Supporting information

ACETATE/ACETIC ACID-ASSISTED ONE-POT SYNTHESIS OF (DIARYLMETHYLENE)IMIDAZOLONE FROM AMIDE OR THIOAMIDE

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Synthesis of 1b–i:

2-(Diphenylmethylene)-5,6,7,8-tetrahydroimidazo[1,2-*a*]pyridin-3(2*H*)-one (1b)

Method A (rt)—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4b-*O*** (91 mg, 0.91 mmol) in CH_2Cl_2 (3.0 mL) at rt, and the mixture thus obtained was stirred at rt for 24 h. Tetramethylammonium acetate (81 mg, 0.61 mmol) was added to the mixture at rt, and the mixture was stirred at the same temperature for 20 min. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the mixture thus obtained was stirred for 72 h at rt. Subsequent to the addition of 10% aqueous HCl and ether to the mixture, the liquid layers thus obtained were shaken and separated. The organic layer was further extracted twice with 10% aqueous HCl, and the combined aqueous layer was neutralized with $NaHCO_3$ and then re-extracted twice with ethyl acetate. The combined ethyl acetate layer was washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to yield **1b** (91 mg, 49%) as a yellow solid.

Method B—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4b-*S*** (77 mg, 0.67 mmol) in 1,2-dichloroethane (3.0 mL) at ice-cooling temperature, and the thus obtained mixture was initially stirred for 1 h at the same temperature and then for 6 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was then added to the mixture at rt, and the obtained mixture was stirred at the same temperature for 20 min. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the resulting mixture was stirred for 24 h under reflux conditions. The rest of the procedure was the same as that detailed above, and it yielded **1b** (91 mg, 49%).

5-(Diphenylmethylene)-2,3-dimethyl-3,5-dihydro-4*H*-imidazol-4-one (1c)

Method A (reflux)—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4c-*O*** (67 mg, 0.91 mmol) in 1,2-dichloroethane (3.0 mL) at rt, and the resulting mixture was stirred for 24 h at the same temperature. Tetramethylammonium acetate (81 mg, 0.61 mmol) was then added to the mixture at rt, and the obtained mixture was stirred for 20 min at the same temperature. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the mixture thus obtained was stirred for 24 h under reflux conditions. Subsequent to the addition of 10% aqueous HCl and ether to the mixture, the liquid layers thus obtained were shaken and separated. The organic layer was further extracted with 10% aqueous HCl, and the combined aqueous layer was neutralized with $NaHCO_3$ and then re-extracted twice with ethyl acetate. The combined ethyl acetate layer was washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1 to 1/1) to yield **1c** (25 mg, 15%) as a yellow solid.

Method B—Methyl trifluoromethanesulfonate (134 µL, 1.22 mmol) was added to a stirred solution of **4c-*S*** (120 mg, 1.35 mmol) in 1,2-dichloroethane (6.0 mL) at ice-cooling temperature, and the resulting mixture was initially stirred for 1 h at the same temperature and then for 24 h at rt. Tetramethylammonium acetate (163 mg, 1.22 mmol) was added to the mixture at rt, and the obtained mixture was stirred for 20 min at the same temperature. Acetic acid (700 µL, 12.2 mmol) and glycinate **3** (1.64 g, 6.12 mmol) were then added to the mixture at rt, and the resulting mixture was stirred for 24 h under reflux conditions. The rest of the procedure was the same as that described above, except

for the eluent utilized for the silica gel column chromatography (hexane/ethyl acetate = 3/2); ultimately, the procedure yielded **1c** (159 mg, 47%).

