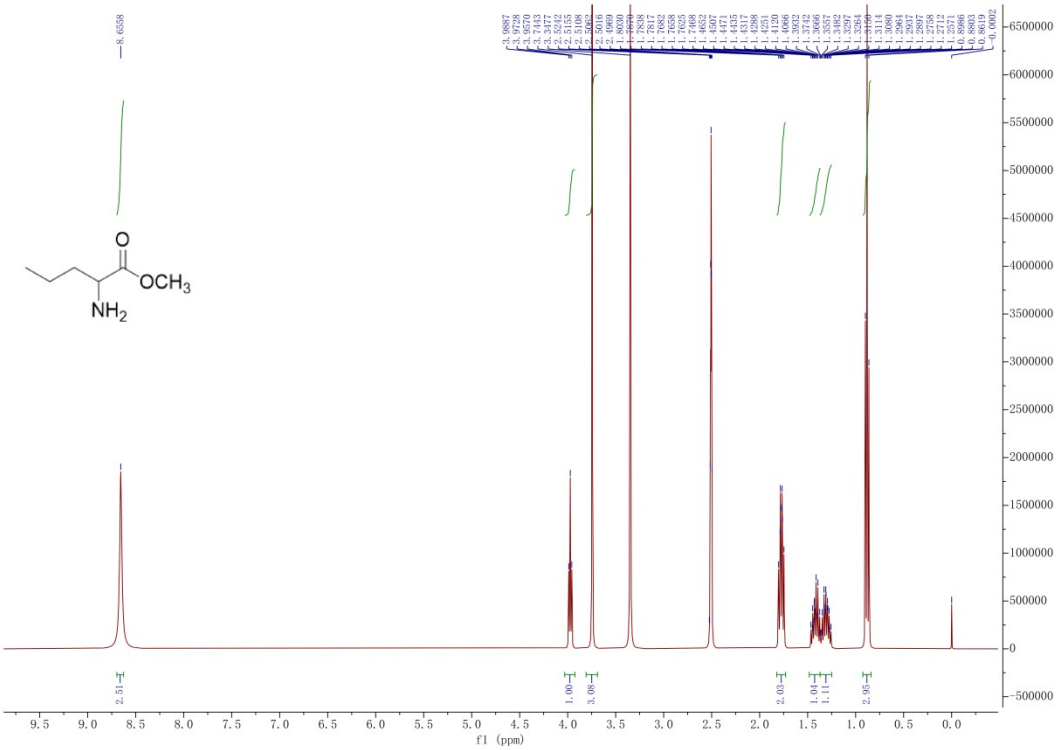
--- End Of Report ---

8.5 HPLC spectra of compound (**15**)

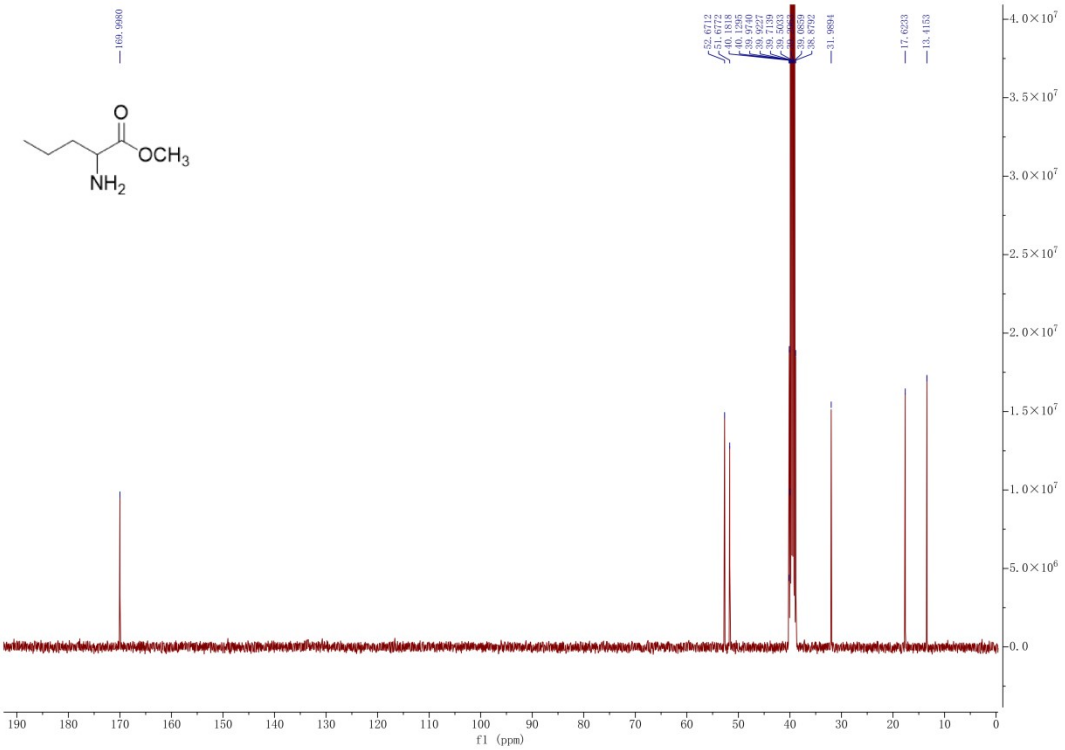


9. Compound （4）

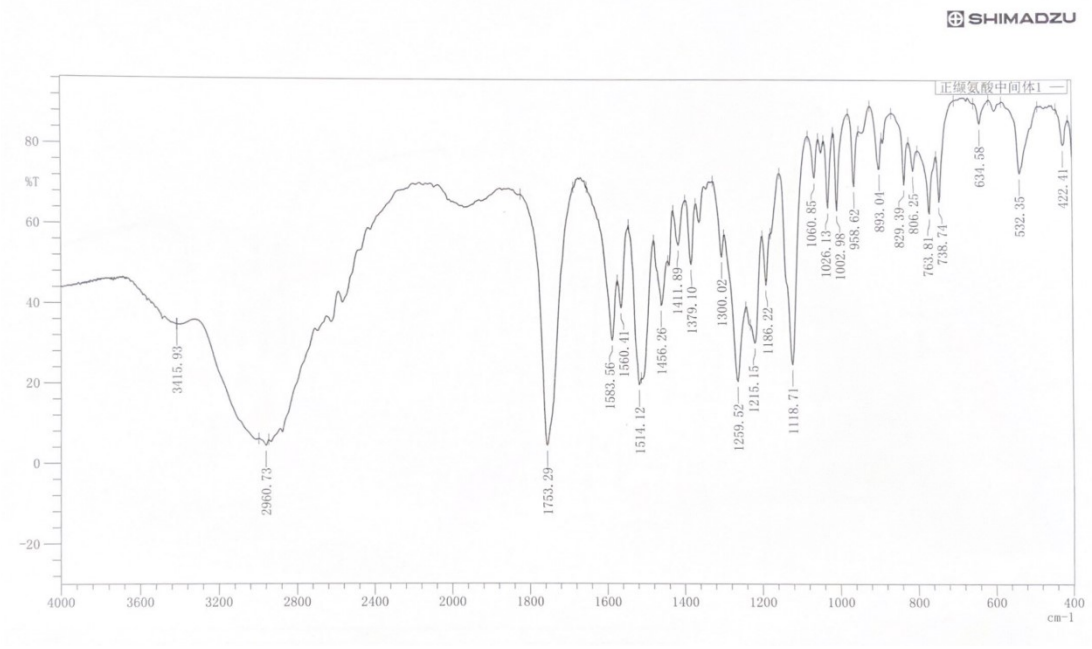
9.1 ^{1}H NMR spectra of crude compound (**4**)



9.2 ^{13}C NMR spectra of crude compound (**4**)

