**Table S1.** Media used for isolation and cultivation in this study.

**Table S2.** Phylogenetic analysis of cultivable actinomycetes associated with *P. fuliginosa*.

**Figure S1.** Colony morphology of part symbiotic actinomycetes.

**Figure S2.** Neighbor-joining phylogenetic tree of 16S rRNA sequences of ZLC-87

**Figure S3.** The inhibitory effect of compound **4** on *E. crusgalli* and *A. theophrasti*.

**Figure S4.** The 1H NMR spectrum of compound **1** (600 MHz, CDCl3).

**Figure S5.** The 13C NMR spectrum of compound **1** (150 MHz, CDCl3).

**Figure S6.** The HR-ESI-MS spectrum of compound **1**.

**Figure S7.** The 1H NMR spectrum of compound **2** (600 MHz, DMSO- *d6*).

**Figure S8.** The 13C NMR spectrum of compound **2** (150 MHz, DMSO- *d6*).

**Figure S9.** The HR-ESI-MS spectrum of compound **2**.

**Figure S10.** The 1H NMR spectrum of compound **3** (600 MHz, CDCl3).

**Figure S11.** The 13C NMR spectrum of compound **3** (150 MHz, CDCl3).

**Figure S12.** The HR-ESI-MS spectrum of compound **3**.

**Figure S13.** The 1H NMR spectrum of compound **4** (600 MHz, Acetone-*d6*).

**Figure S14.** The 13C NMR spectrum of compound **4** (150 MHz, Acetone-*d6*).

**Figure S15.** The HR-ESI-MS spectrum of compound **4**.

**Figure S16.** The 1H NMR spectrum of compound **5** (600 MHz, CDCl3).

**Figure S17.** The 13C NMR spectrum of compound **5** (150 MHz, CDCl3).

**Figure S18.** The HR-ESI-MS spectrum of compound **5**.

**Figure S19.** The 1H NMR spectrum of compound **6** (600 MHz, DMSO- *d6*).

**Figure S20.** The 13C NMR spectrum of compound **6** (150 MHz, DMSO- *d6*).

**Figure S21.** The HR-ESI-MS spectrum of compound **6**.

**Figure S22.** The 1H NMR spectrum of compound **7** (600 MHz, Acetone-*d6*).

**Figure S23.** The 13C NMR spectrum of compound **7** (150 MHz, Acetone-*d6*).

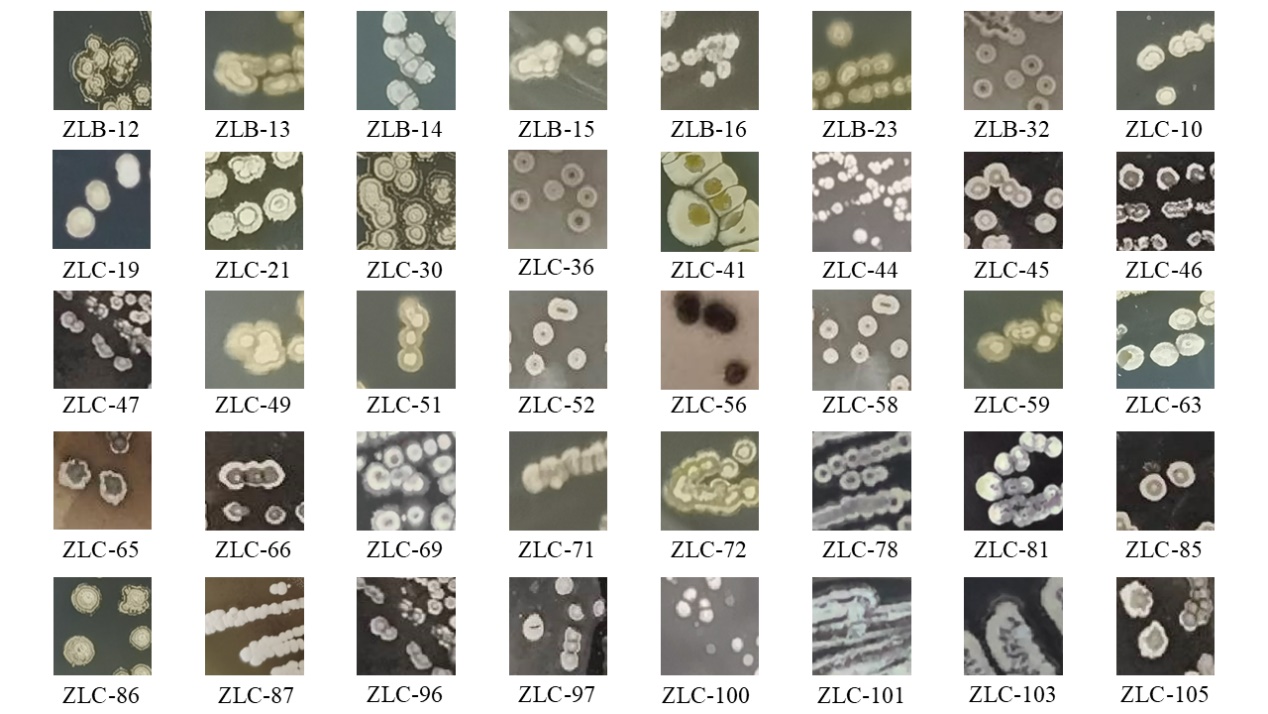
**Figure S24.** The HR-ESI-MS spectrum of compound **7**.

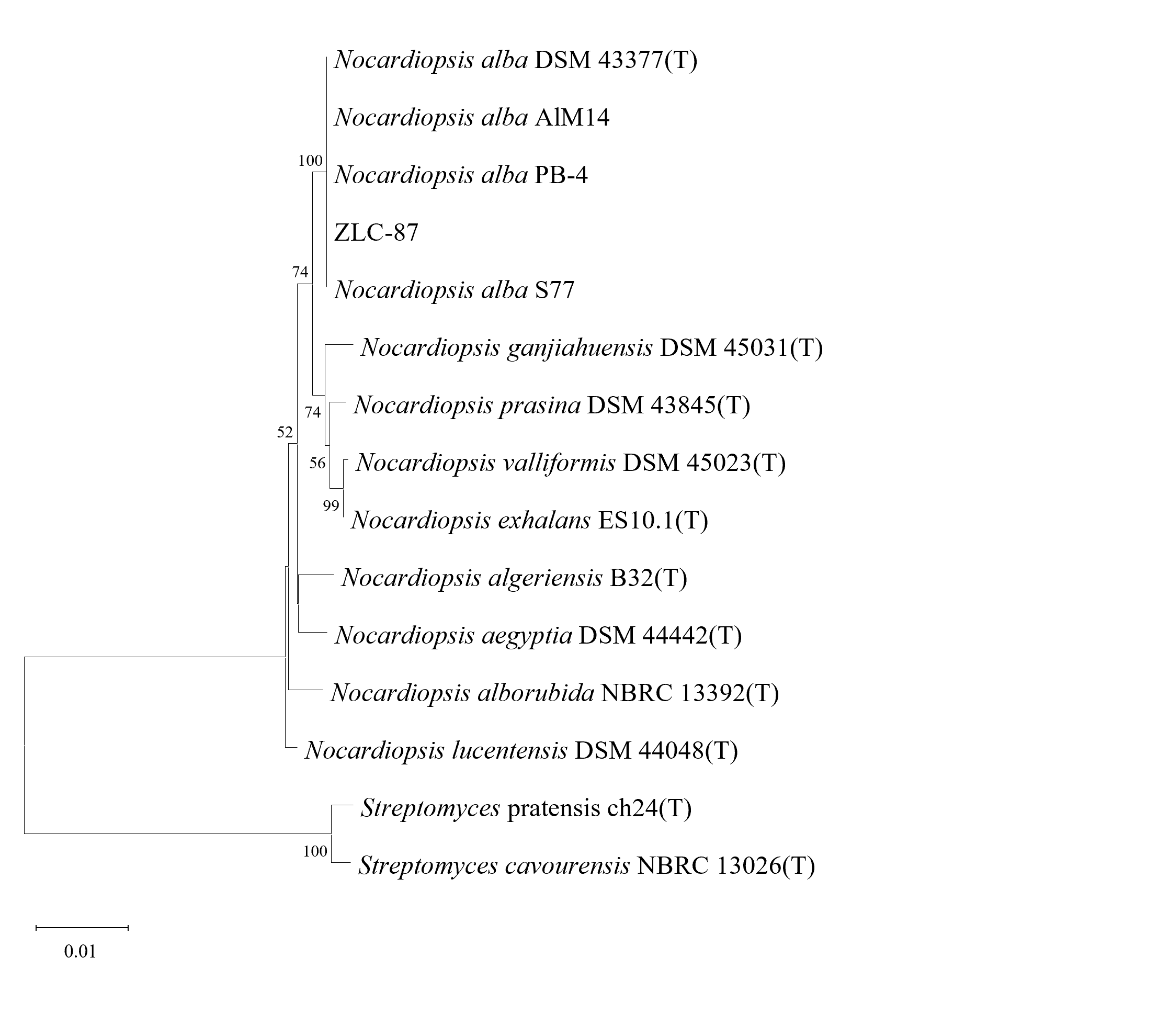
**Table S1.** Media used for isolation and cultivation in this study.

|  |  |  |
| --- | --- | --- |
| **Usage** | **Media** | **Components** |
| Isolation | ISP2 (ISP Medium No. 2) | Malt extract 10.0 g, yeast extract 4.0 g, glucose4.0 g, agar 18.0 g, H2O 1000 mL, pH 7.0 |
| CA (chitin agar medium) | Chitin 4.0 g, K2HPO4·3H2O 0.7 g, KH2PO4 0.3 g, MgSO4·7H2O 0.5 g, FeSO4·7H2O 0.01 g, ZnSO4·7H2O 0.001 g, MnCl2·2H2O 0.001 g, agar 18.0 g, H2O 1000 mL, pH 7.4-7.6 |
| SCA (starch casein agar) | Soluble starch 10.0 g, casein 0.3 g, KNO3 2.0 g, NaCl 2.0 g, K2HPO4 2.0 g, MgSO4·7H2O 0.05 g, CaCO3 0.02 g, FeSO4·7H2O 0.01 g, Vitamins (0.5 mg each of thiamine-HCl, riboflavin, niacin, pyridoxin-HCl, inositol, Ca-pantothenat, p-aminobenzoic acid, and 0.25 mg of biotin), agar 18.0 g, H2O 1000 mL, pH 7.5 |
| GYM (GYM *Streptomyces* Agar) | Malt extract 10.0 g, yeast extract 4.0 g, glucose4 g, CaCO3 2.0 g, agar 18.0 g, H2O 1000 mL, pH 7.2 |
| GS (Gause’s No. 1) | Soluble starch 20 g, KNO3 1.0 g, K2HPO4·3H2O 0.5 g, MgSO4·7H2O 0.5 g, NaCl 0.5 g, FeSO4·7H2O 0.01 g, agar 18 g, H2O 1000 mL, pH 7.4-7.6 |
| M-HV (modified HV medium) | Soluble starch 2.0 g, KNO3 0.5 g, KCl 1.71 g, Na2HPO4 0.5 g, CaCO3 0.02 g, MgSO4·7H2O 0.05 g, FeSO4·7H2O 0.01 g, HV Multi-Vitamins (thiamine 0.05 g, riboflavin 0.05 g, inose 0.05 g, pantothenic acid 0.05 g, p-aminobenzoic acid 0.05 g, vitamin B6 0.05 g, biotin 0.025 g, niacin 0.05 g, H2O 100 mL), agar 18.0 g, H2O 1000 mL |
| Cultivation | GS (Gause’s No. 1) | Soluble starch 20 g, KNO3 1.0 g, K2HPO4·3H2O 0.5 g, MgSO4·7H2O 0.5 g, NaCl 0.5 g, FeSO4·7H2O 0.01 g, agar 18 g, H2O 1000 mL, pH 7.4-7.6 |
| LB (Luria Bertani) | Yeast extract 5.0 g, NaCl 10.0 g, peptone 10.0 g, agar 18.0 g, H2O 1000 mL |