3-(But-3-yn-1-yl)-5-(diphenylmethylene)-2-methyl-3,5-dihydro-4*H*-imidazol-4-one (1d)

Method A (reflux)—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4d-*O*** (102 mg, 0.91 mmol) in 1,2-dichloroethane (3.0 mL) at rt, and the resulting mixture was stirred for 24 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was then added to the mixture at rt, and the mixture thus obtained was stirred for 20 min at rt. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the obtained mixture was stirred for 24 h under reflux conditions. Subsequent to the addition of 10% aqueous HCl and ether to the mixture, the liquid layers thus obtained were shaken and separated. The organic layer was further extracted twice with 10% aqueous HCl, and the combined aqueous layer was neutralized with $NaHCO_3$ and then re-extracted twice with ethyl acetate. The combined ethyl acetate layer was washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1 to 1/1), and further by PLC (CH_2Cl_2/ethyl acetate = 20/1) to yield **1d** (27 mg, 14%) as a yellow solid.

Method B—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4d-*S*** (85 mg, 0.67 mmol) in 1,2-dichloroethane (3.0 mL) at ice-cooling temperature, and the resulting mixture was initially stirred for 1 h at the same temperature and then for 1 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was added to the obtained mixture at rt, and the resulting mixture was stirred for 20 min at rt. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the resulting mixture was stirred for 22 h under reflux conditions. The rest of the procedure was the same as that described above, except for the eluent of silica gel column chromatography (hexane/ethyl acetate = 2/1); ultimately, the procedure yielded **1d** (79 mg, 41%).

5-(Diphenylmethylene)-2-methyl-3,5-dihydro-4*H*-imidazol-4-one (1e)

Method B—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4e-*S*** (50 mg, 0.67 mmol) in 1,2-dichloroethane (3.0 mL) at ice-cooling temperature, and the resulting mixture was initially stirred for 1 h at the same temperature and then for 6 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was then added to the mixture at rt, and the mixture thus obtained was stirred for 20 min at rt. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were added to the mixture at rt, and the obtained mixture was stirred for 24 h under reflux conditions. The rest of the procedure was the same as that described for the synthesis of **1c**, except for the eluent of silica gel column chromatography (hexane/ethyl acetate = 1/2); ultimately, the procedure yielded **1e** (79 mg, 50%) as a pale yellow solid.

2-(Diphenylmethylene)-5,6-dihydroimidazo[2,1-*a*]isoquinolin-3(2*H*)-one (1f)

Method A (reflux)—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred solution of **4f-*O*** (135 mg, 0.91 mmol) in 1,2-dichloroethane (3.0 mL) at rt, and the resulting mixture was stirred for 24 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was then added to the mixture at rt, and the mixture thus obtained was stirred for 20 min at rt. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added at rt, and the resulting mixture was stirred for 24 h under reflux conditions. After dilution of the mixture with ethyl acetate, the organic layer was washed with saturated $NaHCO_3$ solution and brine, dried over Na_2SO_4, and

concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 4/1) to yield **1f** (135 mg, 63%) as a yellow solid.

5-(Diphenylmethylene)-2-(4-iodophenyl)-3-methyl-3,5-dihydro-4*H*-imidazol-4-one (1g)

Method B—Methyl trifluoromethanesulfonate (67 µL, 0.61 mmol) was added to a stirred suspension of **4g-*S*** (186 mg, 0.67 mmol) in 1,2-dichloroethane (3.0 mL) at ice-cooling temperature, and the resulting mixture was initially stirred for 15 min at the same temperature and then for 6 h at rt. Tetramethylammonium acetate (81 mg, 0.61 mmol) was added to the mixture at rt, and the obtained mixture was vigorously stirred for 45 min at rt. Acetic acid (349 µL, 6.10 mmol) and glycinate **3** (815 mg, 3.05 mmol) were then added to the mixture at rt, and the mixture thus obtained was stirred for 24 h under reflux conditions. After dilution of the mixture with CH_2Cl_2, the organic layer was washed with 10% aqueous HCl (four times), water, saturated $NaHCO_3$ solution, and brine; it was then dried over Na_2SO_4 and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/CH_2Cl_2 = 1/2 to CH_2Cl_2) to yield **1g** (152 mg, 54%) as a yellow solid.