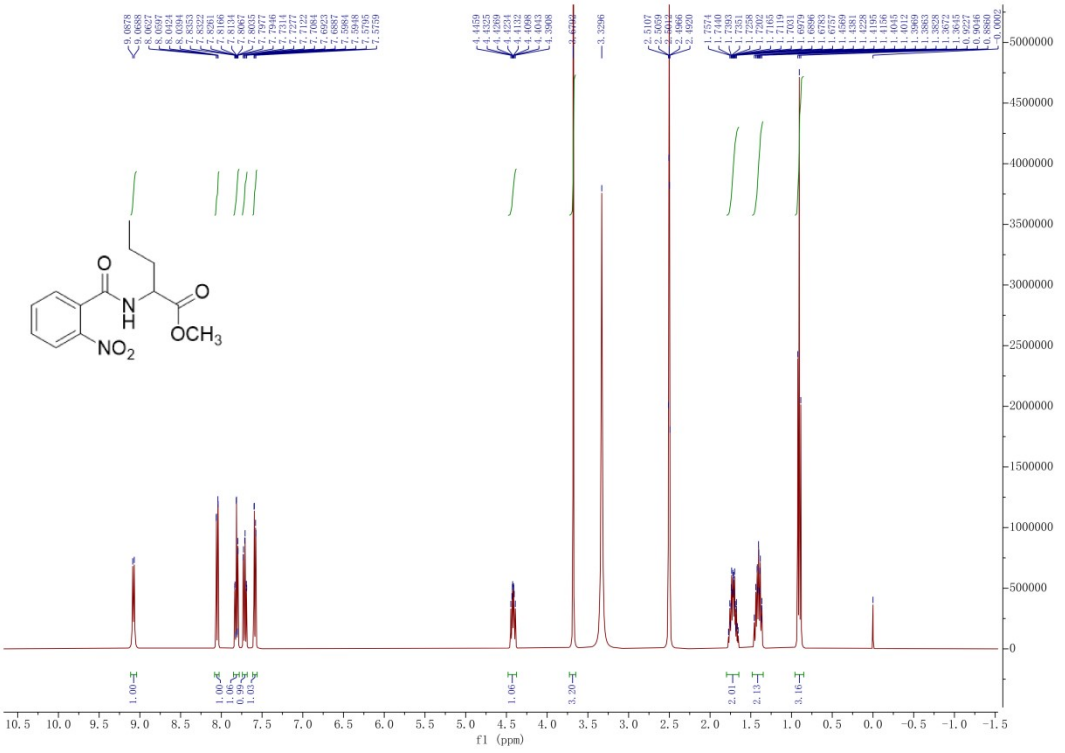


9.3 IR spectra of compound (**4**)

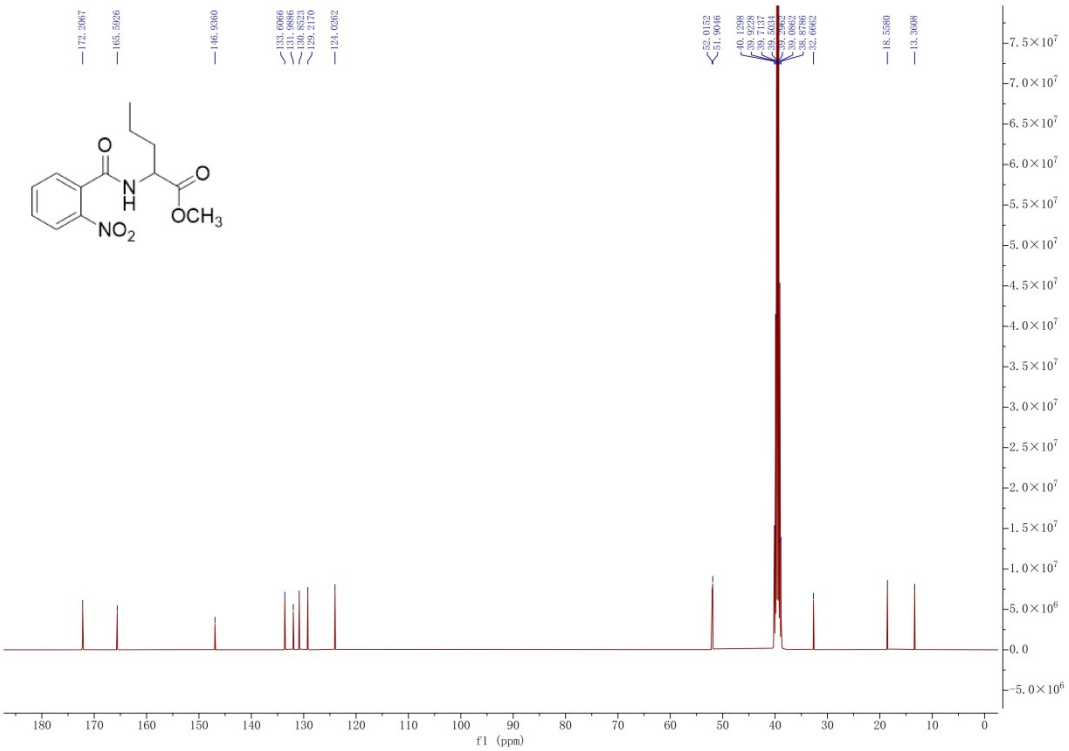


10. Compound （6）

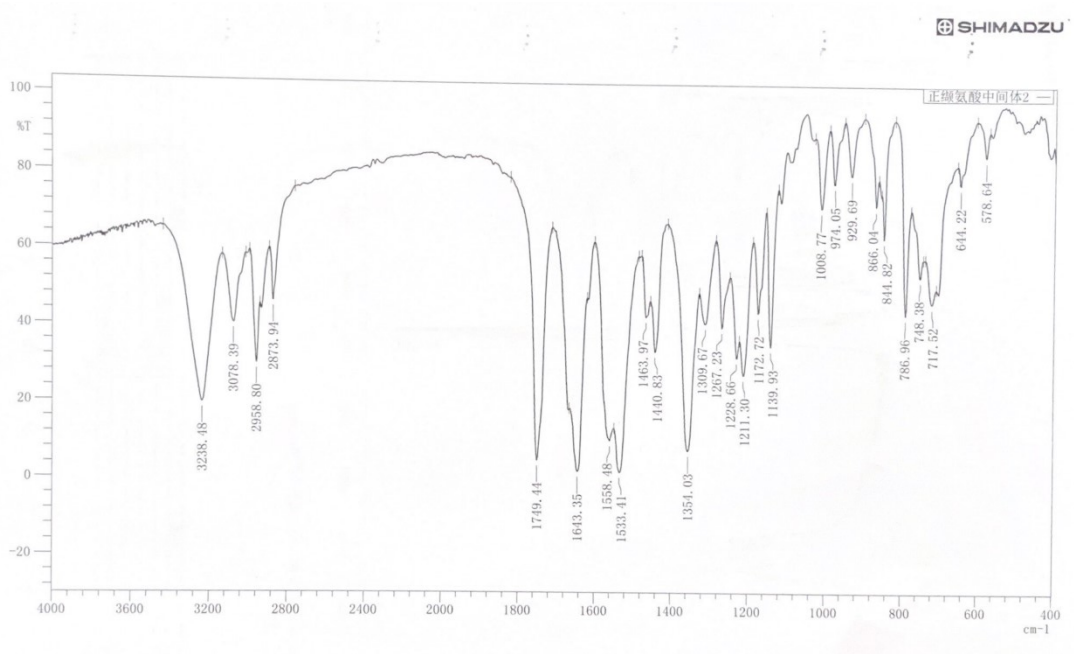
10.1 ^{1}H NMR spectra of crude compound (**6**)



10.2 ^{13}C NMR spectra of crude compound (**6**)