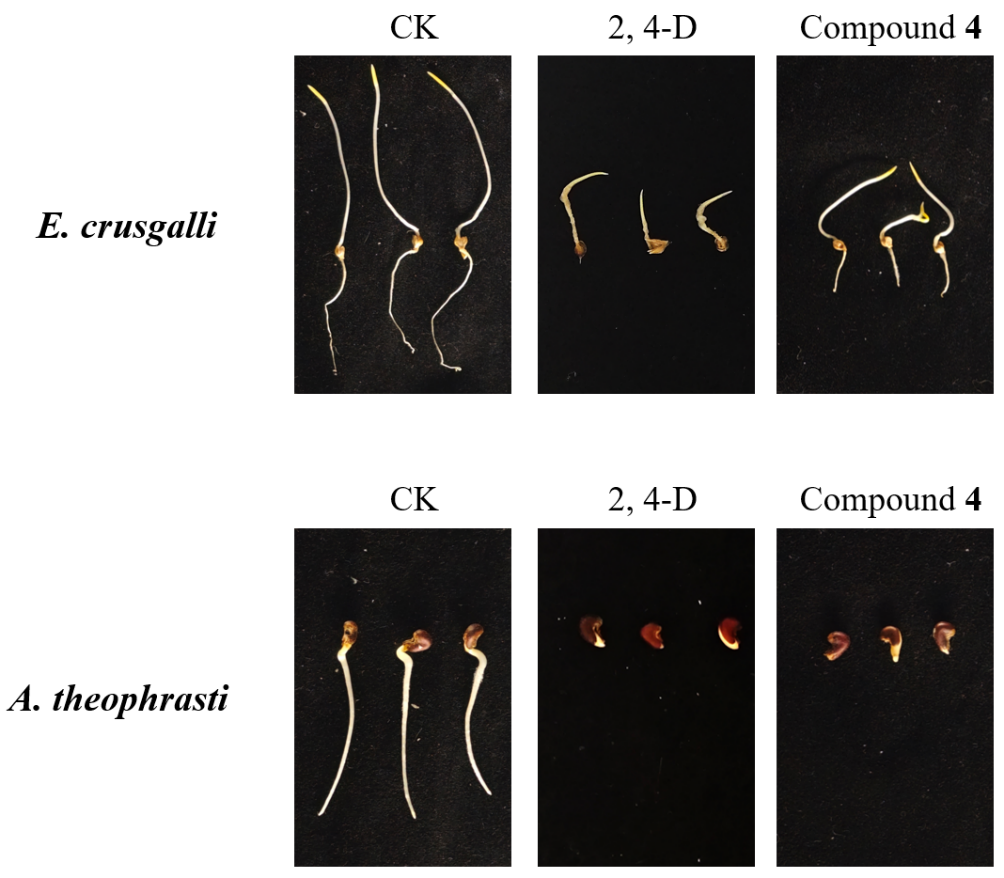
**Table S2.** 16S rRNA similarity values of cultivable actinomycetes isolates with closely related species

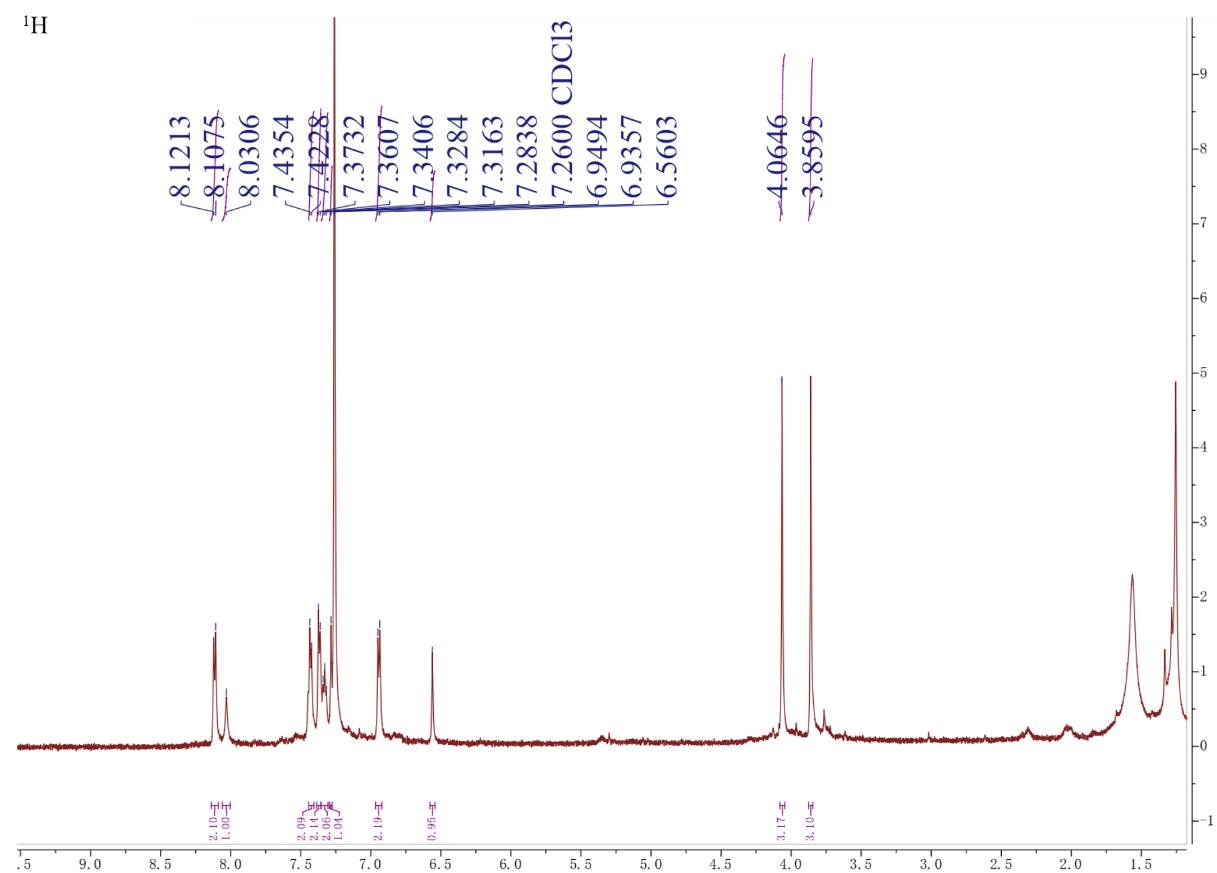
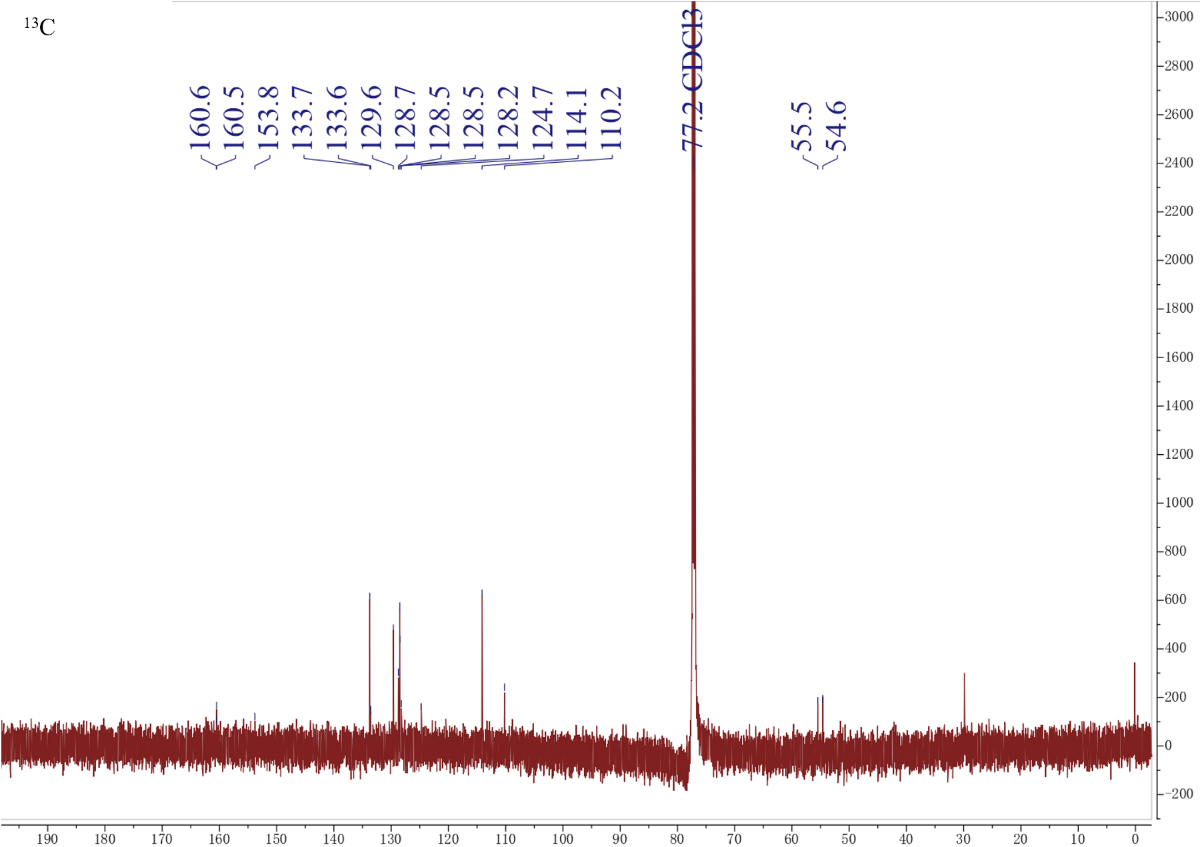
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Strains** | **Source** | **Closest Type Strain** | **Accession no.** | **Similarity (%)** | **GenBank accession no.** |
| ZLB-11 | nymph cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.71 | PP456360 |
| ZLB-12 | nymph cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.64 | PP456365 |
| ZLB-13 | nymph cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.71 | PP456358 |
| ZLB-14 | nymph cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456317 |
| ZLB-15 | nymph cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.86 | PP456361 |
| ZLB-16 | nymph cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456304 |
| ZLB-17 | nymph cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456298 |
| ZLB-18 | nymph cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456299 |
| ZLB-20 | nymph cuticle | *Streptomyces albidoflavus* | DSM 40455 | 99.08 | PP456295 |
| ZLB-21 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456359 |
| ZLB-22 | adults cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.57 | PP456333 |
| ZLB-23 | adults cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.78 | PP456362 |
| ZLB-24 | adults cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.86 | PP456363 |
| ZLB-25 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456320 |
| ZLB-26 | adults cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.36 | PP456296 |
| ZLB-27 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.27 | PP456318 |
| ZLB-29 | adults cuticle | *Streptomyces cavourensis* | NBRC 13026 | 99.78 | PP456364 |
| ZLB-30 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.71 | PP456351 |
| ZLB-32 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.93 | PP456297 |
| ZLB-39 | adults cuticle | *Streptomyces asenjonii* | KNN 35.1b | 98.48 | PP456344 |
| ZLB-43 | adults cuticle | *Streptomyces pratensis* | ch24 | 99.78 | PP456350 |
| ZLC-10 | nymph gut | *Streptomyces pratensis* | ch24 | 99.86 | PP456301 |
| ZLC-19 | nymph gut | *Streptomyces cavourensis* | NBRC 13026 | 99.86 | PP456332 |
| ZLC-20 | nymph gut | *Streptomyces araujoniae* | ASBV-1 | 99.36 | PP456355 |
| ZLC-21 | nymph gut | *Streptomyces daghestanicus* | NRRL B-5418 | 99.08 | PP456353 |
| ZLC-22 | nymph gut | *Streptomyces tendae* | ATCC 19812 | 99.93 | PP456328 |
| ZLC-24 | nymph gut | *Streptomyces violascens* | ISP 5183 | 99.14 | PP456357 |
| ZLC-25 | nymph gut | *Streptomyces albidoflavus* | DSM 40455 | 99.28 | PP456329 |
| ZLC-26 | nymph gut | *Streptomyces violascens* | ISP 5183 | 99.21 | PP456294 |
| ZLC-27 | nymph gut | *Streptomyces albidoflavus* | DSM 40455 | 99.57 | PP456349 |
| ZLC-29 | nymph gut | *Streptomyces intermedius* | NBRC 13049 | 99.16 | PP456289 |
| ZLC-31 | nymph gut | *Streptomyces violascens* | ISP 5183 | 99.14 | PP456354 |
| ZLC-32 | nymph gut | *Streptomyces intermedius* | NBRC 13049 | 99.1 | PP456290 |
| ZLC-33 | nymph gut | *Streptomyces albidoflavus* | DSM 40455 | 99.1 | PP456285 |
| ZLC-34 | nymph gut | *Streptomyces violascens* | ISP 5183 | 98.15 | PP456356 |
| ZLC-36 | nymph gut | *Streptomyces rochei* | NRRL B-2410 | 99.78 | PP456327 |
| ZLC-37 | nymph gut | *Streptomyces daghestanicus* | NRRL B-5418 | 99.5 | PP456330 |
| ZLC-38 | nymph gut | *Streptomyces intermedius* | NBRC 13049 | 99.17 | PP456288 |
| ZLC-39 | nymph gut | *Streptomyces violascens* | ISP 5183 | 99.36 | PP456293 |
| ZLC-40 | nymph gut | *Streptomyces violascens* | ISP 5183 | 98.44 | PP456305 |
| ZLC-41 | nymph gut | *Streptomyces violascens* | ISP 5183 | 99.64 | PP456352 |
| ZLC-42 | nymph gut | *Streptomyces albidoflavus* | DSM 40455 | 99.51 | PP456287 |
| ZLC-43 | nymph gut | *Streptomyces albidoflavus* | DSM 40455 | 99.17 | PP456280 |
| ZLC-44 | nymph gut | *Streptomyces intermedius* | NBRC 13049 | 99.21 | PP456326 |
| ZLC-45 | nymph gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456292 |
| ZLC-46 | nymph gut | *Streptomyces badius* | NRRL B-2567 | 100 | PP456286 |
| ZLC-47 | nymph gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456321 |
| ZLC-48 | nymph gut | *Streptomyces pratensis* | ch24 | 99.71 | PP456341 |
| ZLC-49 | nymph gut | *Streptomyces cavourensis* | NBRC 13026 | 99.52 | PP456284 |
| ZLC-50 | nymph gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456319 |
| ZLC-51 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456308 |
| ZLC-52 | adults gut | *Streptomyces albidoflavus* | DSM 40455 | 99.36 | PP456340 |
| ZLC-54 | adults gut | *Streptomyces coelicoflavus* | NBRC 15399 | 99.79 | PP456335 |
| ZLC-55 | adults gut | *Streptomyces albidoflavus* | DSM 40455 | 99.5 | PP456339 |
| ZLC-56 | adults gut | *Streptomyces badius* | NRRL B-2567 | 99.86 | PP456343 |
| ZLC-57 | adults gut | *Streptomyces pratensis* | ch24 | 99.71 | PP456338 |
| ZLC-58 | adults gut | *Streptomyces pactum* | NBRC 13433 | 99.3 | PP456307 |
| ZLC-59 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456337 |
| ZLC-61 | adults gut | *Streptomyces albidoflavus* | DSM 40455 | 99.29 | PP456348 |
| ZLC-63 | adults gut | *Streptomyces pratensis* | ch24 | 99.71 | PP456342 |
| ZLC-64 | adults gut | *Streptomyces albidoflavus* | DSM 40455 | 99.36 | PP456347 |
| ZLC-65 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456346 |
| ZLC-66 | adults gut | *Streptomyces badius* | NRRL B-2567 | 99.79 | PP456345 |
| ZLC-69 | adults gut | *Streptomyces djakartensis* | NBRC 15409 | 98.78 | PP456331 |
| ZLC-71 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456322 |
| ZLC-72 | adults gut | *Streptomyces cavourensis* | NBRC 13026 | 99.93 | PP456334 |
| ZLC-77 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456325 |
| ZLC-78 | adults gut | *Streptomyces coelicoflavus* | NBRC 15399 | 100 | PP456336 |
| ZLC-79 | adults gut | *Streptomyces setonii* | NRRL ISP-5322 | 100 | PP456323 |
| ZLC-80 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456291 |
| ZLC-81 | adults gut | *Streptomyces olivaceus* | NRRL B-3009 | 100 | PP456283 |
| ZLC-85 | adults gut | *Streptomyces olivaceus* | NRRL B-3009 | 99.3 | PP456314 |
| ZLC-86 | adults gut | *Streptomyces violascens* | ISP 5183 | 99.64 | PP456306 |
| ZLC-87 | adults gut | *Nocardiopsis alba* | DSM 43377 | 99.09 | PP456310 |
| ZLC-88 | adults gut | *Streptomyces olivaceus* | NRRL B-3009 | 99.02 | PP456315 |
| ZLC-95 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456300 |
| ZLC-96 | adults gut | *Streptomyces badius* | NRRL B-2567 | 100 | PP456282 |
| ZLC-97 | adults gut | *Streptomyces badius* | NRRL B-2567 | 100 | PP456281 |
| ZLC-100 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456303 |
| ZLC-101 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456312 |
| ZLC-102 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456316 |
| ZLC-103 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456313 |
| ZLC-105 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456309 |
| ZLC-106 | adults gut | *Streptomyces violascens* | ISP 5183 | 99.14 | PP456324 |
| ZLC-107 | adults gut | *Streptomyces pratensis* | ch24 | 99.93 | PP456311 |
| ZLC-112 | adults gut | *Streptomyces olivaceus* | NRRL B-3009 | 99.11 | PP456302 |