2-(Bis(4-methoxyphenyl)methylene)-2,5,6,7,8,9-hexahydro-3*H*-imidazo[1,2-*a*]azepin-3-one (1′h)

Method A (rt)—Methyl trifluoromethanesulfonate (33 µL, 0.30 mmol) was added to a stirred solution of **4a-*O*** (52 mg, 0.46 mmol) in CH_2Cl_2 (1.5 mL) at rt, and the resulting mixture was stirred for 24 h at rt. Tetramethylammonium acetate (41 mg, 0.30 mmol) was then added to the mixture at rt, and the mixture thus obtained was stirred for 20 min at rt. Acetic acid (174 µL, 3.05 mmol) and a glycinate, ethyl 2-((bis(4-methoxyphenyl)methylene)amino)acetate, (499 mg, 1.52 mmol) were then added to the mixture at rt, and the obtained mixture was stirred for 48 h at rt. After dilution of the mixture with ethyl acetate, the organic layer was washed with saturated $NaHCO_3$ solution, water, and brine; it was then dried over Na_2SO_4 and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1 to 1/1) to yield **1′h** (58 mg, 51%) as a yellow solid.

2-(9*H*-Fluoren-9-ylidene)-2,5,6,7,8,9-hexahydro-3*H*-imidazo[1,2-*a*]azepin-3-one (1′i)

Method A (rt)—Methyl trifluoromethanesulfonate (33 µL, 0.30 mmol) was added to a stirred solution of **4a-*O*** (52 mg, 0.46 mmol) in CH_2Cl_2 (1.5 mL) at rt, and the resulting mixture was stirred for 24 h at the same temperature. Tetramethylammonium acetate (41 mg, 0.30 mmol) was then added to the mixture at rt, and the obtained mixture was stirred for 20 min at rt. Acetic acid (174 µL, 3.05 mmol) and a glycinate, methyl 2-((9*H*-fluoren-9-ylidene)amino)acetate, (383 mg, 1.52 mmol) were then added to the mixture at rt, and the mixture thus obtained was stirred for 48 h at rt. After dilution of the mixture with ethyl acetate, the organic layer was washed twice with 10% aqueous HCl, water, saturated $NaHCO_3$ solution, and brine; it was then dried over Na_2SO_4 and concentrated under reduced pressure. The residue thus obtained was purified by silica gel column chromatography (hexane/ethyl acetate = 20/1 to 9/1) to yield **1′i** (39 mg, 41%) as a yellow solid.

Compound **1c**

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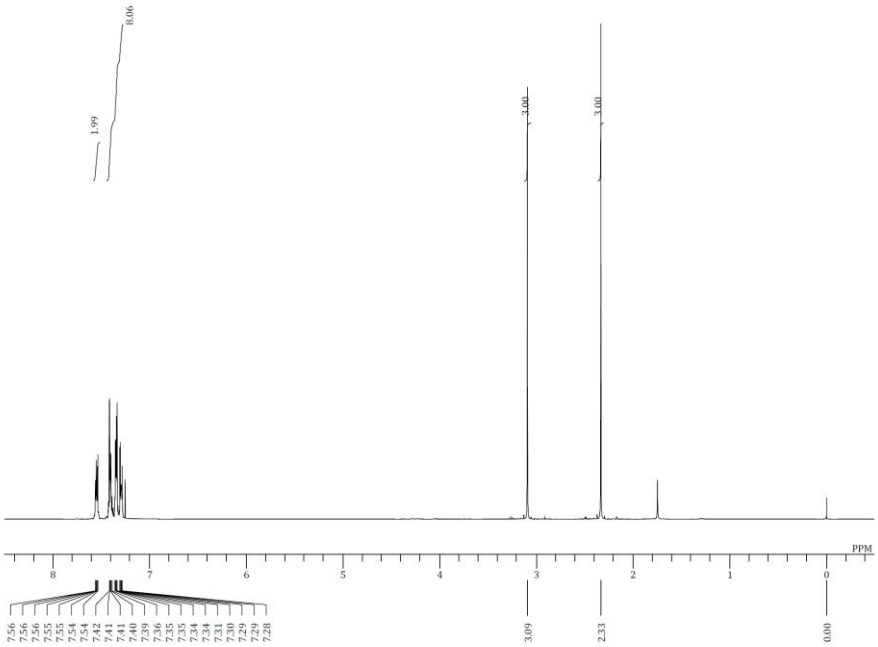