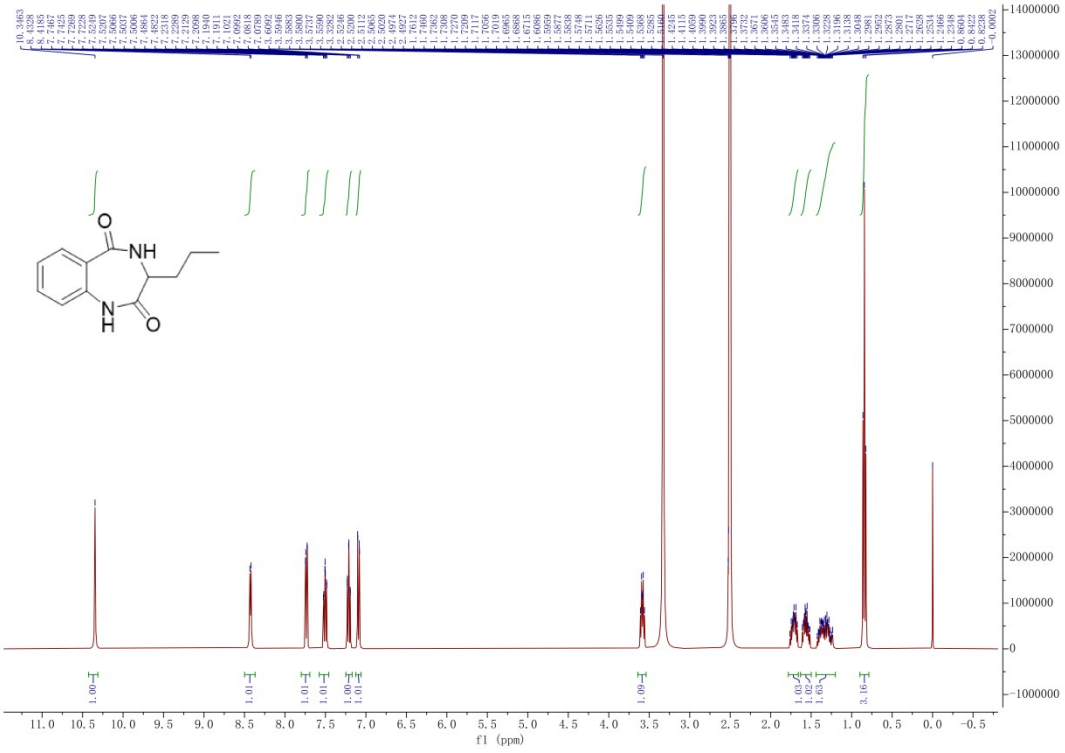


10.3 IR spectra of compound (**6**)

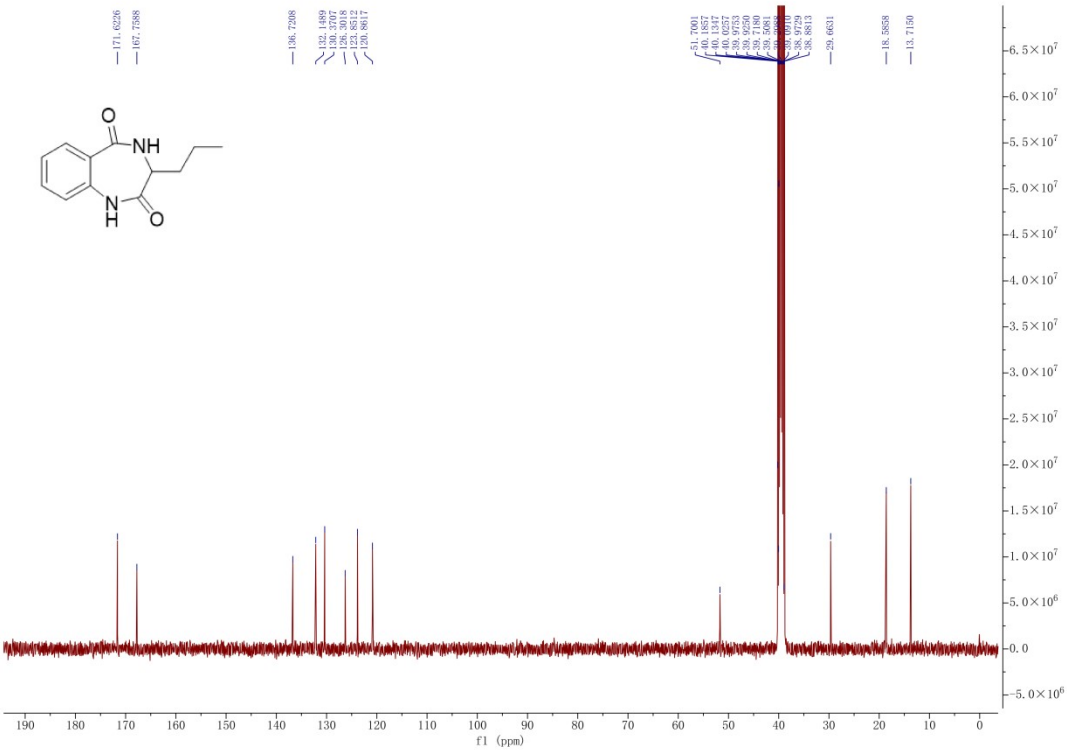


11. Compound （10）

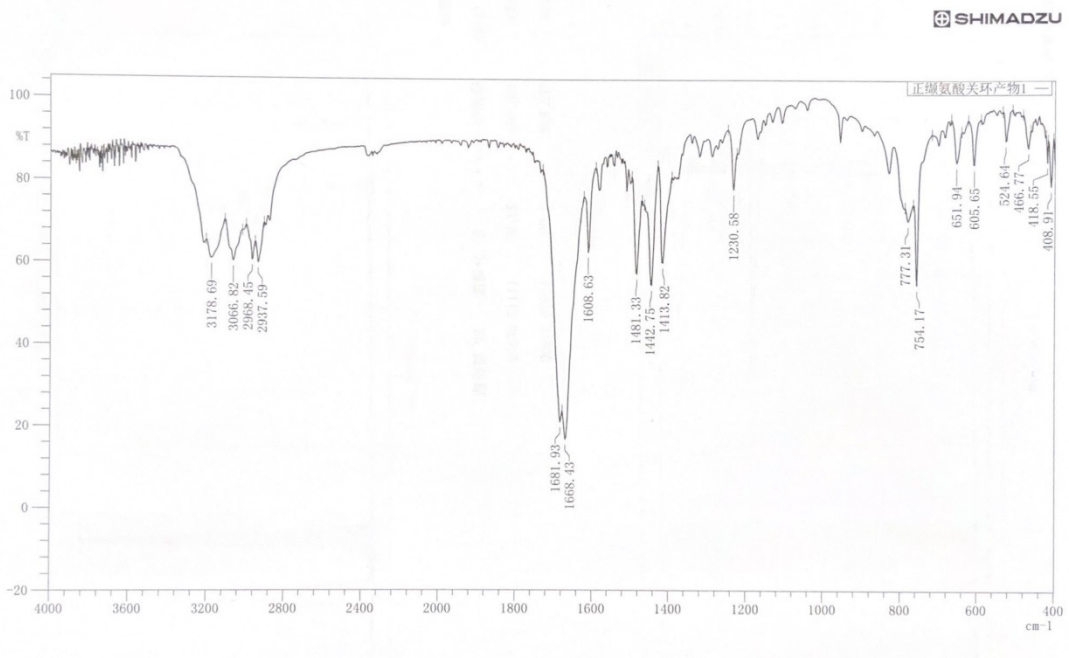
11.1 ^{1}H NMR spectra of crude compound (**10**)



11.2 ^{13}C NMR spectra of crude compound (**10**)



11.3 IR spectra of compound (**10**)

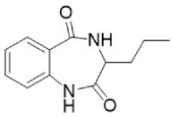


11.4 HRMS spectra of compound (**10**)

Qualitative Analysis Report

Data Filename	ZDJ.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-B4
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	7/21/2023 10:14:19 PM
IRM Calibration Status	All Ions Missed	**DA Method**	Default.m
Comment			