**Figure S1.** Colony morphology of part symbiotic actinomycetes.

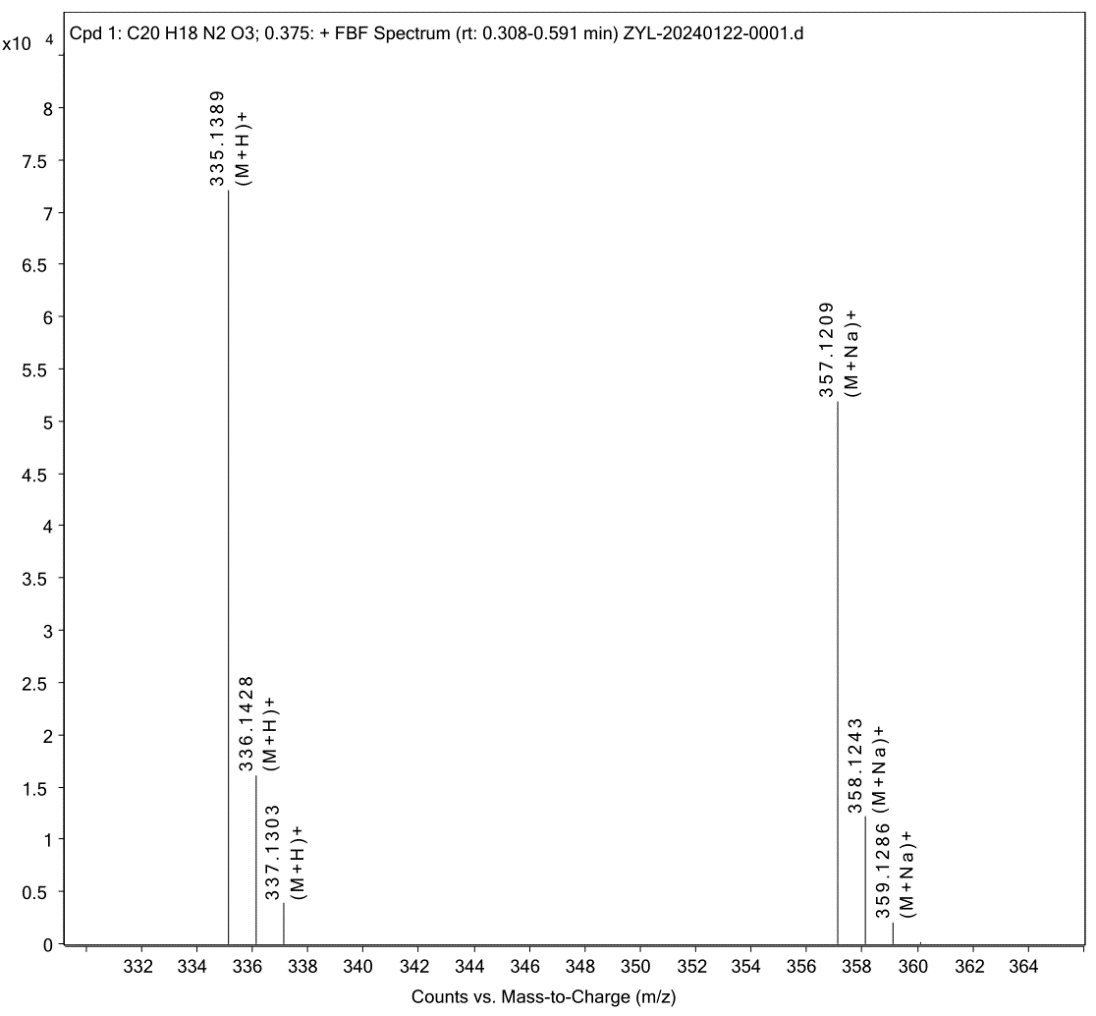
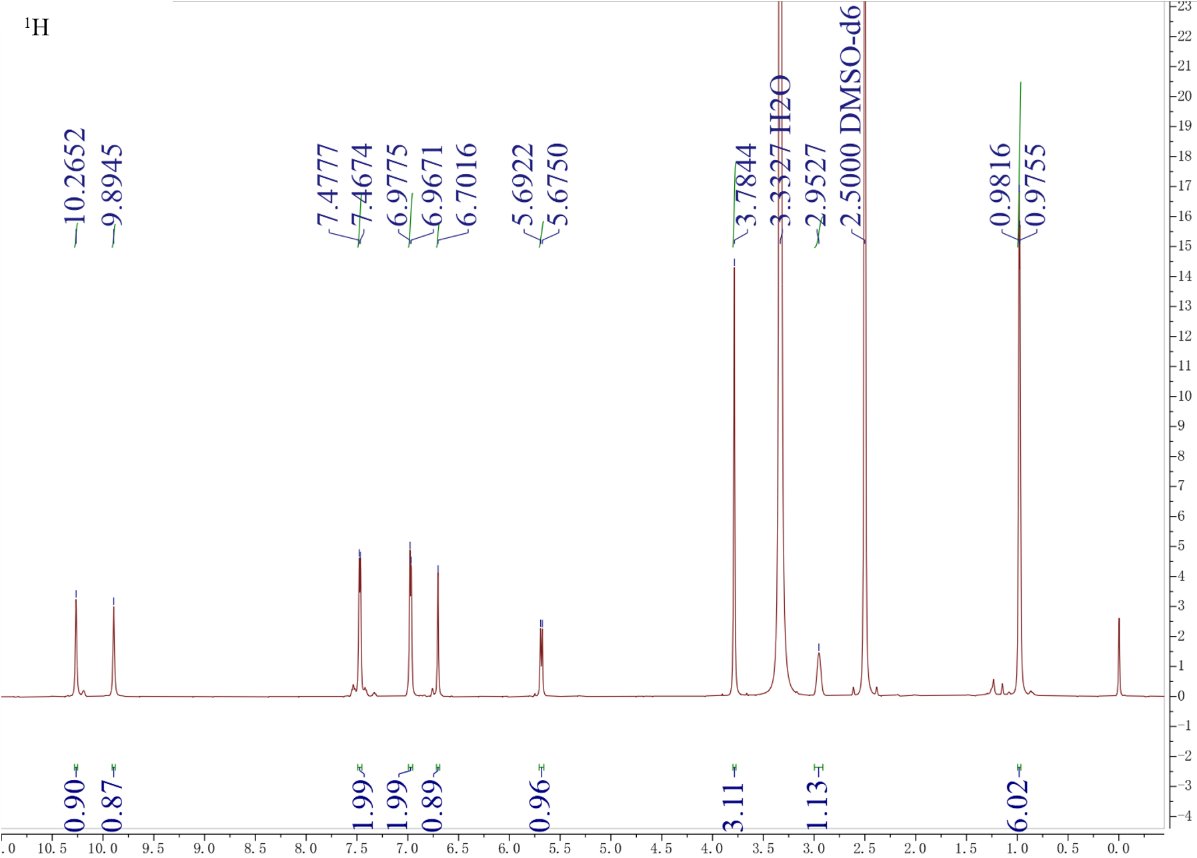
**Figure S2.** Neighbor-joining phylogenetic tree of 16S rRNA sequences of ZLC-87