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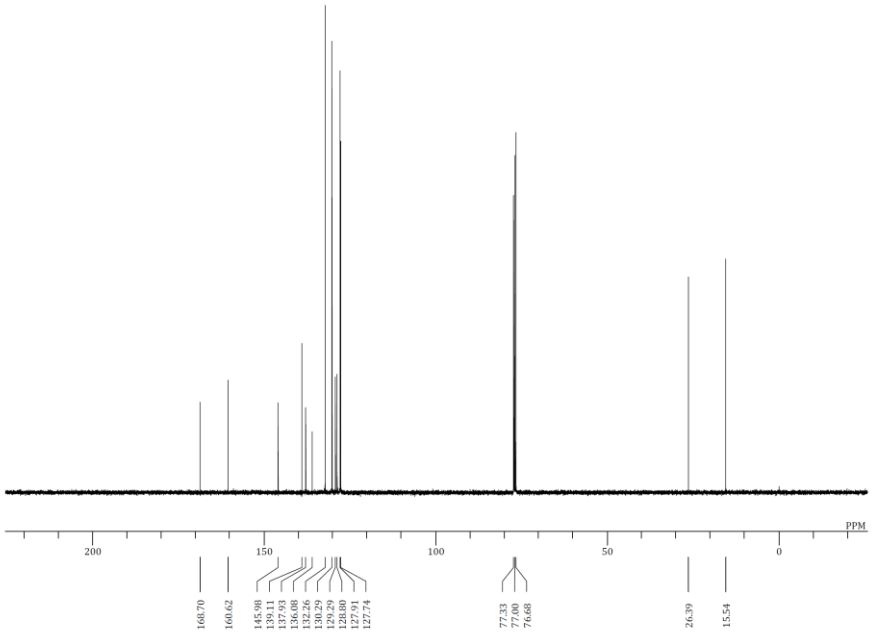

Compound **1d**

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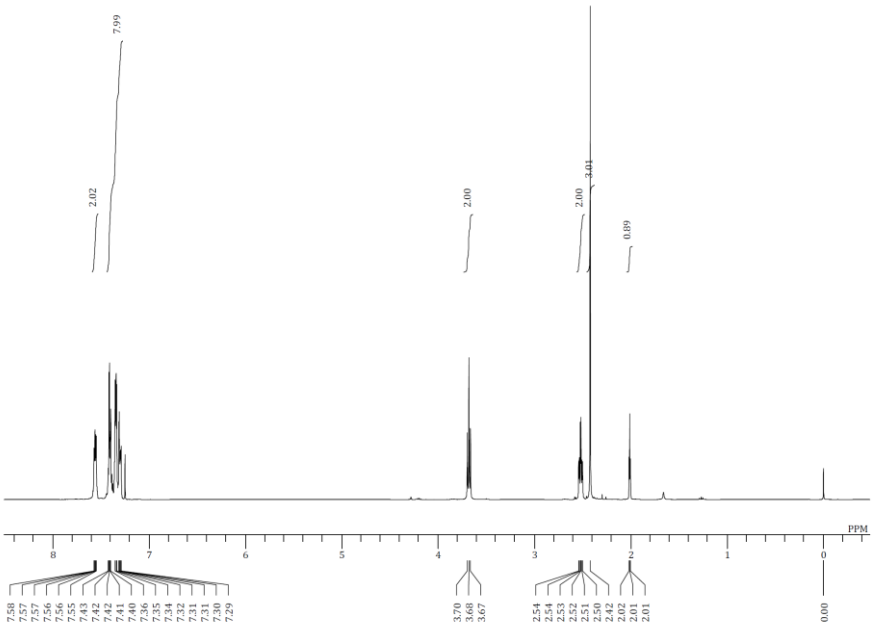