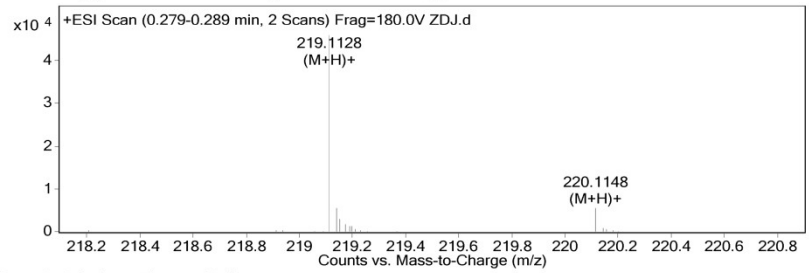
Sample Group **Info.**



Chemical Formula: $C_{12}H_{14}N_2O_2$
Exact Mass: 218.1055

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	30
S	0	5
Cl	0	3

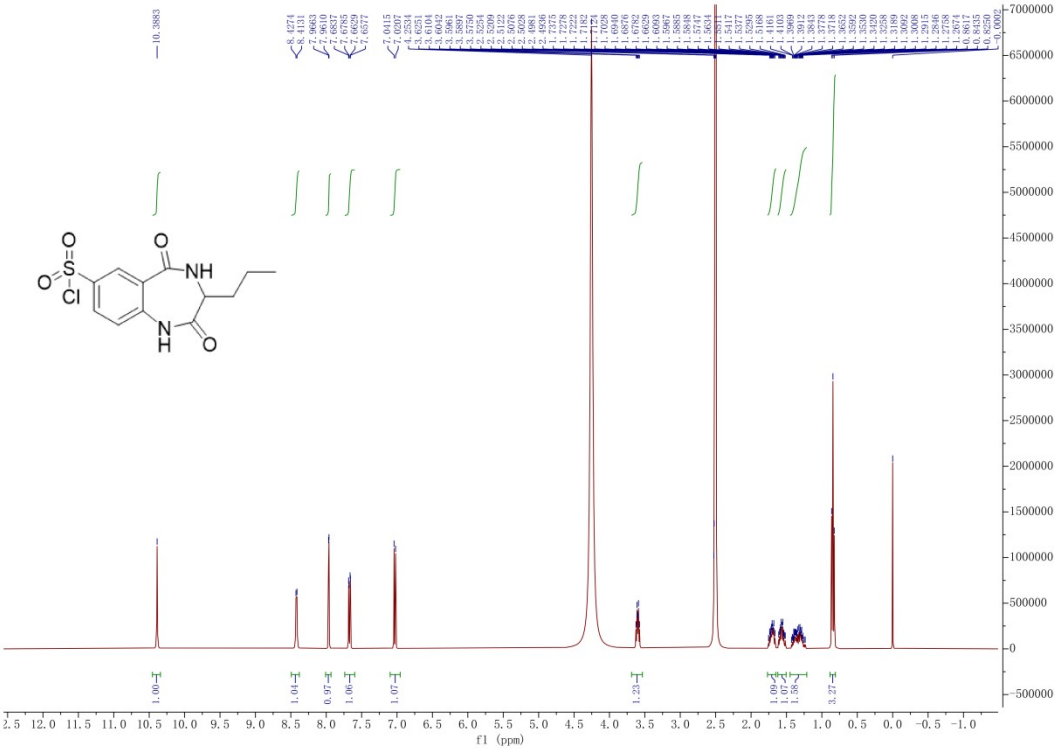
Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C12 H14 N2 O2	TRUE	218.1055	218.1055	0.27	C12 H15 N2 O2	69.94
C8 H10 N8		218.1055	218.1028	-12.07	C8 H11 N8	52.01

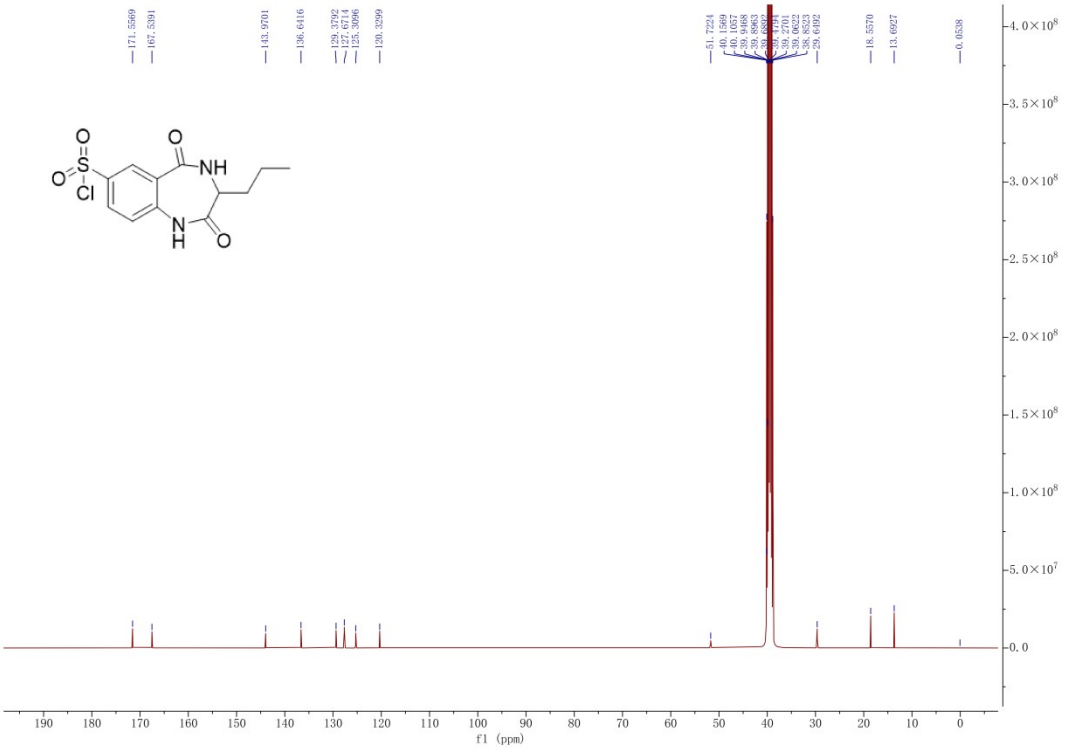
--- End Of Report ---

12. Compound （12）

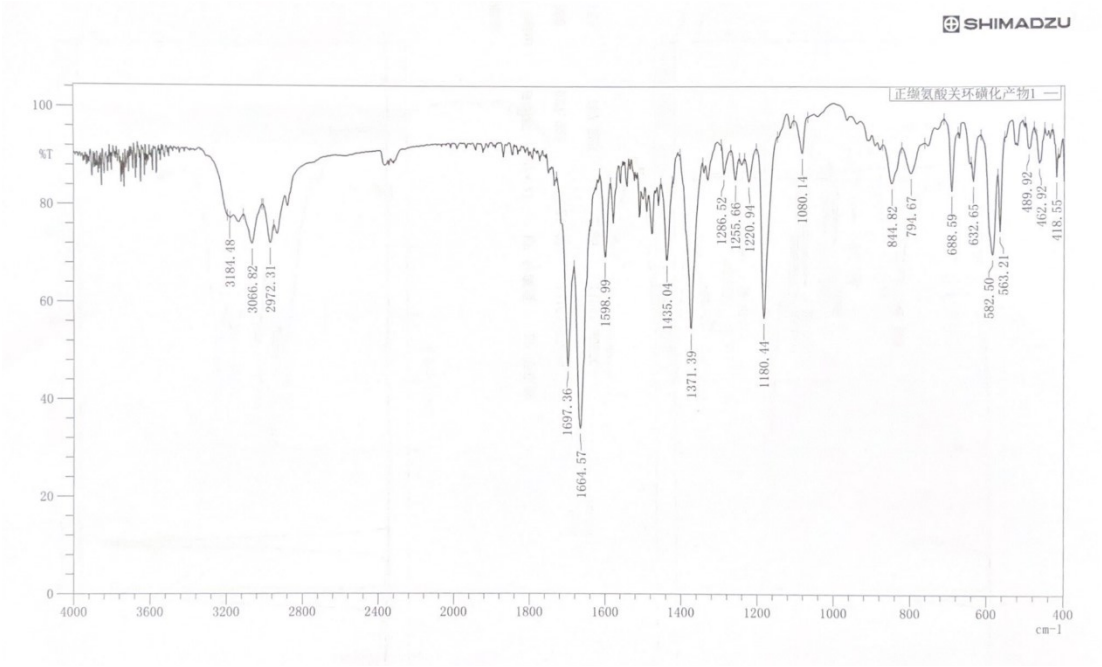
12.1 ^{1}H NMR spectra of crude compound (**12**)



12.2 ^{13}C NMR spectra of crude compound (**12**)



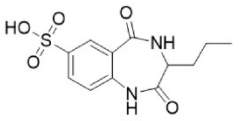
12.3 IR spectra of compound (**12**)



12.4 HRMS spectra of compound (**12**)

Qualitative Analysis Report

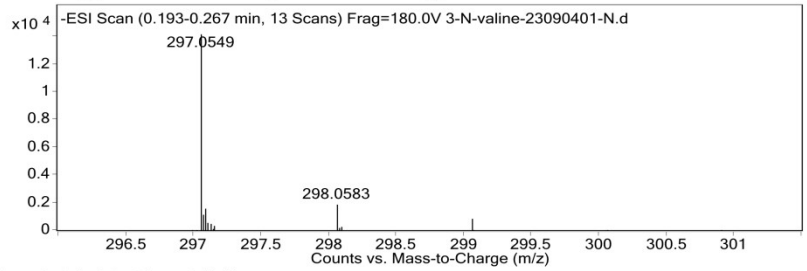
Data Filename	3-N-valine-23090401-N.d	**Sample Name**	Unavailable
Sample Type	Unavailable	**Position**	Unavailable
Instrument Name	Unavailable	**User Name**	Unavailable
Acq Method		**Acquired Time**	Unavailable
IRM Calibration Status	Success	**DA Method**	Default.m
Comment	Sample information is unavailable		