The test of phylogeny was done using bootstrap method with a value of 1000 bootstrap in MEGA 11 software.

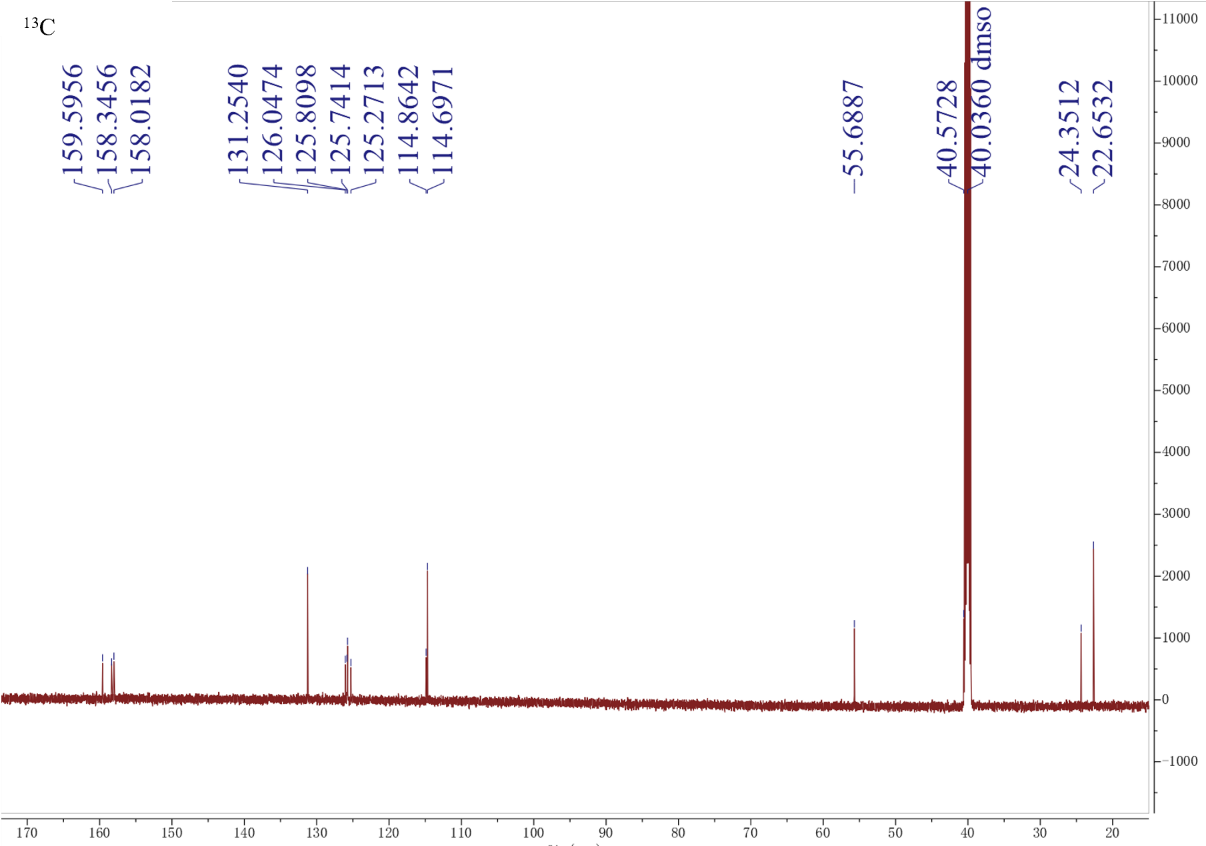
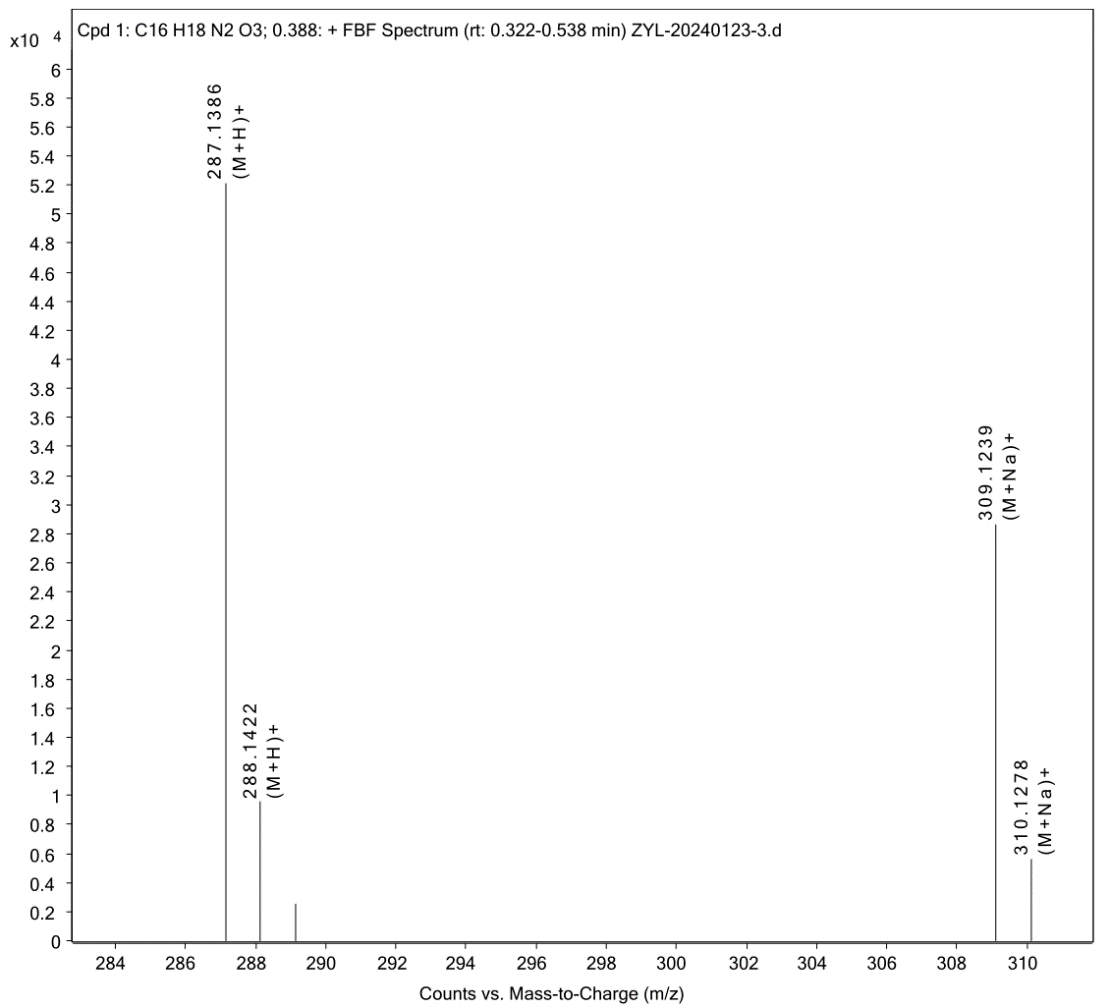
 **Figure S3.** The inhibitory effect of compound **4** on *E. crusgalli* and *A. theophrasti*.