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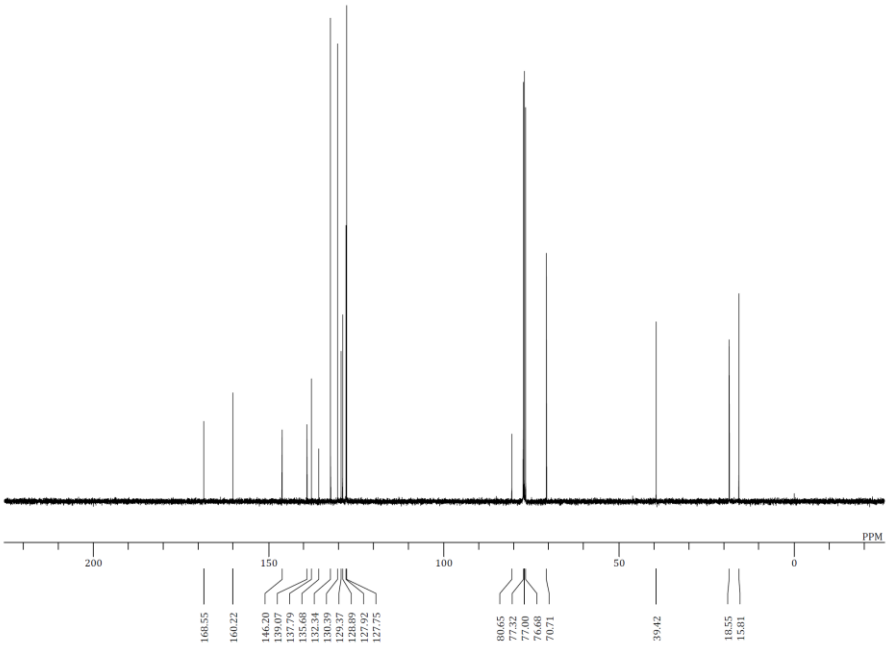

Compound **1e**

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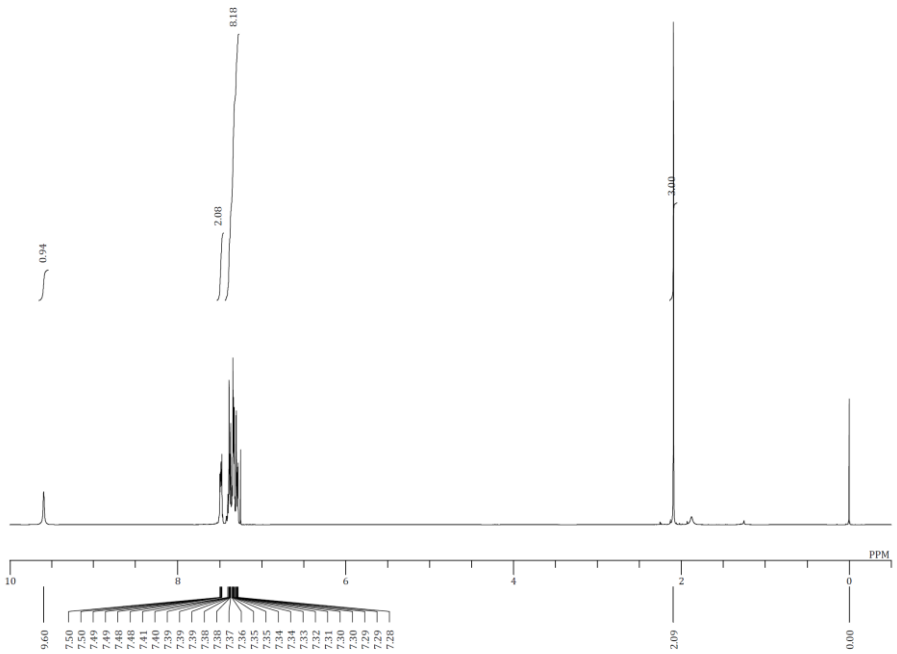