Chemical Formula: $C_{12}H_{14}N_2O_5S$
Molecular Weight: 298.3130

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	0	30
N	0	30
S	0	5
Cl	0	3

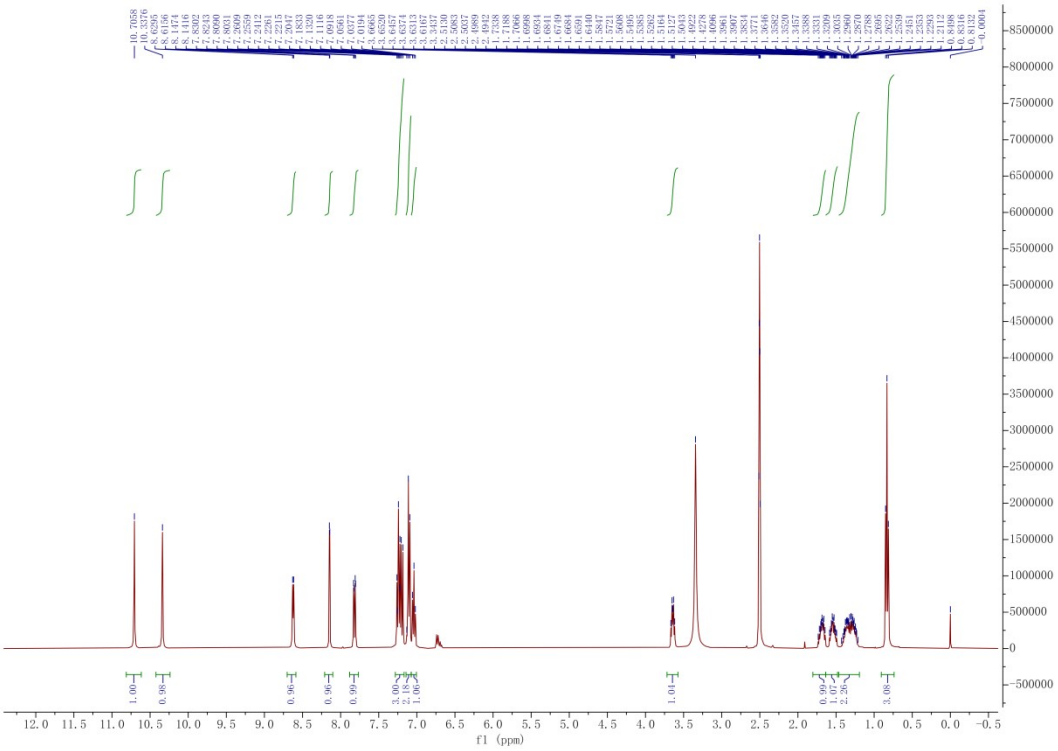
Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C12 H14 N2 O5 S	TRUE	298.0622	298.0623	0.55	C12 H13 N2 O5 S	98.77
C10 H12 N5 O4 S		298.0622	298.061	-3.96	C10 H11 N5 O4 S	93.3
C13 H10 N6 O S		298.0622	298.0637	5.03	C13 H9 N6 O S	87.15
C9 H16 N O8 S		298.0622	298.0597	-8.44	C9 H15 N O8 S	80.45
C13 H18 N2 S3		298.0622	298.0632	3.46	C13 H17 N2 S3	79.73
C8 H10 N8 O3 S		298.0622	298.0597	-8.47	C8 H9 N8 O3 S	77.52
C18 H8 N3 O2		298.0622	298.0617	-1.76	C18 H7 N3 O2	77.29
C7 H16 N5 O4 S2		298.0622	298.0644	7.34	C7 H15 N5 O4 S2	75.05
C10 H20 N O3 S3		298.0622	298.0605	-5.54	C10 H19 N O3 S3	74.3
C20 H10 O3		298.0622	298.063	2.74	C20 H9 O3	74.21

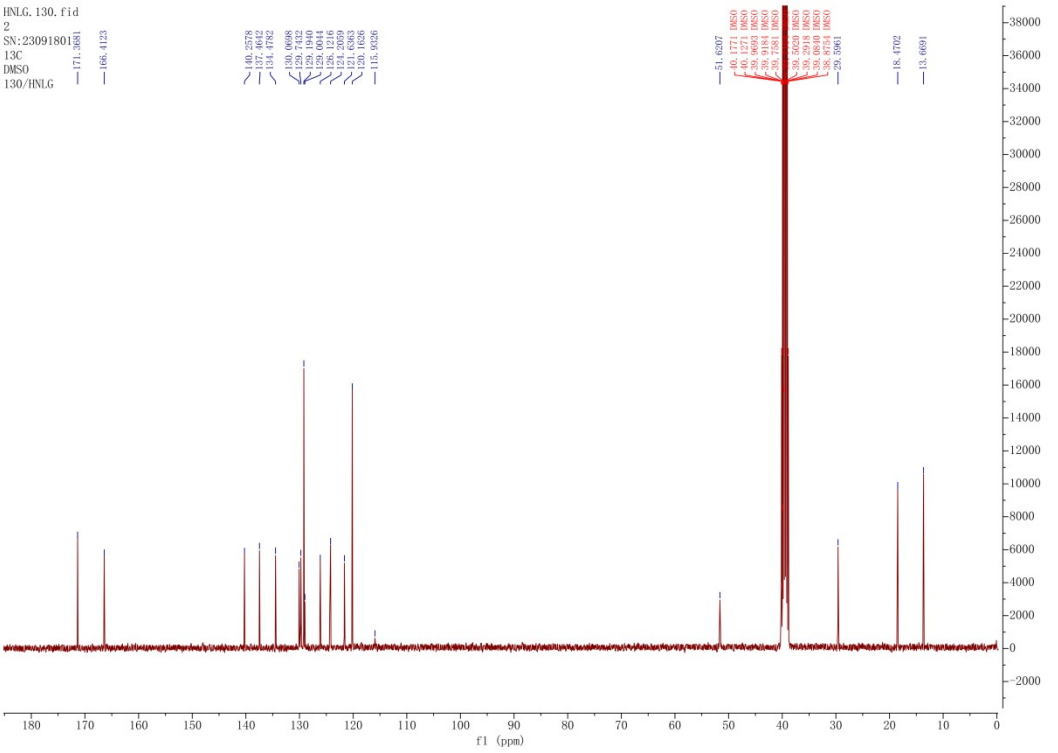
--- End Of Report ---

13. Compound （16）

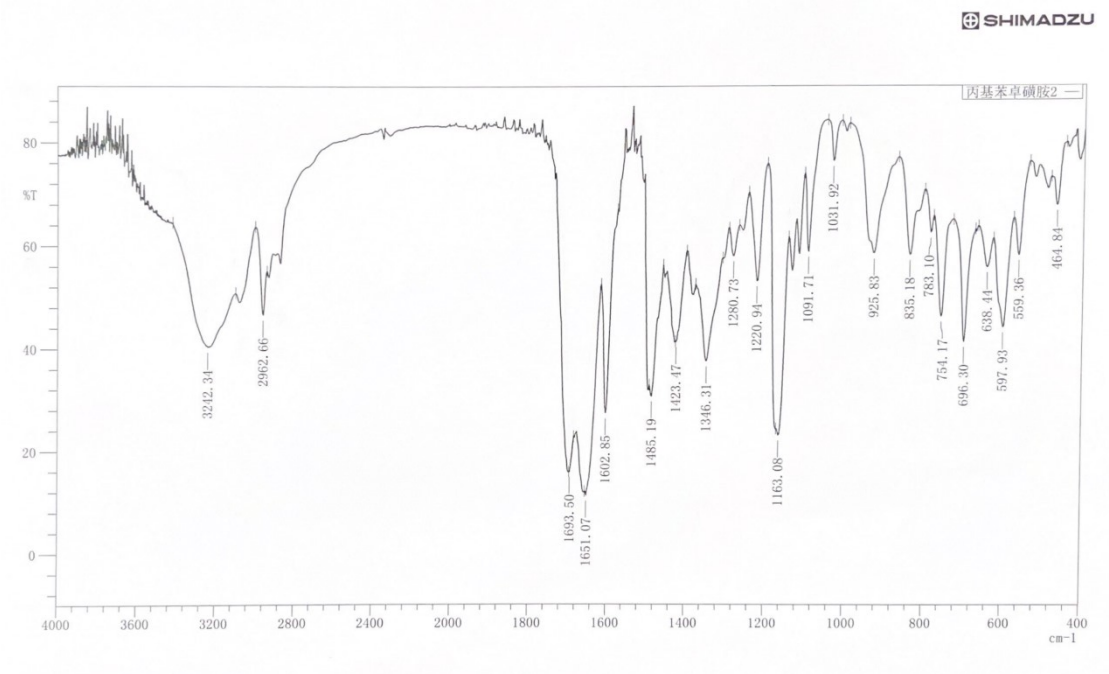
13.1 ^{1}H NMR spectra of crude compound (**16**)



13.2 ^{13}C NMR spectra of crude compound (**16**)



13.3 IR spectra of compound (**16**)

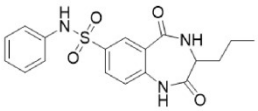


13.4 HRMS spectra of compound (**16**)

Qualitative Analysis Report

Data Filename	9-BJBZHA-2.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-A9
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	10/12/2023 2:53:08 PM
IRM Calibration Status	Success	**DA Method**	Default.m
Comment			