**Figure S4.** The 1H NMR spectrum of compound **1** (600 MHz, CDCl3).

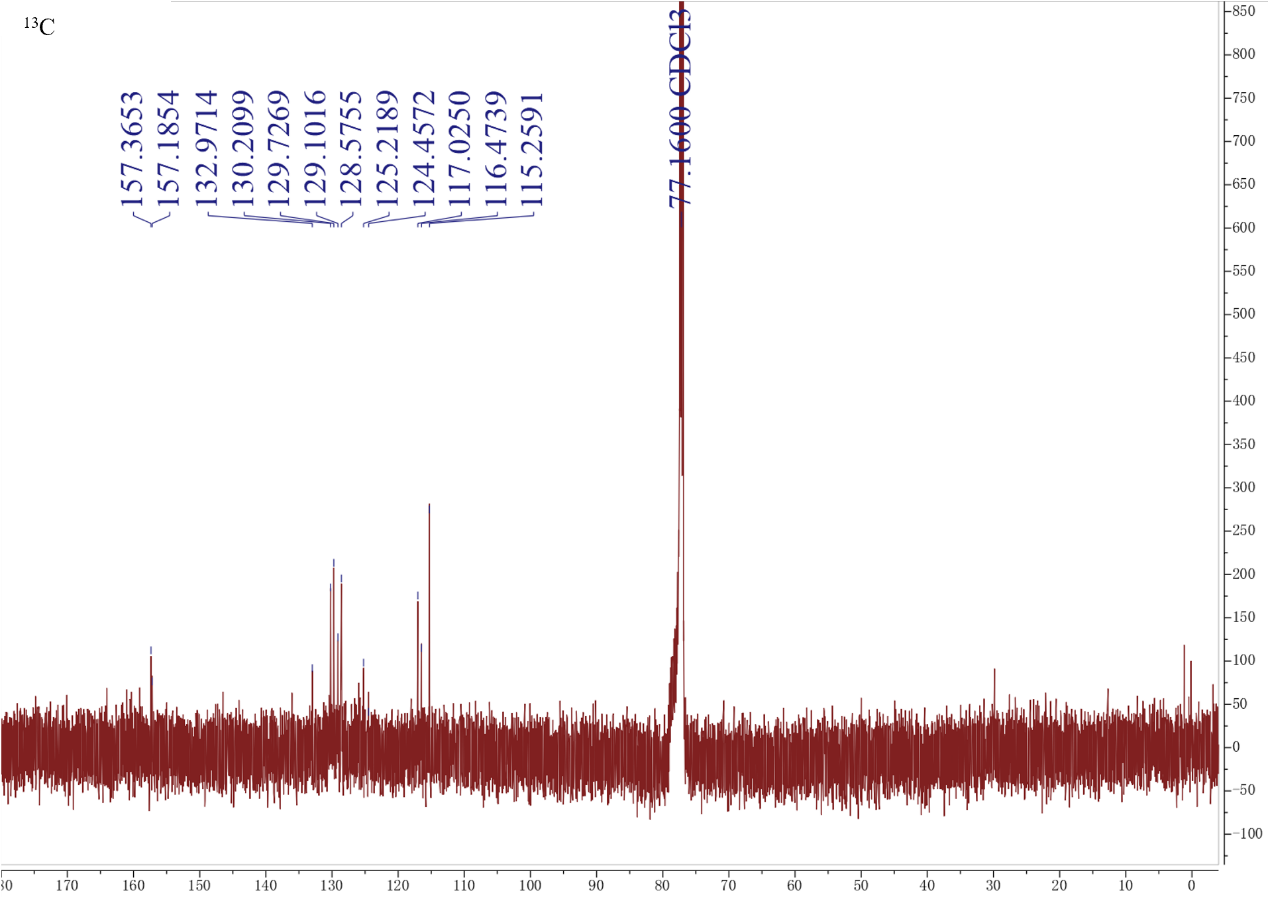
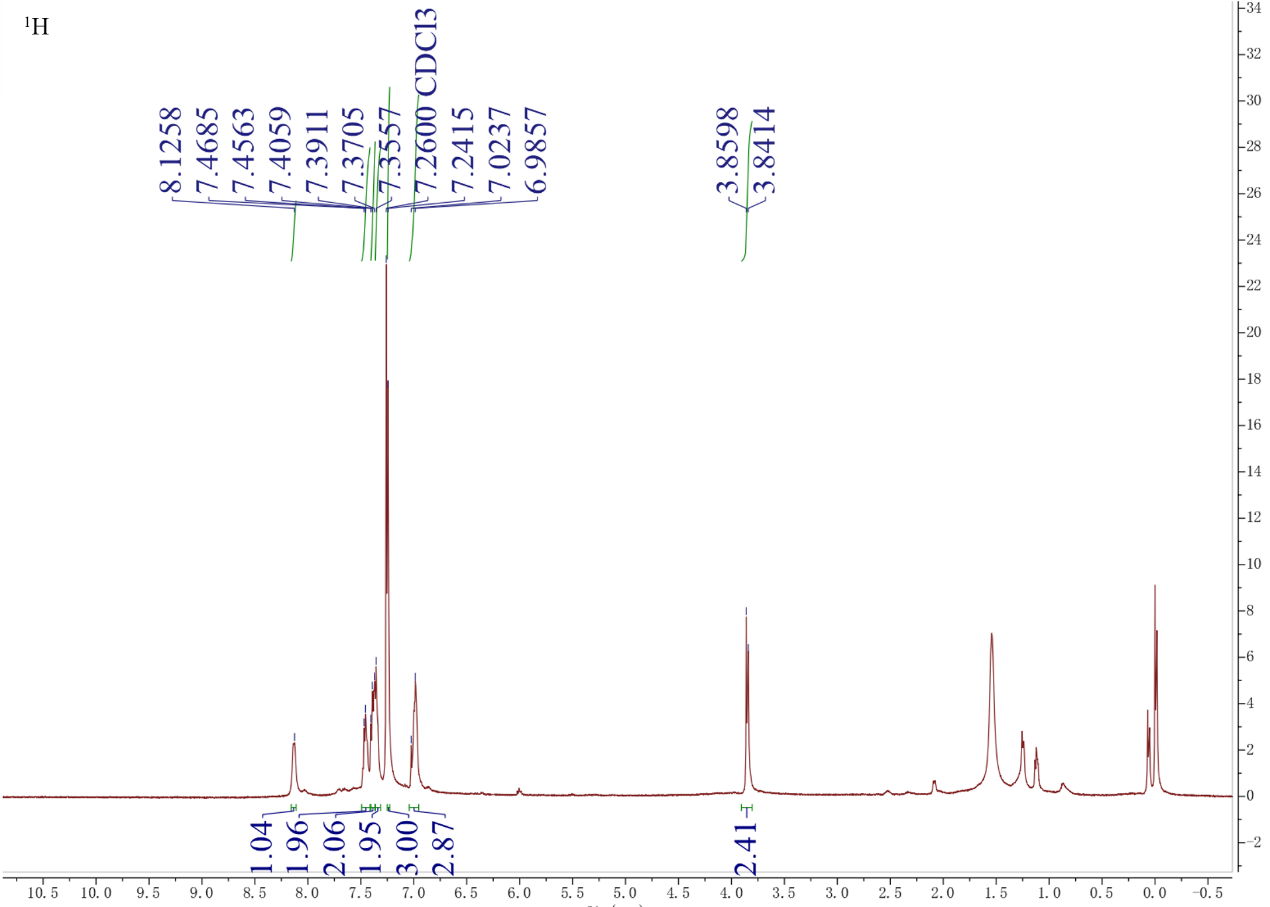
**Figure S5.** The 13C NMR spectrum of compound **1** (150 MHz, CDCl3).

**Figure S6.** The HR-ESI-MS spectrum of compound **1**.

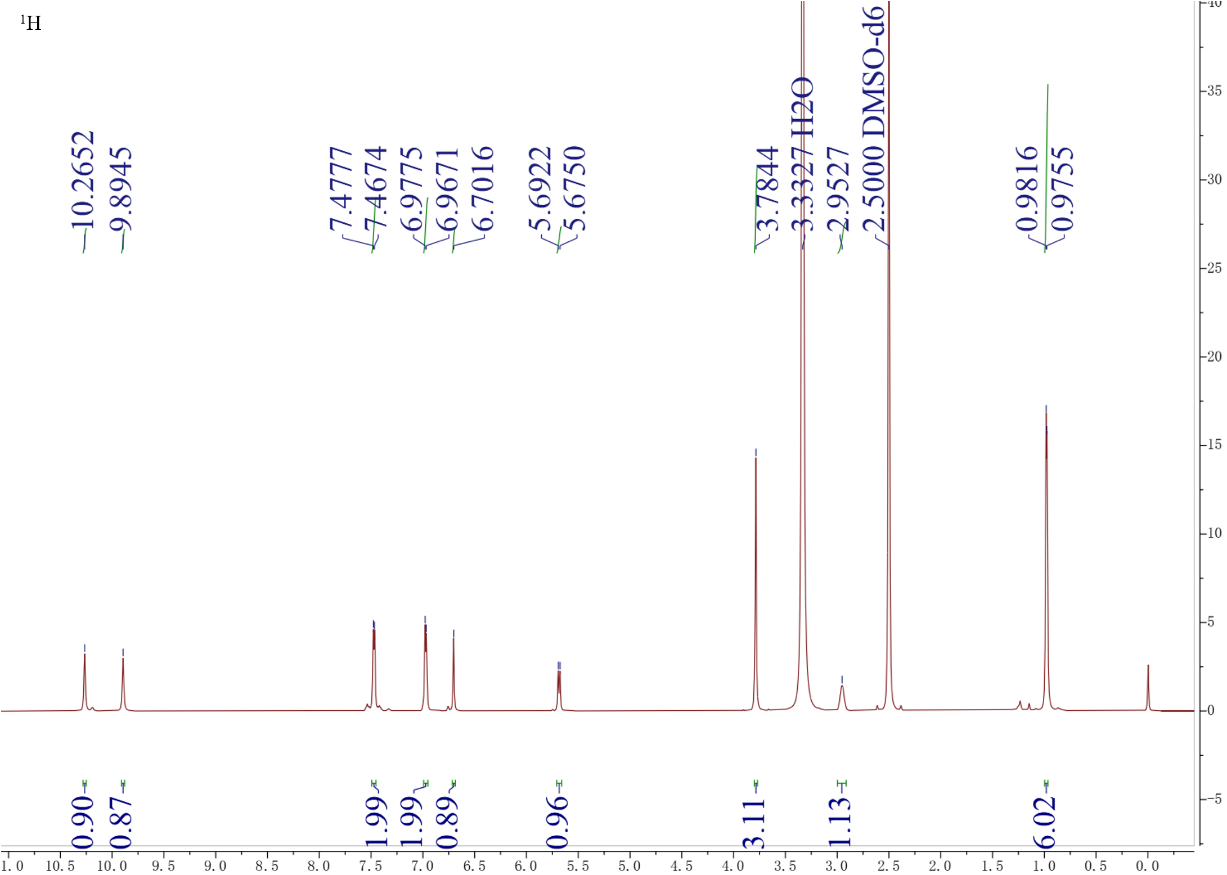
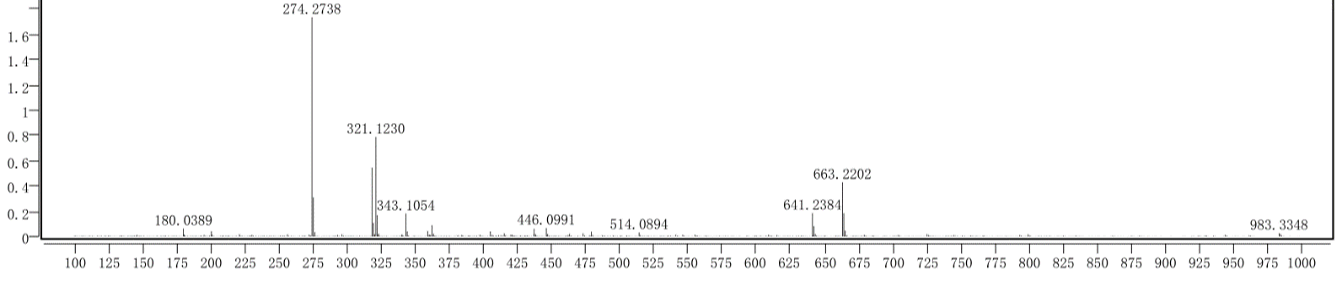
**Figure S7.** The 1H NMR spectrum of compound **2** (600 MHz, DMSO- *d6*).