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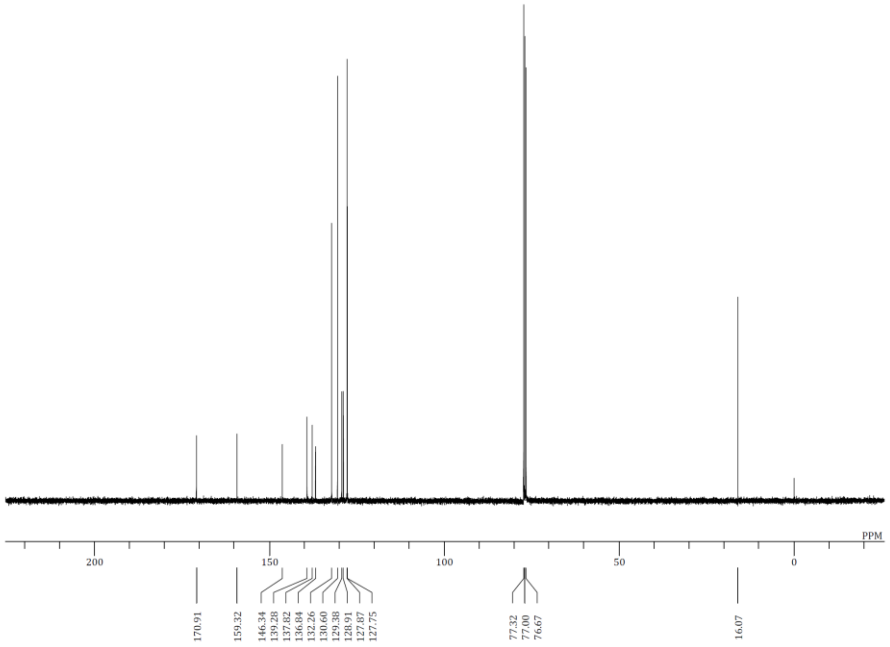

Compound **1j**

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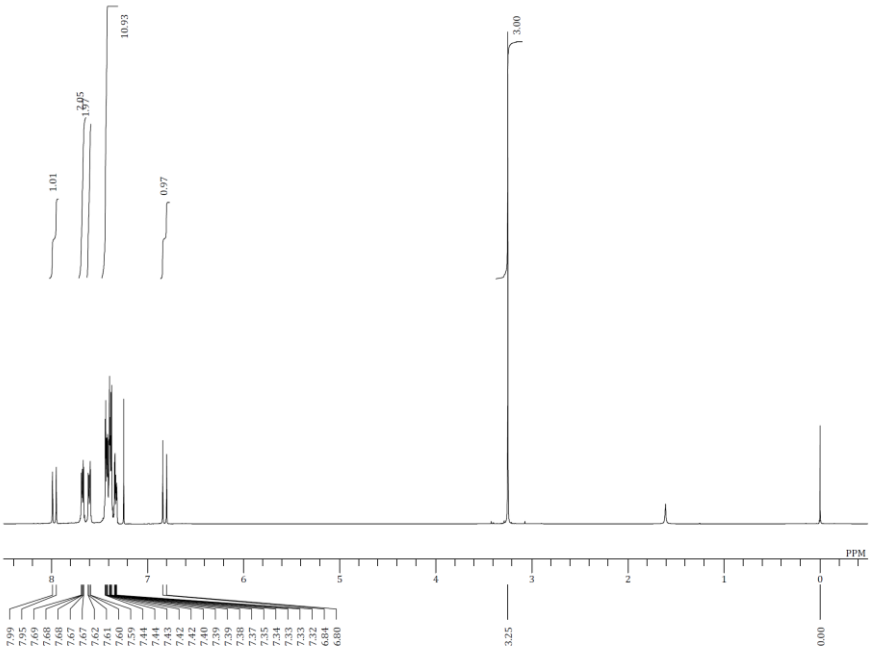