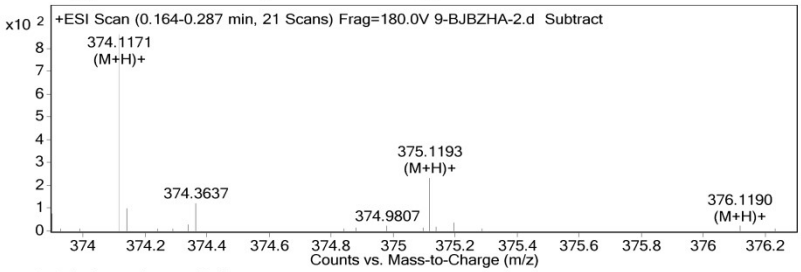
Sample Group **Info.**



Chemical Formula: $C_{18}H_{19}N_3O_4S$
Exact Mass: 373.1096

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

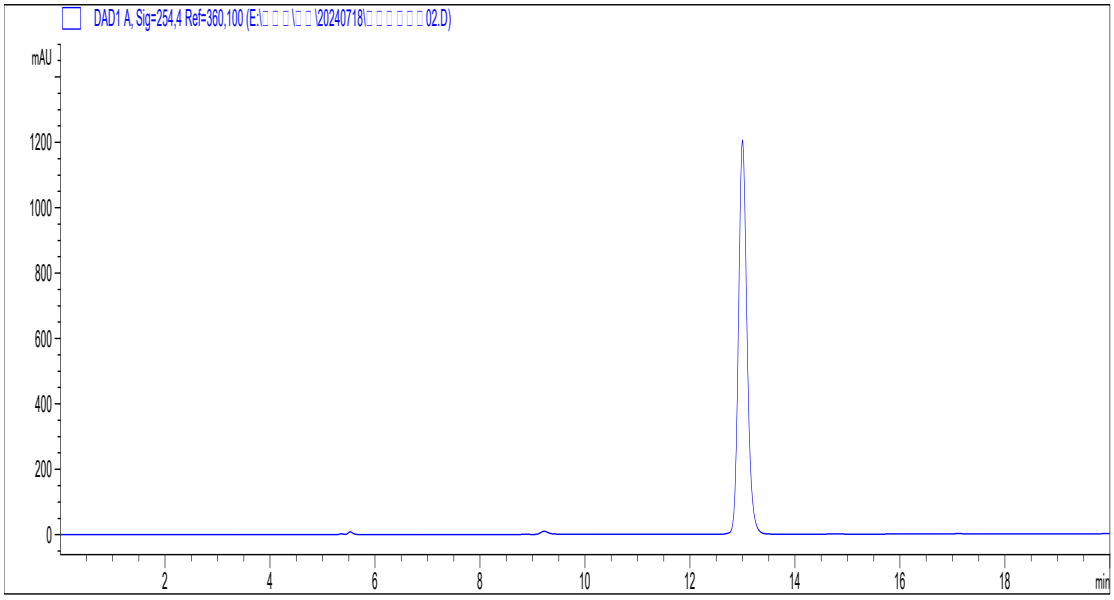
Element	Min	Max
C	3	60
H	0	120
O	1	30
N	0	30
S	1	5

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C18 H19 N3 O4 S	TRUE	373.1098	373.1096	-0.59	C18 H20 N3 O4 S	86.13
C11 H19 N9 O2 S2		373.1099	373.1103	1.19	C11 H20 N9 O2 S2	74.82
C10 H23 N5 O6 S2		373.1099	373.109	-2.37	C10 H24 N5 O6 S2	71.28
C14 H15 N9 O2 S		373.1099	373.1069	-7.83	C14 H16 N9 O2 S	65.52
C23 H19 N O2 S		373.1098	373.1136	10.2	C23 H20 N O2 S	62.36