**Figure S8.** The 13C NMR spectrum of compound **2** (150 MHz, DMSO- *d6*).

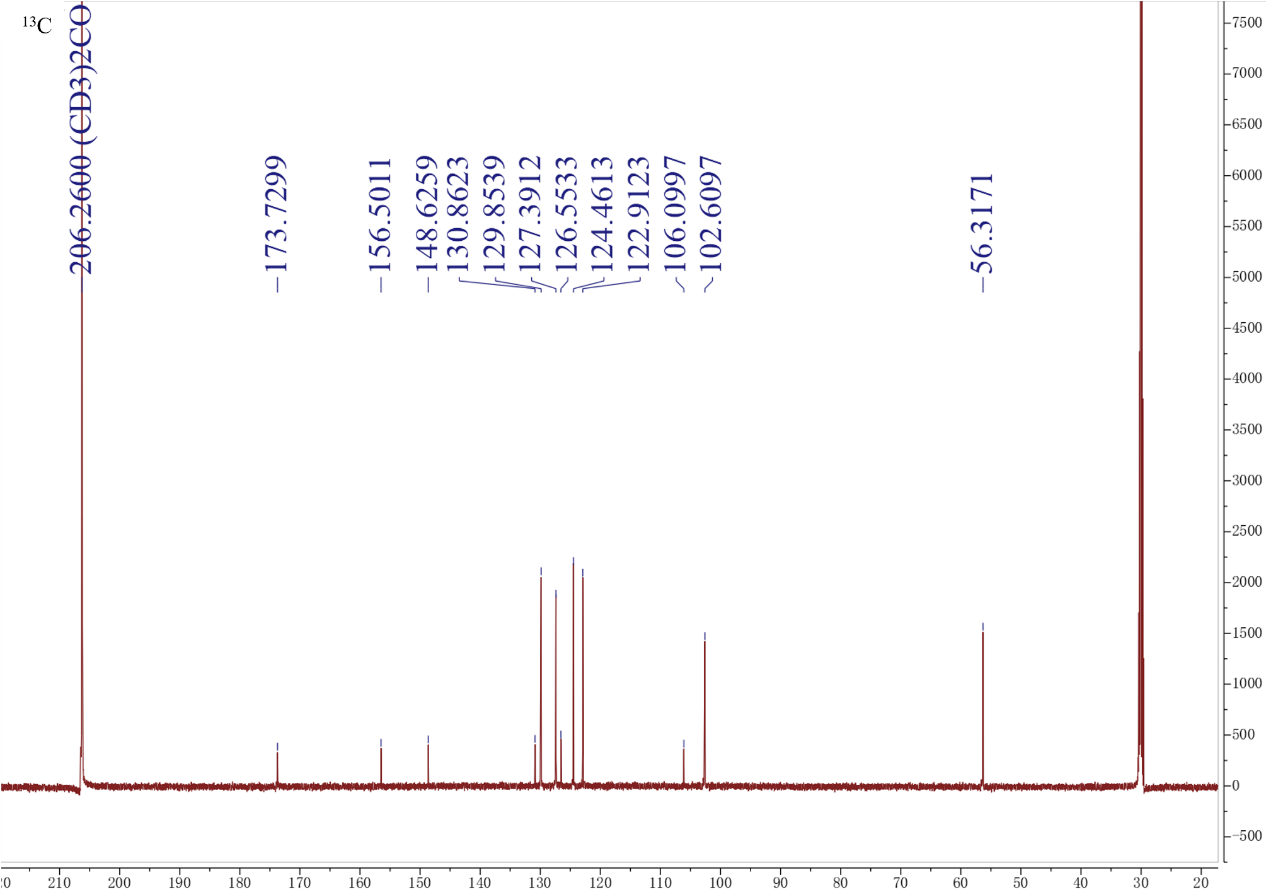
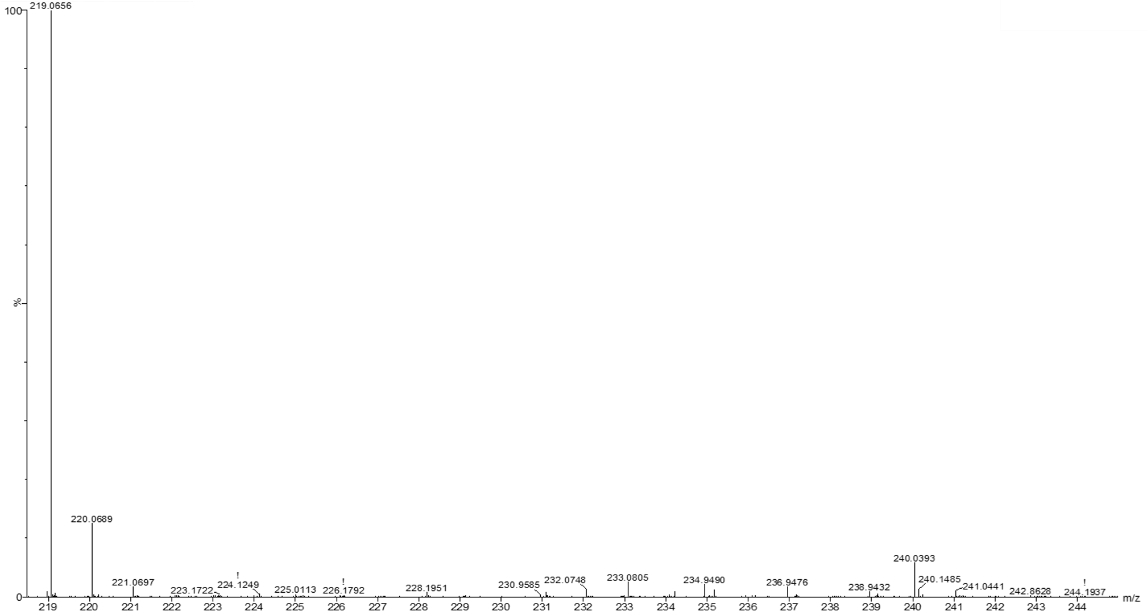
**Figure S9.** The HR-ESI-MS spectrum of compound **2**.

**Figure S10.** The 1H NMR spectrum of compound **3** (600 MHz, CDCl3).

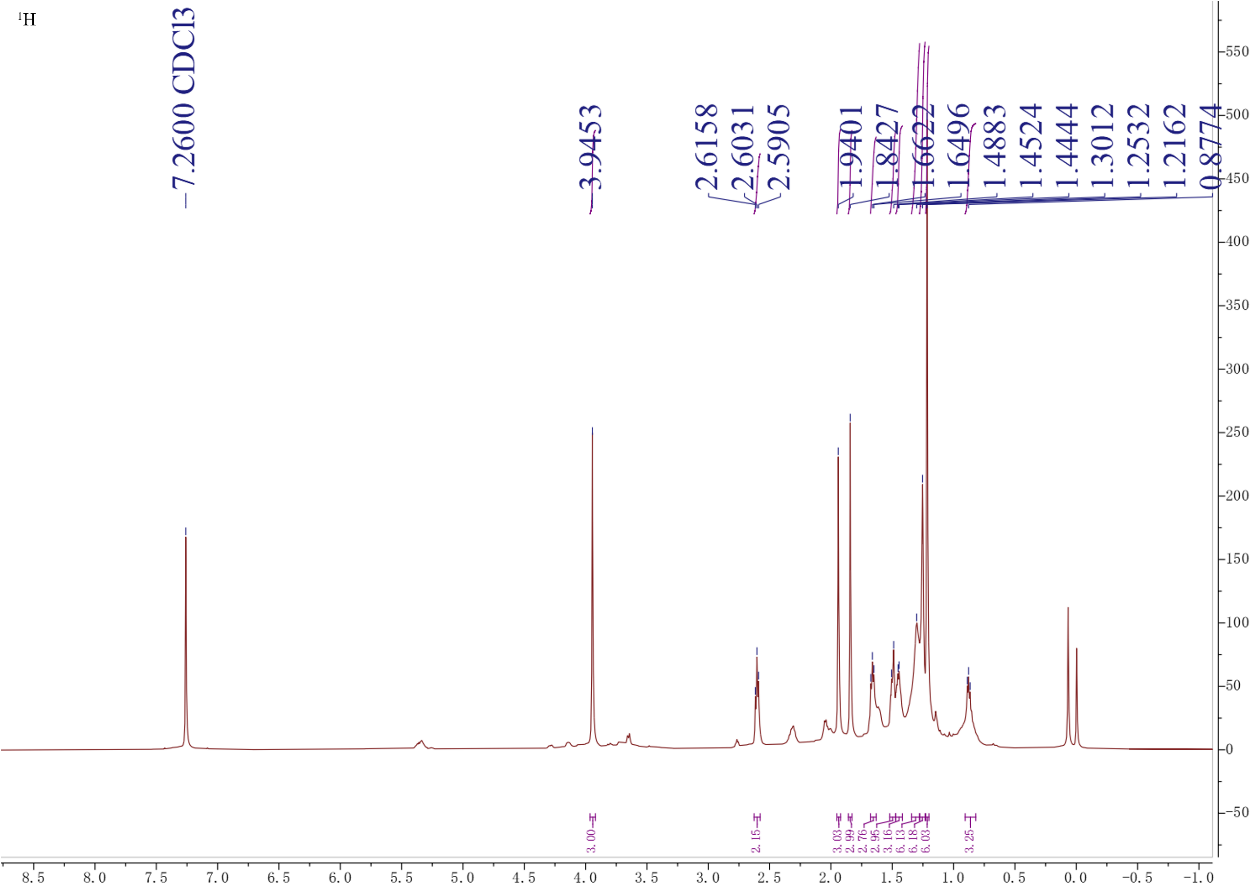
**Figure S11.** The 13C NMR spectrum of compound **3** (150 MHz, CDCl3).

**Figure S12.** The HR-ESI-MS spectrum of compound **3**.

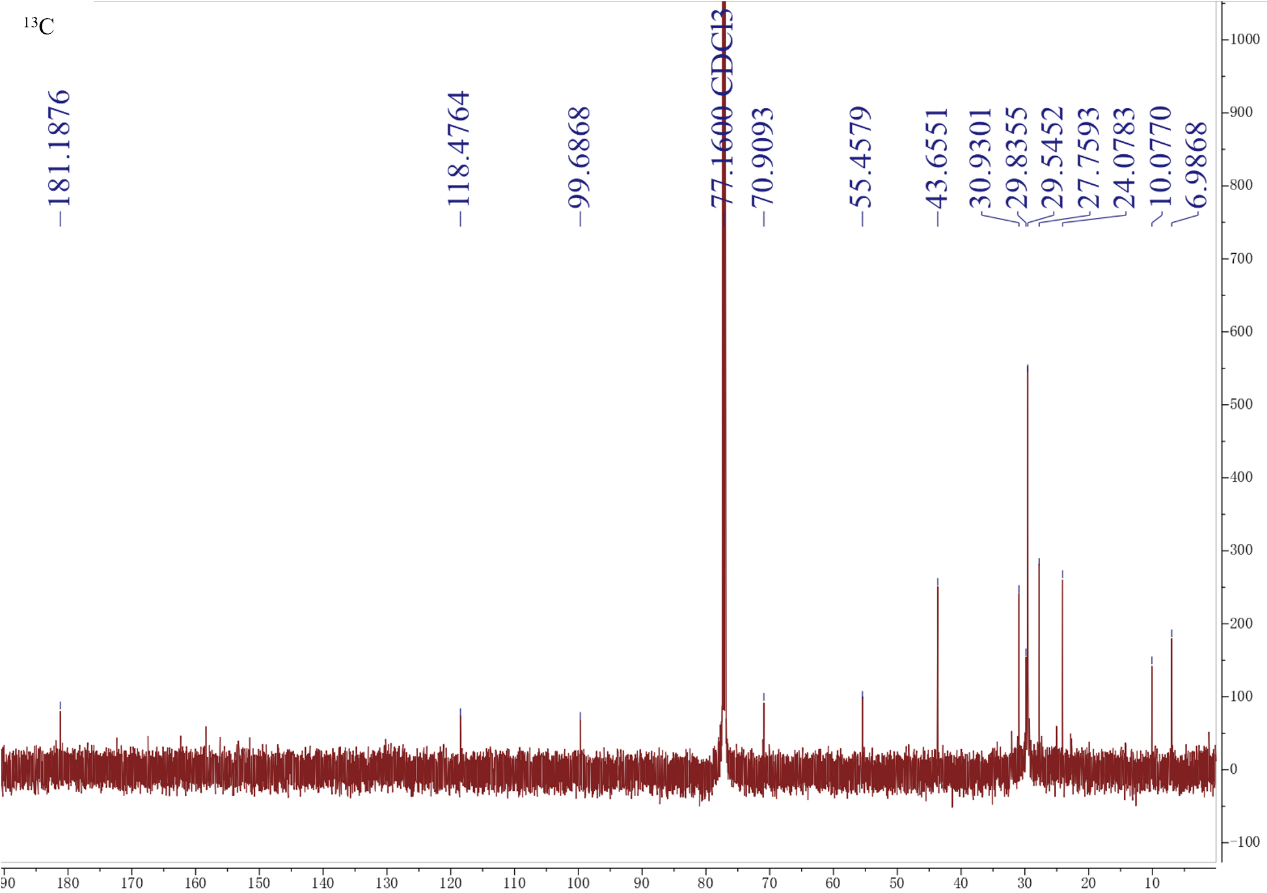
**Figure S13.** The 1H NMR spectrum of compound **4** (600 MHz, Acetone-*d6*).