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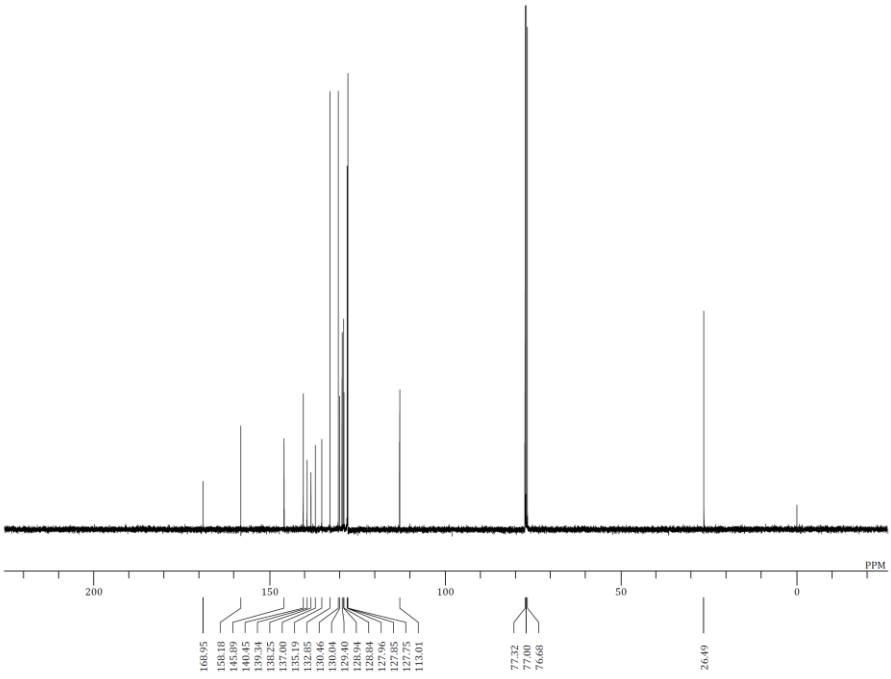

Compound **1k**

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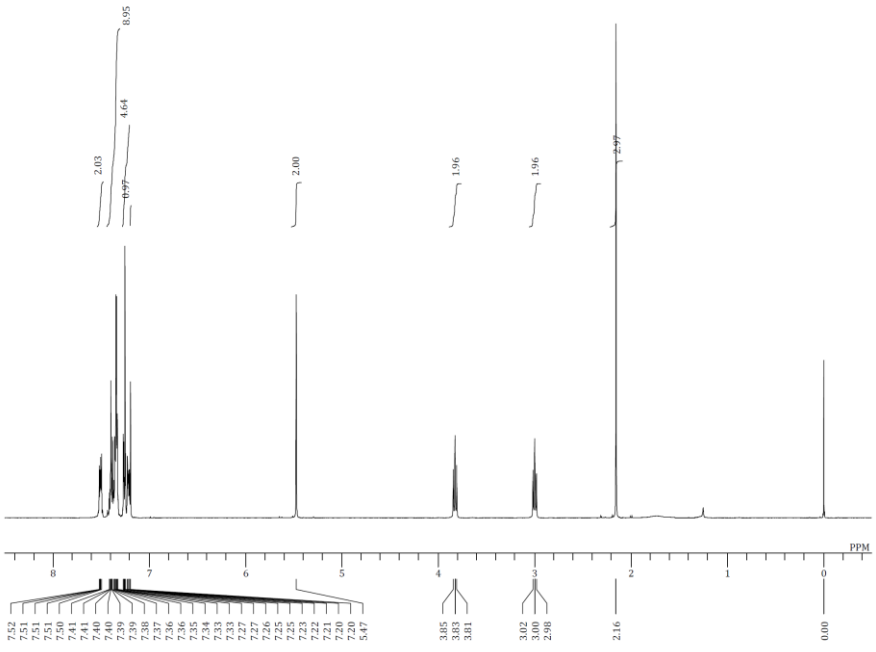