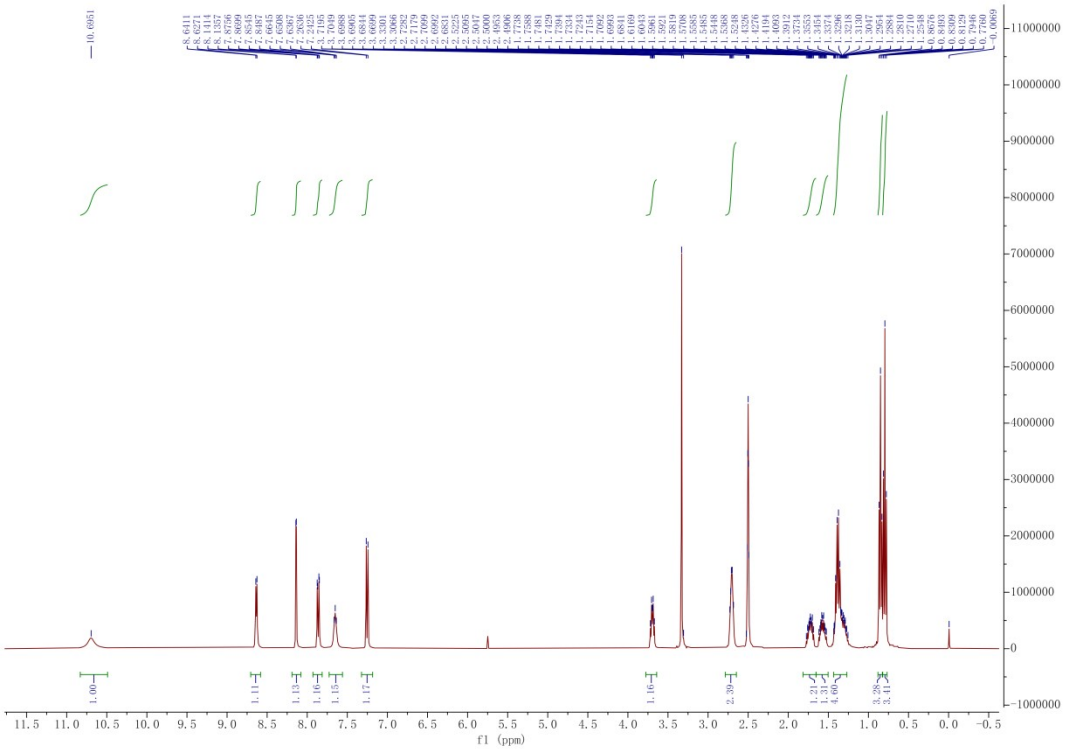
--- End Of Report ---

13.5 HPLC spectra of compound (**16**)

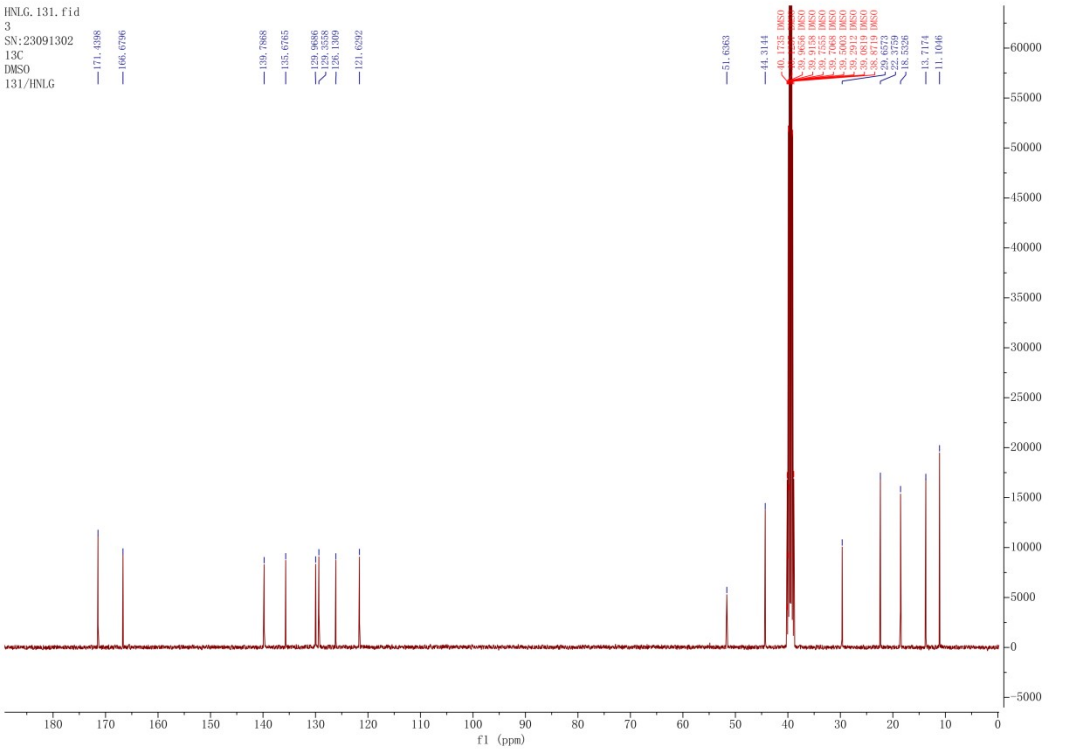


14. Compound （17）

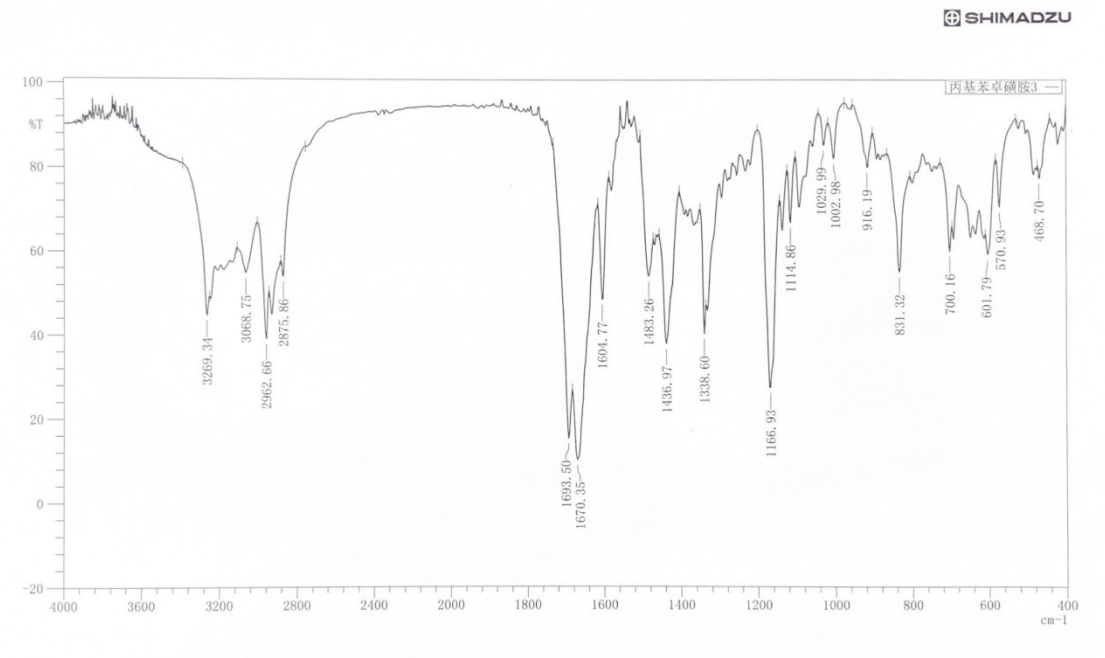
14.1 ^{1}H NMR spectra of crude compound (**17**)



14.2 ^{13}C NMR spectra of crude compound (**17**)



14.3 IR spectra of compound (**17**)

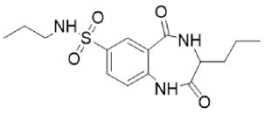


14.4 HRMS spectra of compound (**17**)

Qualitative Analysis Report

Data Filename	10-BJBZHA-3.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-B1
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	10/12/2023 2:54:20 PM
IRM Calibration Status	Success	**DA Method**	Default.m
Comment			

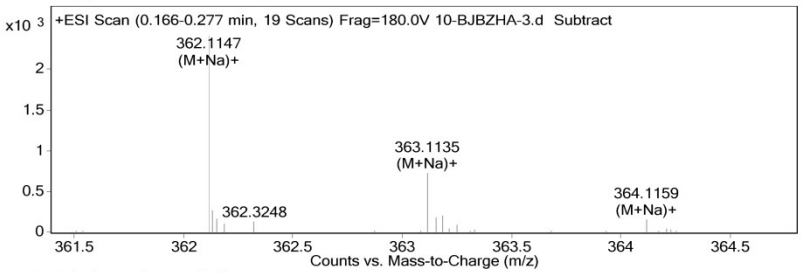
Sample Group **Info.**



Chemical Formula: $C_{15}H_{21}N_3O_4S$
Exact Mass: 339.1253

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

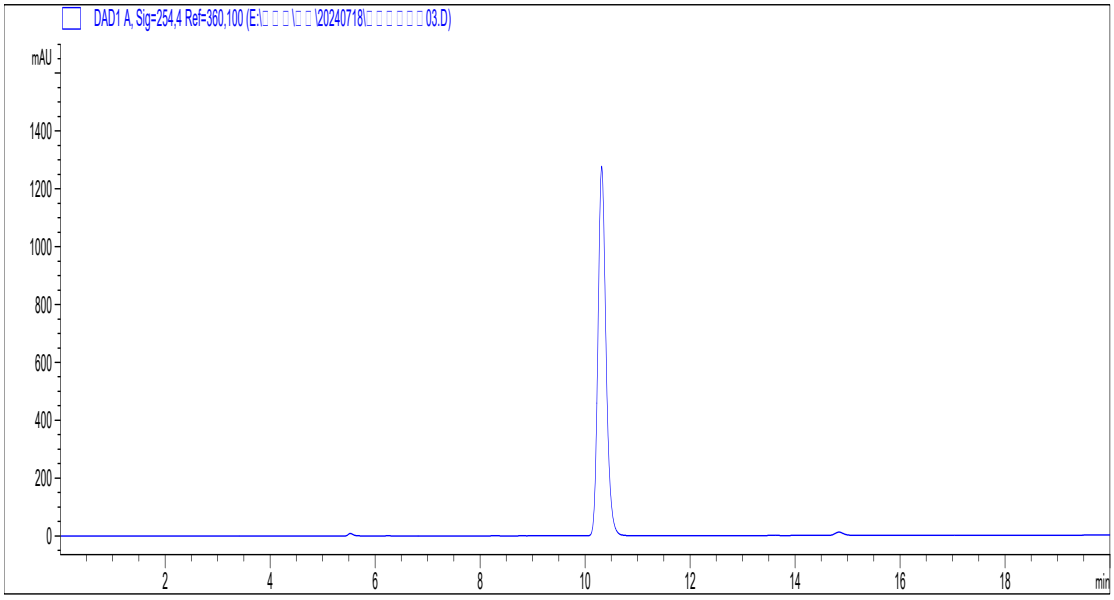
Element	Min	Max
C	3	60
H	0	120
O	1	30
N	0	30
S	1	5

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C15 H21 N3 O4 S	TRUE	339.1254	339.1253	-0.34	C15 H21 N3 Na O4 S	73.1
C8 H21 N9 O2 S2		339.1254	339.126	1.57	C8 H21 N9 Na O2 S2	64.33
C20 H21 N O2 S		339.1254	339.1293	11.55	C20 H21 N Na O2 S	52.93
C11 H17 N9 O2 S		339.1254	339.1226	-8.33	C11 H17 N9 Na O2 S	51.57
C12 H25 N3 O4 S2		339.1254	339.1286	9.58	C12 H25 N3 Na O4 S2	42.57

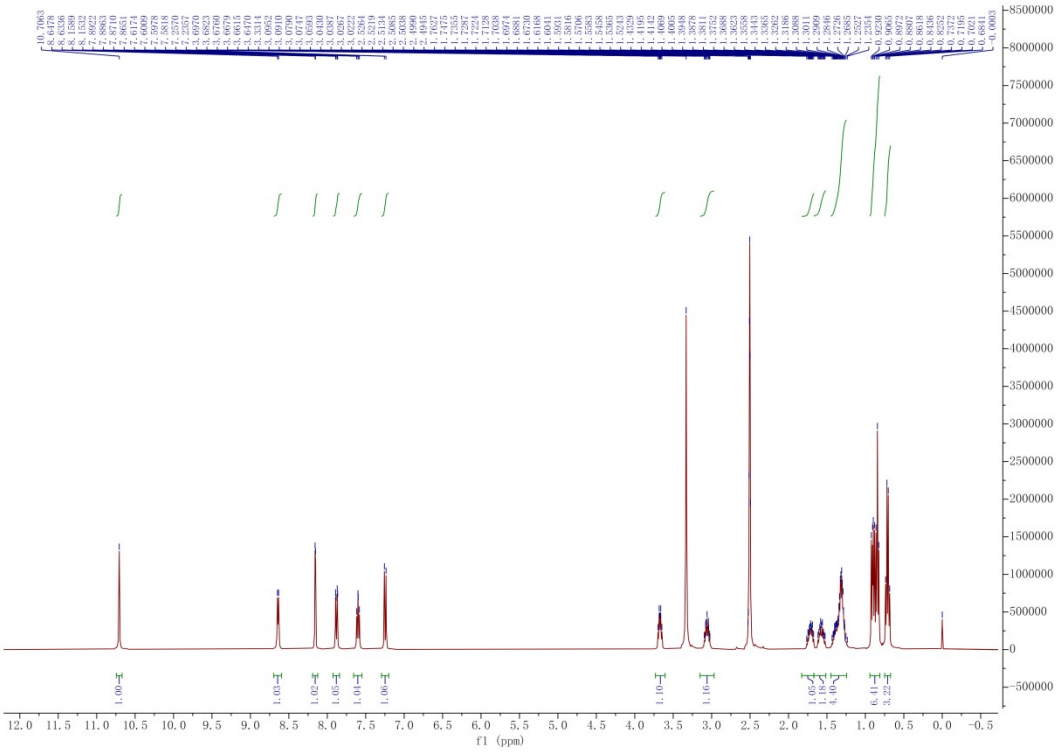
--- End Of Report ---

14.5 HPLC spectra of compound (**17**)

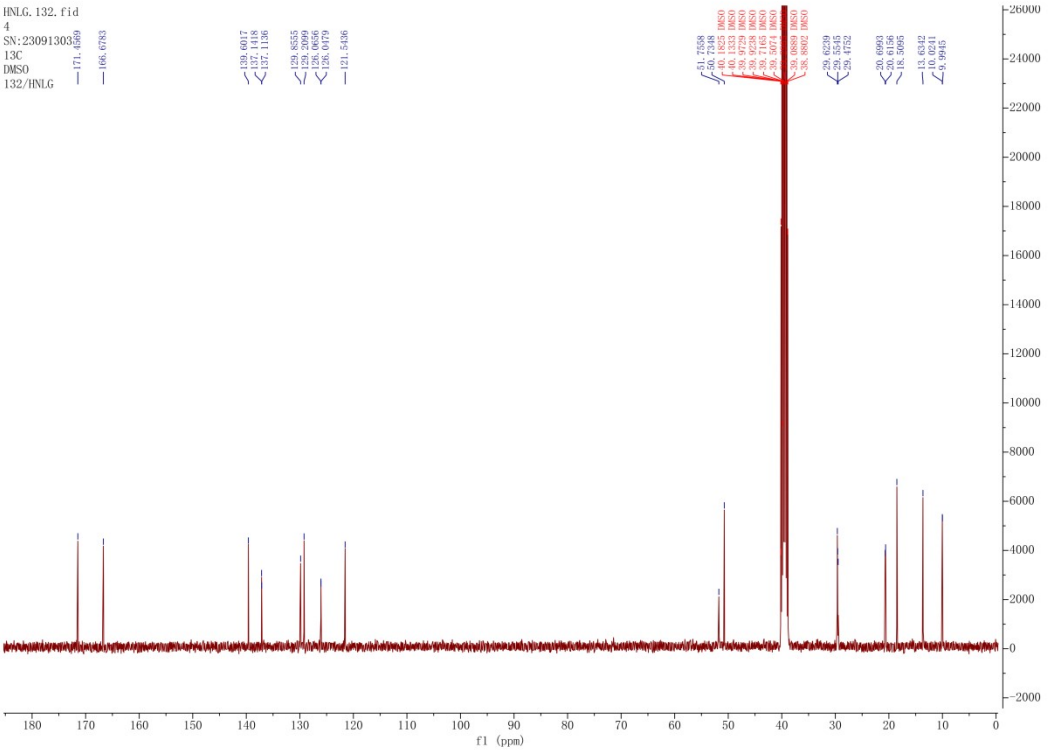


15. Compound （18）

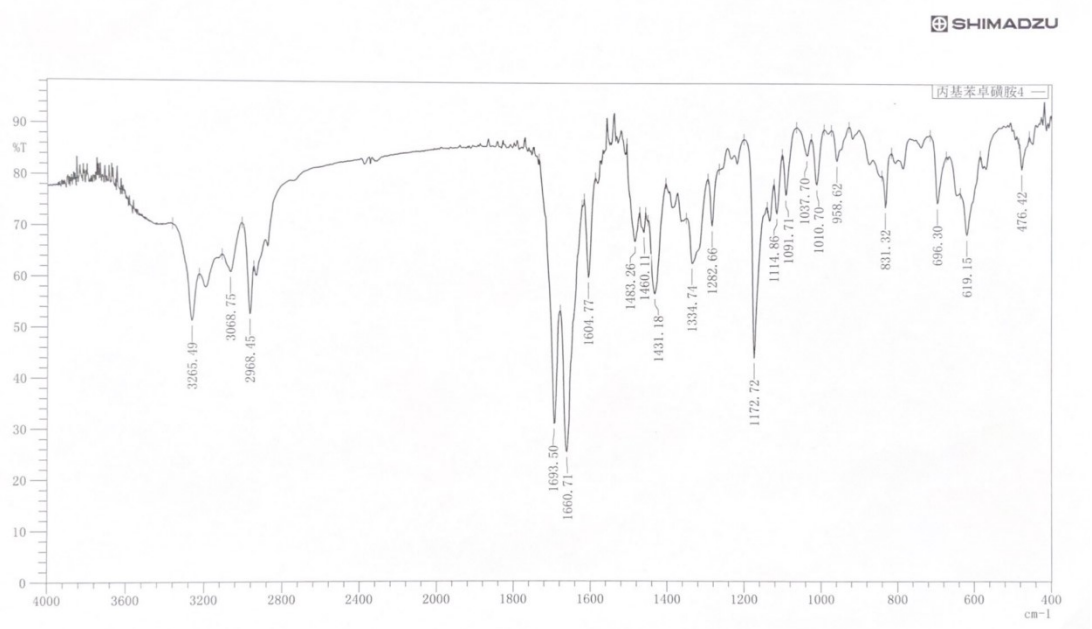
15.1 ^{1}H NMR spectra of crude compound (**18**)



15.2 ^{13}C NMR spectra of crude compound (**18**)



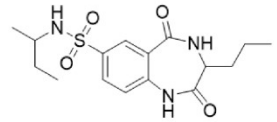
15.3 IR spectra of compound (**18**)



15.4 HRMS spectra of compound (**18**)

Qualitative Analysis Report

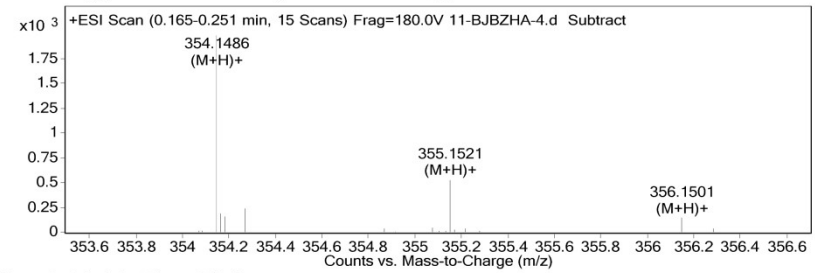
Data Filename	11-BJBZHA-4.d	**Sample Name**	ZDJ
Sample Type	Sample	**Position**	P1-B2
Instrument Name	Instrument 1	**User Name**	
Acq Method	test.m	**Acquired Time**	10/12/2023 2:55:33 PM
IRM Calibration Status	Success	**DA Method**	Default.m
Comment			
Sample Group	**Info.**		



Chemical Formula: $C_{16}H_{23}N_3O_4S$
Exact Mass: 353.1409

User Spectra

Fragmentor Voltage	Collision Energy	Ionization Mode
180	0	ESI



Formula Calculator Element Limits

Element	Min	Max
C	3	60
H	0	120
O	1	30
N	0	30
S	1	5

Formula Calculator Results

Formula	Best	Mass	Tgt Mass	Diff (ppm)	Ion Species	Score
C16 H23 N3 O4 S	TRUE	353.1414	353.1409	-1.22	C16 H24 N3 O4 S	88.91
C9 H23 N9 O2 S2		353.1414	353.1416	0.66	C9 H24 N9 O2 S2	71.01
C21 H23 N O2 S		353.1414	353.1449	10.19	C21 H24 N O2 S	70.81
C12 H19 N9 O2 S		353.1414	353.1382	-8.87	C12 H20 N9 O2 S	59.84
C13 H27 N3 O4 S2		353.1414	353.1443	8.31	C13 H28 N3 O4 S2	57.81

--- End Of Report ---

15.5 HPLC spectra of compound (**18**)