**Figure S14.** The 13C NMR spectrum of compound **4** (150 MHz, Acetone-*d6*).

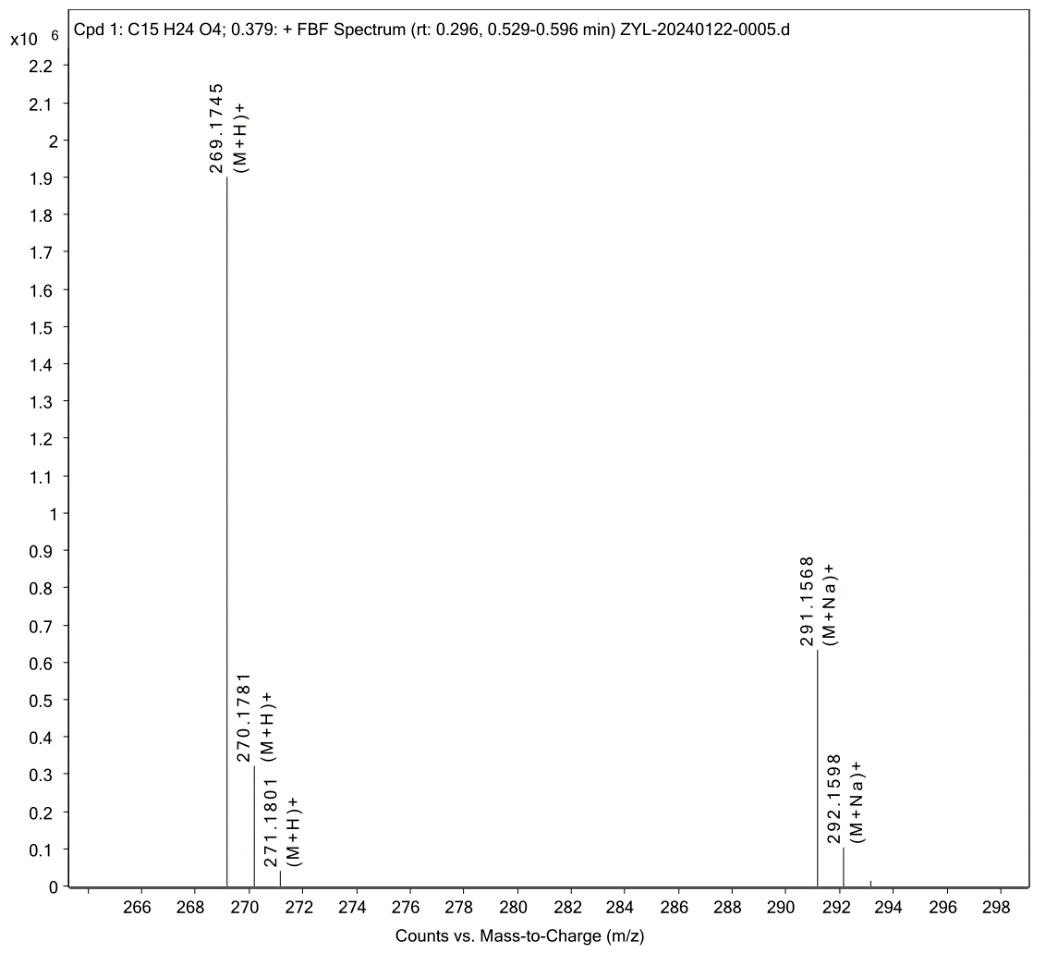
**Figure S15.** The HR-ESI-MS spectrum of compound **4**.

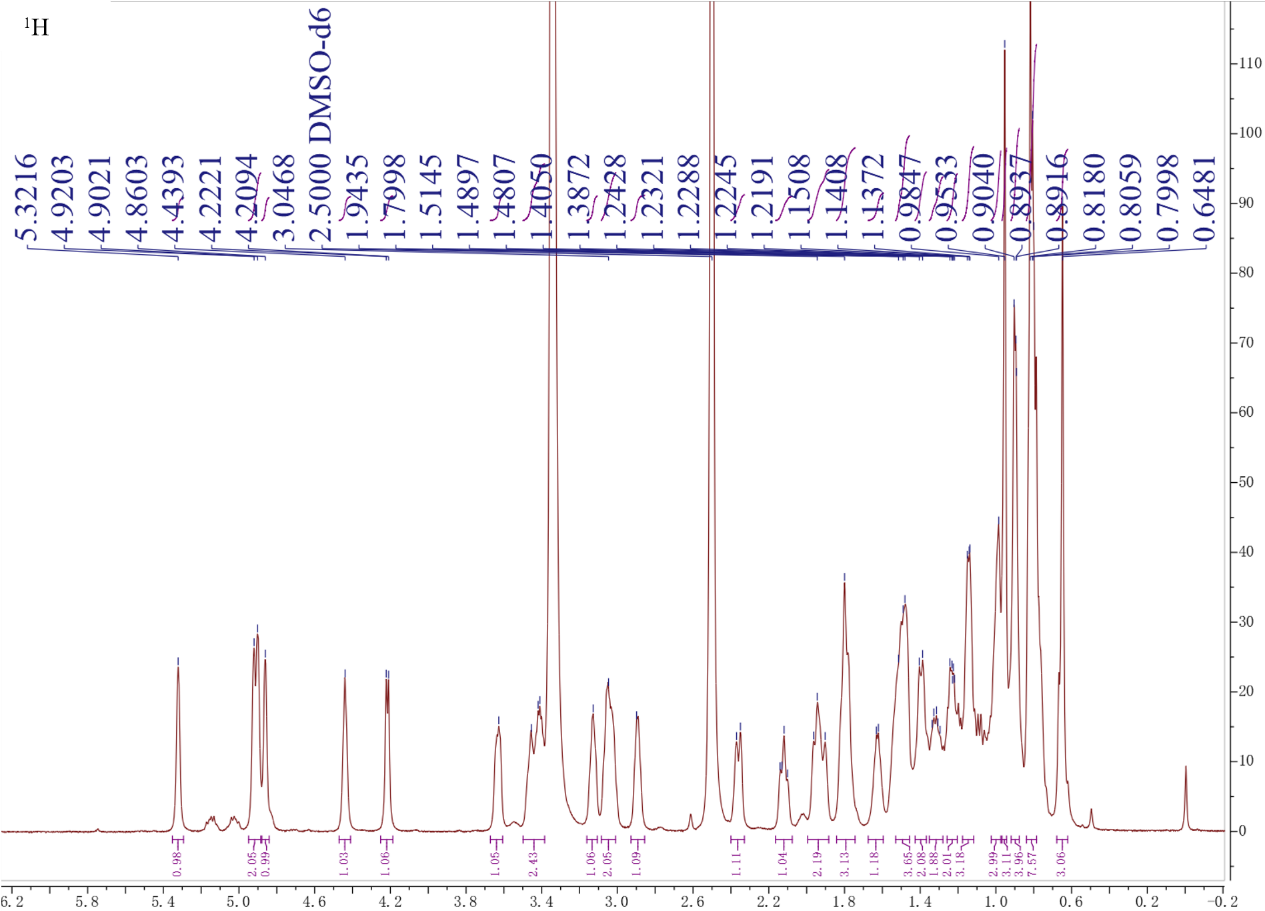


**Figure S16.** The 1H NMR spectrum of compound **5** (600 MHz, CDCl3).

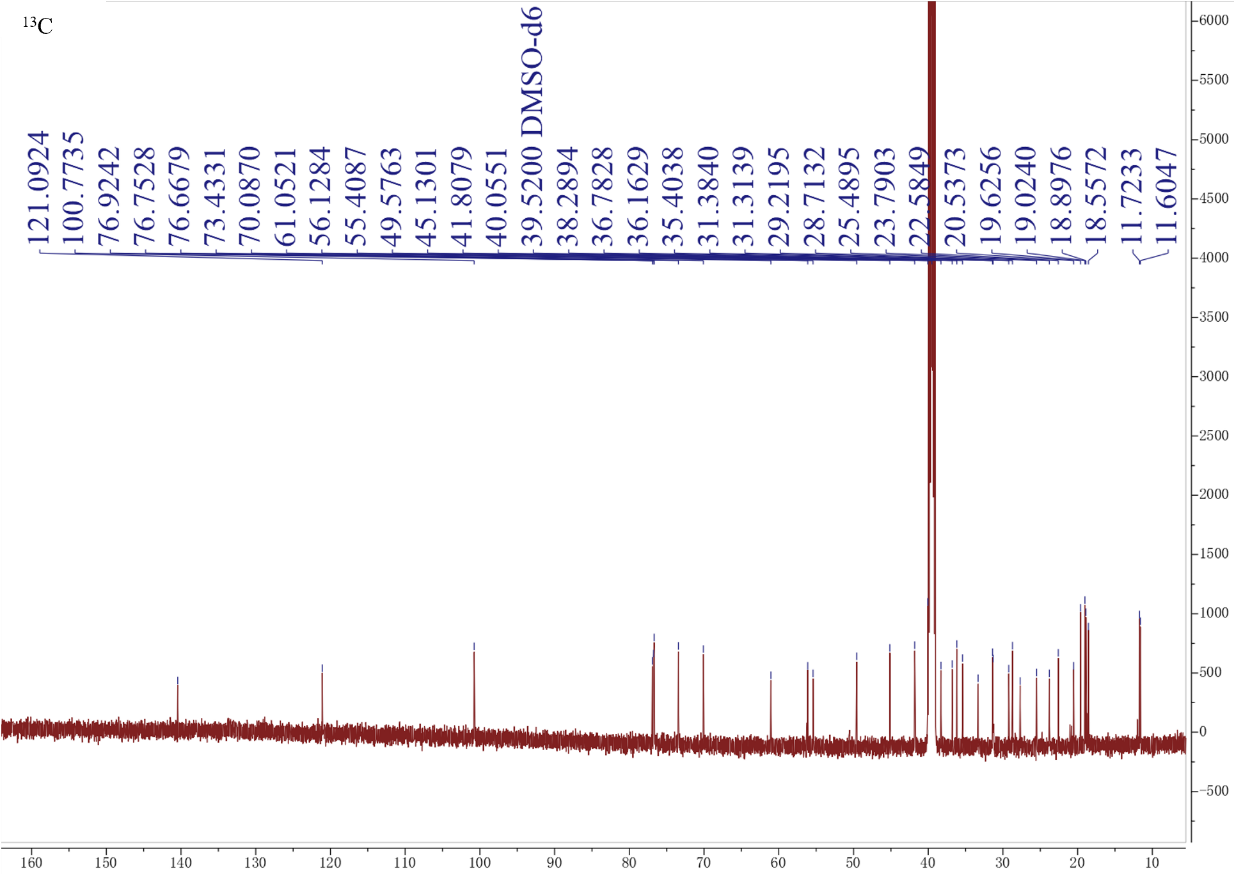


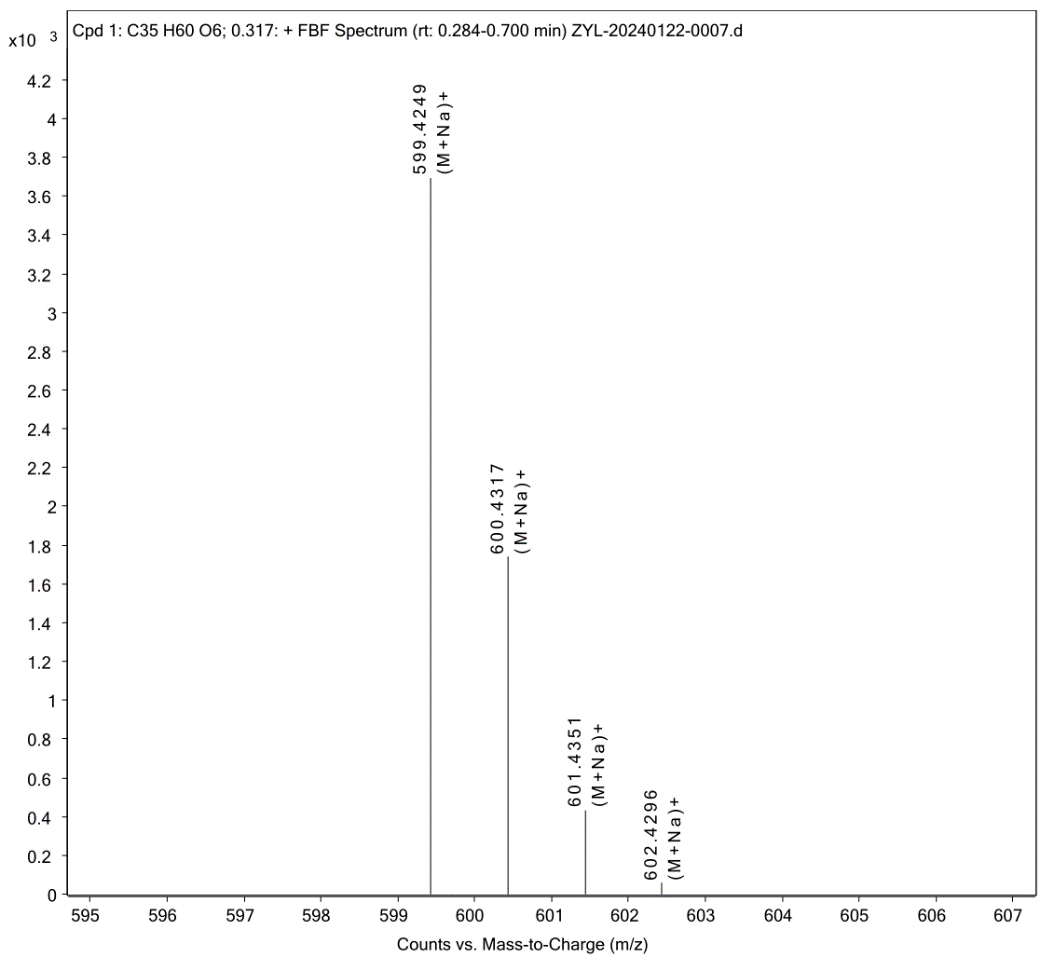
**Figure S17.** The 13C NMR spectrum of compound **5** (150 MHz, CDCl3).

**Figure S18.** The HR-ESI-MS spectrum of compound **5**.

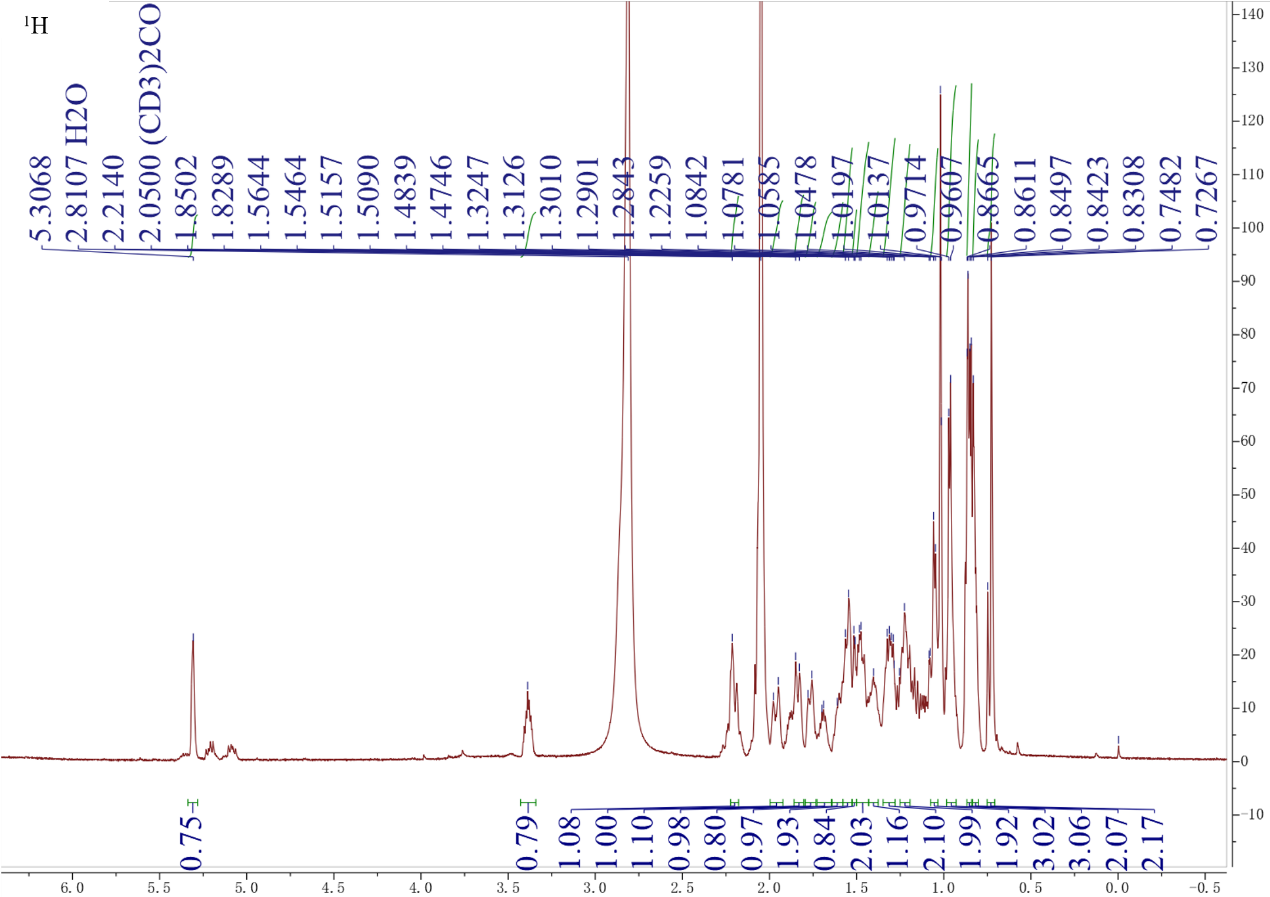


**Figure S19.** The 1H NMR spectrum of compound **6** (600 MHz, DMSO- *d6*).

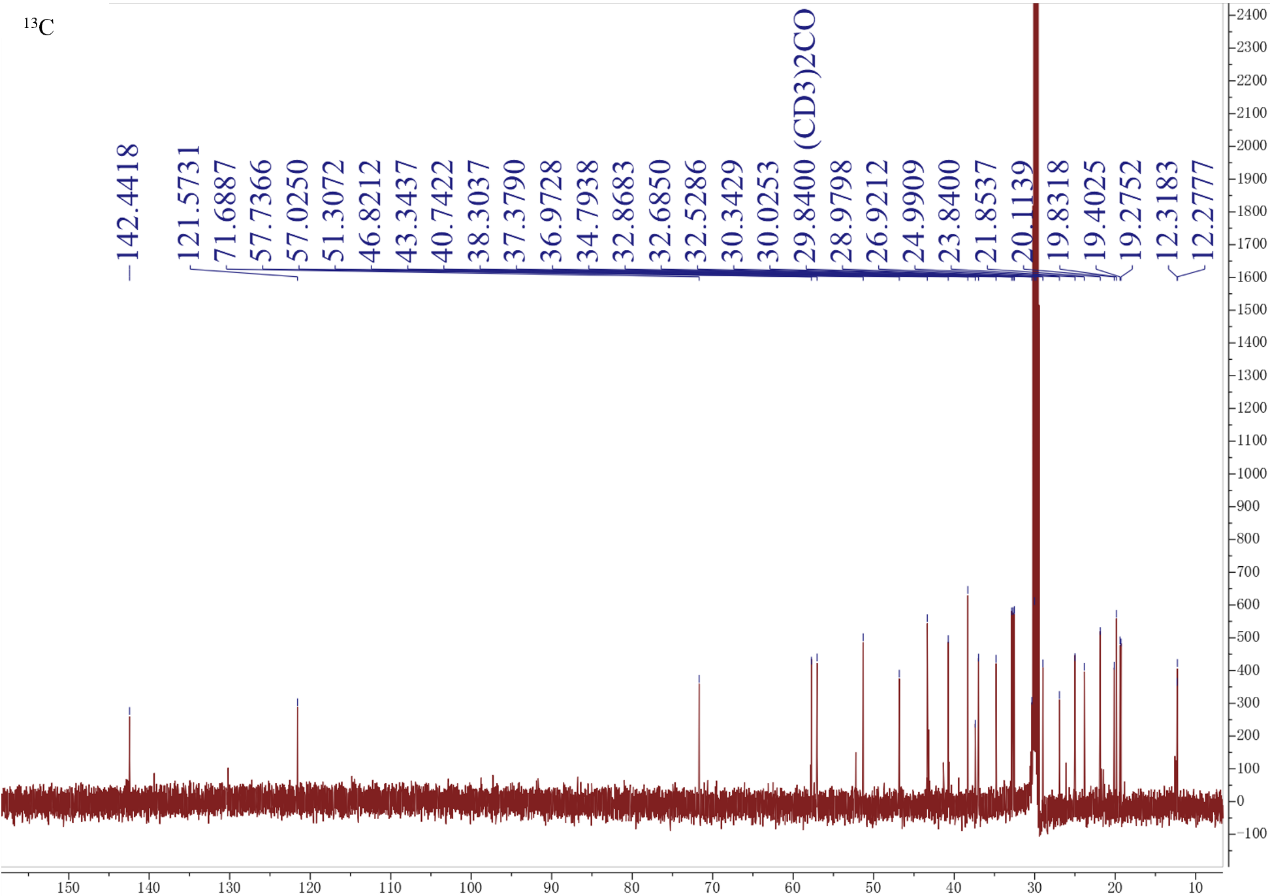


**Figure S20.** The 13C NMR spectrum of compound **6** (150 MHz, DMSO- *d6*).

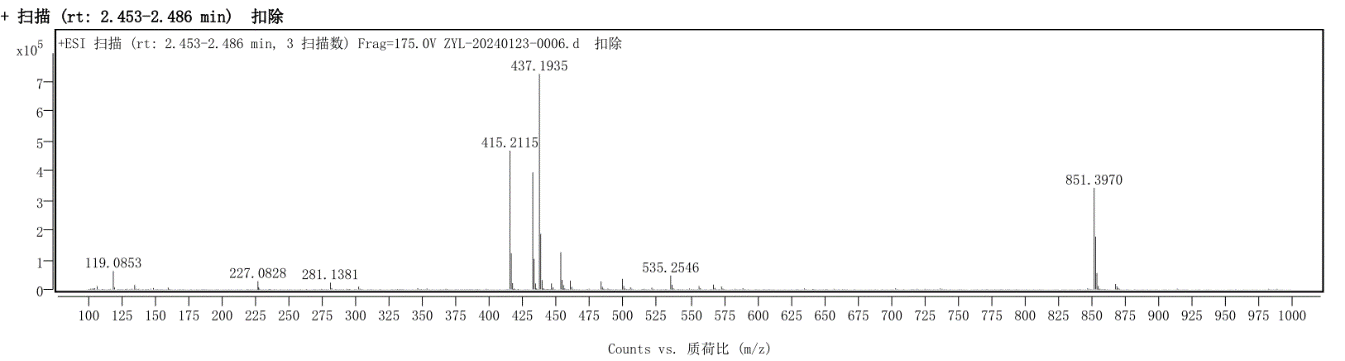
**Figure S21.** The HR-ESI-MS spectrum of compound **6**.



**Figure S22.** The 1H NMR spectrum of compound **7** (600 MHz, Acetone-*d6*).



**Figure S23.** The 13C NMR spectrum of compound **7** (150 MHz, Acetone-*d6*).



**Figure S24.** The HR-ESI-MS spectrum of compound **7**.