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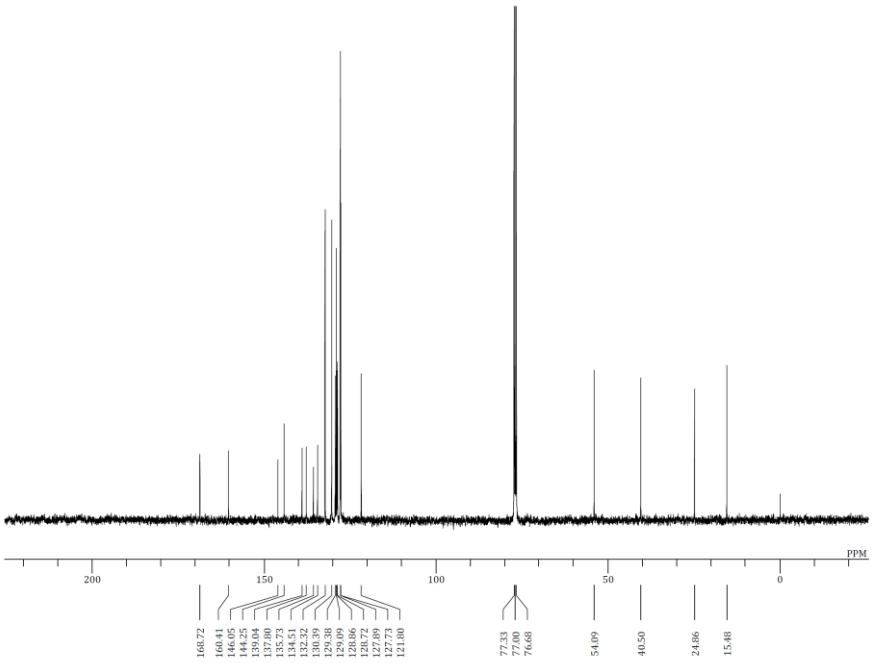

Compound **4d-*S***

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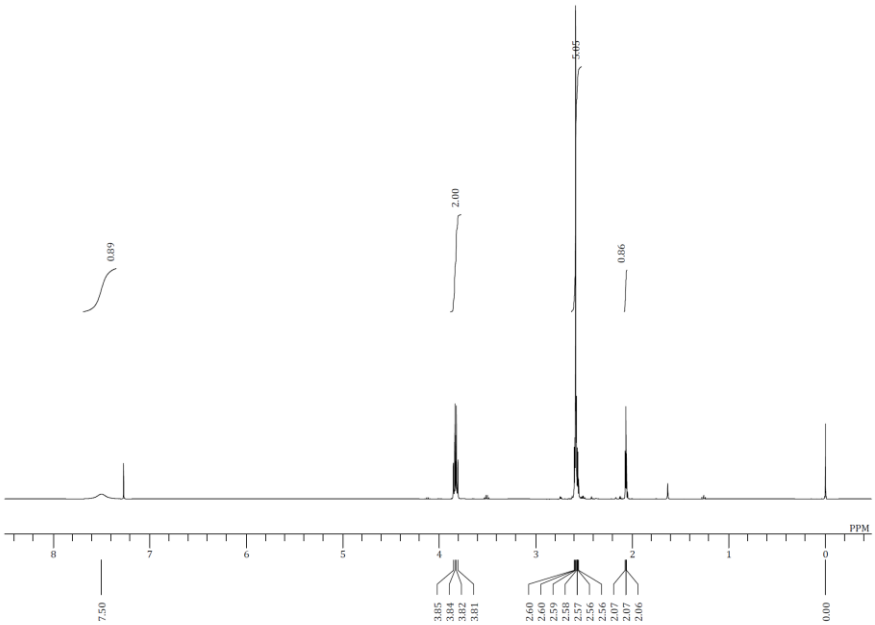

^{13}C-NMR: