Synthesis of novel 2-methyl-3-furyl sulfide flavor derivatives as efficient preservatives

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Supporting Information

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(A) Antimicrobial activity of 2-methyl-3-furyl sulfide flavor derivatives

Table 3. Inhibition zone of 2-methyl-3-furyl sulfide flavor derivatives on foodborne microorganisms. Inhibition zone values are represented as mean ± standard error (including the disc diameter, 6 mm). The means with different letters ($^{a-j}$) are significantly different ($p<0.05$).

Compounds	Inhibition zone (mm)					
	Bacteria					
	EC	BS	SA	SP	LM	VP
3a	0	12.57±0.29^{abc}	11.57±0.29^{c}	11.03±0.47^{c}	0	0
3b	8.77±0.33^{g}	17.57±0.29^{bcd}	8.57±0.29^{ef}	19.90±0.42^{a}	18.57±0.29^{a}	0
3c	0	0	0	0	0	0
3d	8.90±0.20^{g}	0	7.37±0.13^{g}	8.43±0.33^{d}	0	0
3e	12.03±0.29^{d}	0	0	0	0	0
3f	0	7.23±0.13^{e}	0	8.37±0.13^{d}	7.57±0.47^{f}	10.03±0.29^{b}
3g	7.57±0.29^{h}	9.23±0.47^{cde}	10.23±0.47^{d}	13.70±0.42^{b}	13.57±0.29^{c}	0
3h	0	8.70±0.42^{cde}	7.57±0.29^{g}	11.23±0.47^{c}	9.70±0.42^{d}	9.70±0.42^{bc}
3i	11.23±0.47^{e}	16.77±0.33^{a}	17.77±0.33^{a}	8.70±0.42^{d}	8.57±0.29^{e}	0
3j	17.70±0.20^{b}	13.43±0.33^{ab}	18.17±0.33^{a}	0	0	0
3k	0	0	7.57±0.29^{g}	0	0	0
3l	19.57±0.29^{a}	14.57±0.29^{ab}	17.57±0.29^{a}	11.90±0.20^{bc}	10.03±0.29^{d}	9.57±0.29^{c}
3m	0	0	8.90±0.20^{e}	0	0	0
5a	9.37±0.13^{fg}	0	7.83±0.33^{fg}	0	0	0
5b	0	0	0	0	0	0
5c	0	0	0	0	0	0
5d	0	0	0	0	0	0
5e	0	0	0	0	0	0
5f	9.77±0.33^{f}	7.83±0.33^{de}	8.57±0.29^{ef}	7.57±0.29^{d}	7.23±0.13^{f}	0
Pcn	15.83±0.33^{c}	15.37±0.13^{ab}	16.17±0.33^{b}	17.83±0.33^{a}	14.57±0.29^{b}	12.37±0.13^{a}

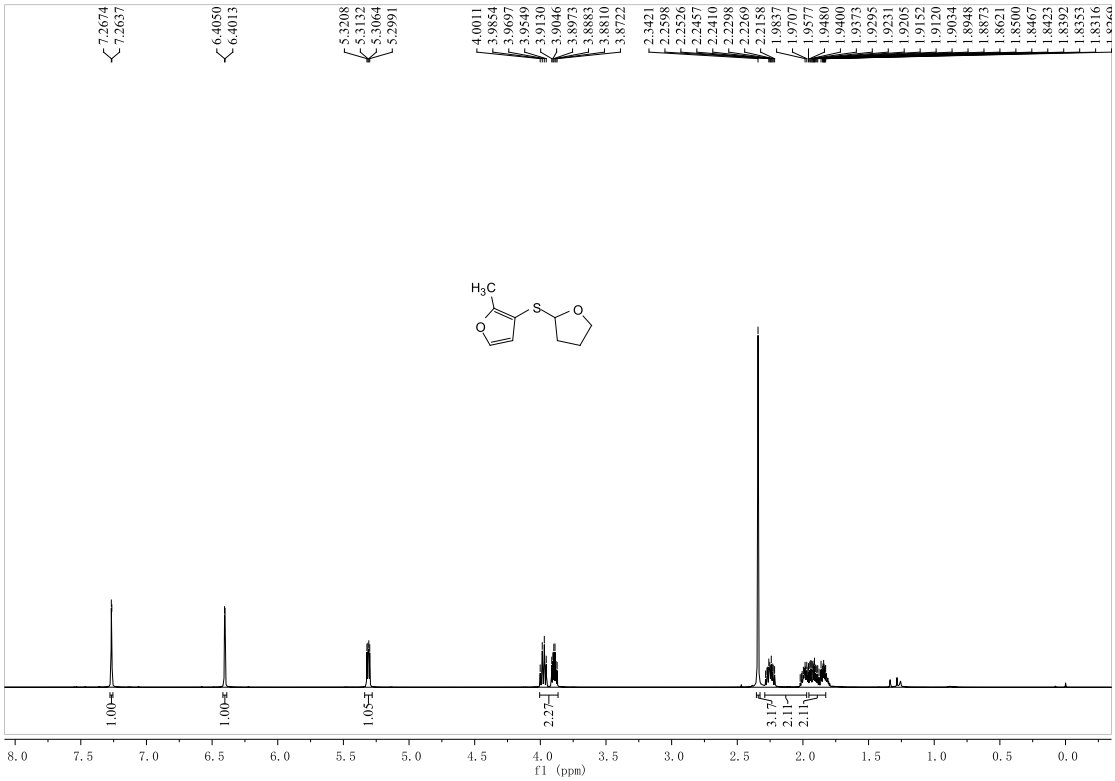
EC = *E. coli*. **BS** = *B. subtilis*. **SA** = *S. aureus*. **SP** = *S. paratyphi*. **LM** = *L. monocytogenes*. **VP** = *V. parahemolyticus*. **Pcn** = penicillin. The means with different letters ($^{a-h}$) are significantly different ($p<0.05$).

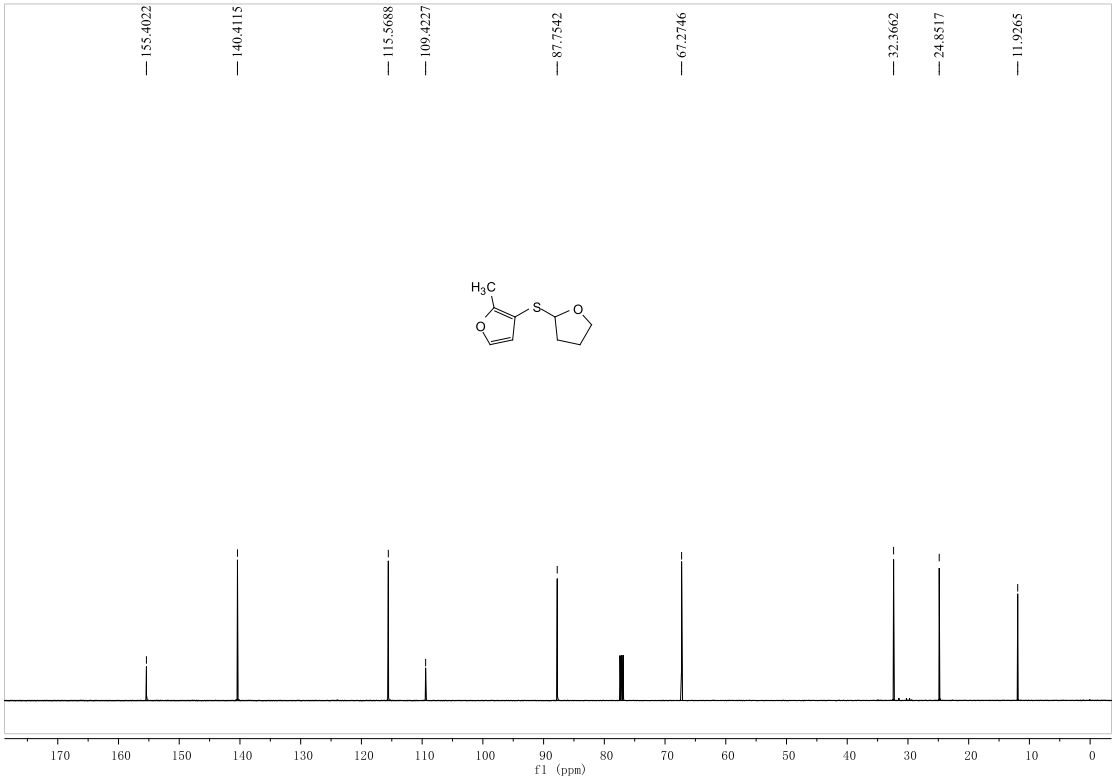
Compounds	Inhibition zone (mm)			
	Fungi			
	PI	**AN**	**MR**	**RO**
3a	12.37±0.13^{f}	13.70±0.42^{d}	15.83±0.33^{f}	11.03±0.29^{cd}
3b	7.37±0.13^{h}	0	9.17±0.33^{i}	0
3c	0	0	0	0
3d	20.23±0.47^{b}	0	20.57±0.29^{b}	8.17±0.33^{gh}
3e	21.57±0.29^{a}	8.70±0.42^{f}	0	7.70±0.42^{h}
3f	0	0	12.17±0.33^{g}	0
3g	9.37±0.47^{g}	17.70±0.42^{b}	15.57±0.29^{f}	8.77±0.33^{g}
3h	13.37±0.13^{e}	12.77±0.33^{e}	18.03±0.29^{d}	9.57±0.29^{f}
3i	15.77±0.33^{d}	18.70±0.20^{a}	10.43±0.33^{h}	19.70±0.42^{a}
3j	0	9.23±0.13^{f}	7.37±0.13^{j}	10.70±0.20^{de}
3k	0	0	7.70±0.20^{j}	0
3l	9.23±0.13^{g}	8.70±0.20^{f}	21.43±0.33^{a}	8.57±0.29^{g}
3m	8.70±0.42^{g}	7.83±0.33^{g}	19.43±0.33^{c}	11.57±0.29^{c}
5a	0	0	0	0
5b	7.57±0.29^{h}	0	0	0
5c	0	0	0	0
5d	0	0	0	0
5e	0	0	0	0
5f	14.03±0.29^{e}	0	16.70±0.20^{e}	10.17±0.33^{ef}
Amb	17.83±0.33^{c}	18.37±0.13^{a}	18.57±0.29^{d}	17.57±0.29^{b}
TMTD	15.23±0.13^{d}	15.70±0.20^{c}	17.90±0.20^{d}	17.37±0.13^{b}

PI = *P. italicum*. **AN** = *A. niger*. **MR** = *M. racemosus*. **RO** = *R. oryzae*. **Pcn** = penicillin. **Amb** = amphotericin B. **TMTD** = thiram. The means with different letters ($^{a-j}$) are significantly different ($p<0.05$).

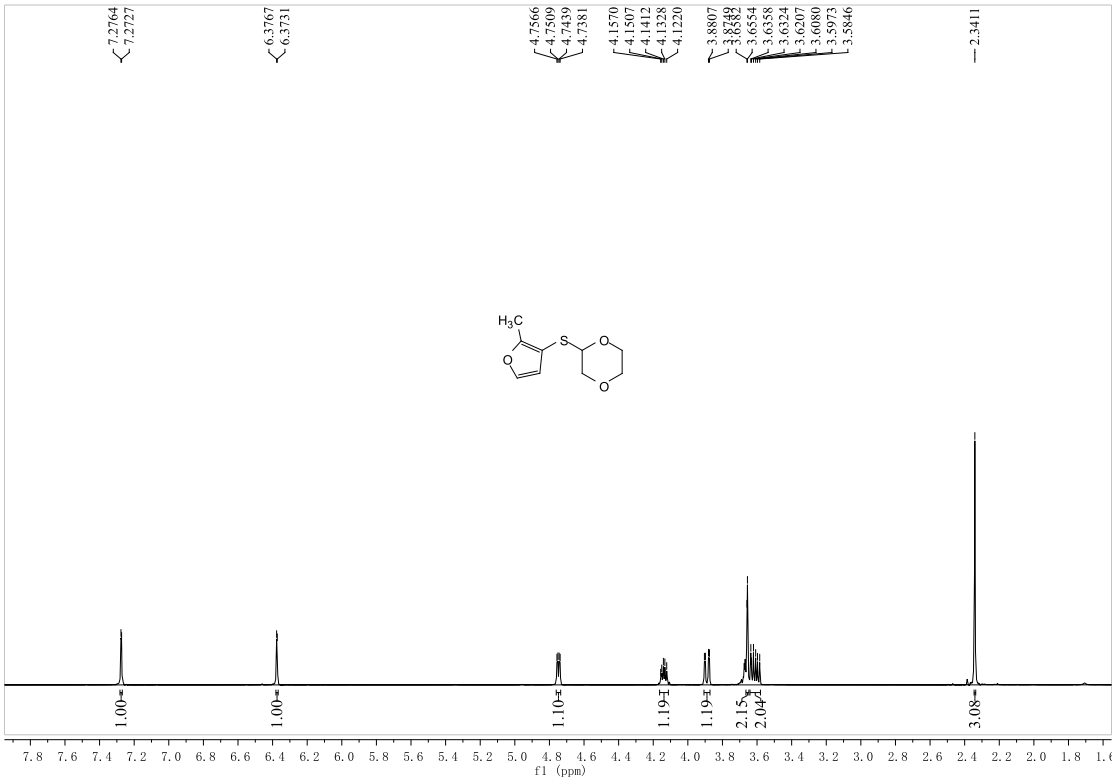
(B) NMR Spectra for products

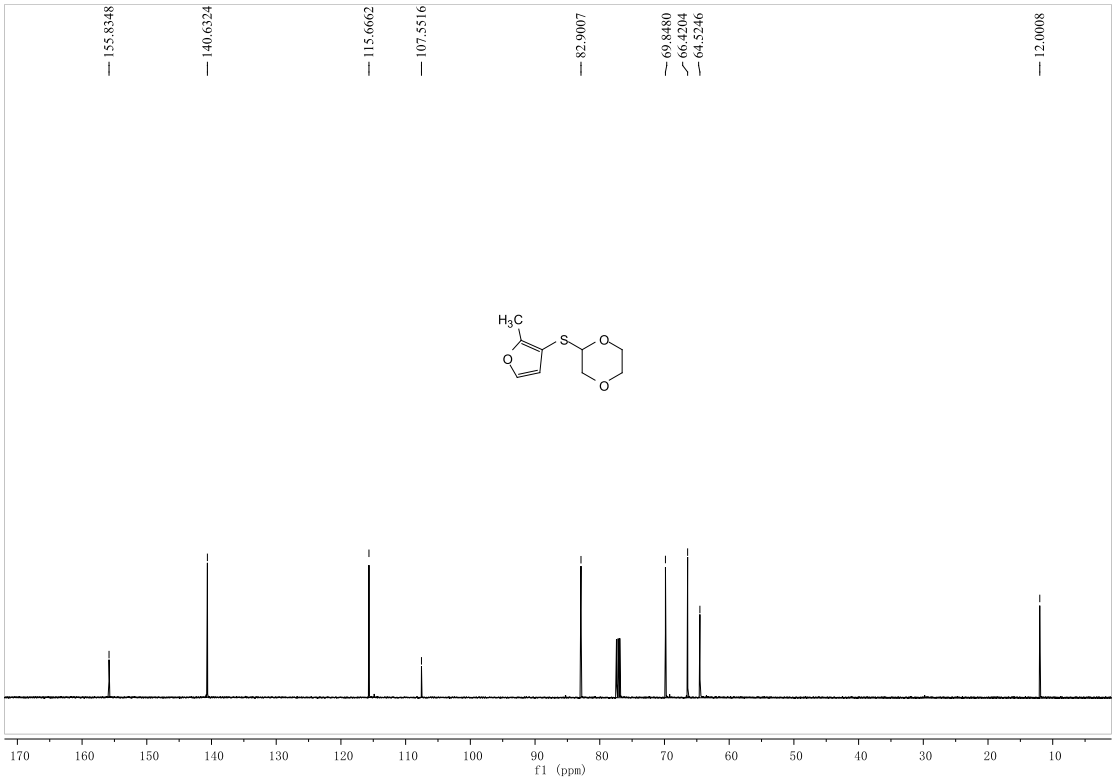
2-methyl-3-((tetrahydrofuran-2-yl)thio)furan (3a)



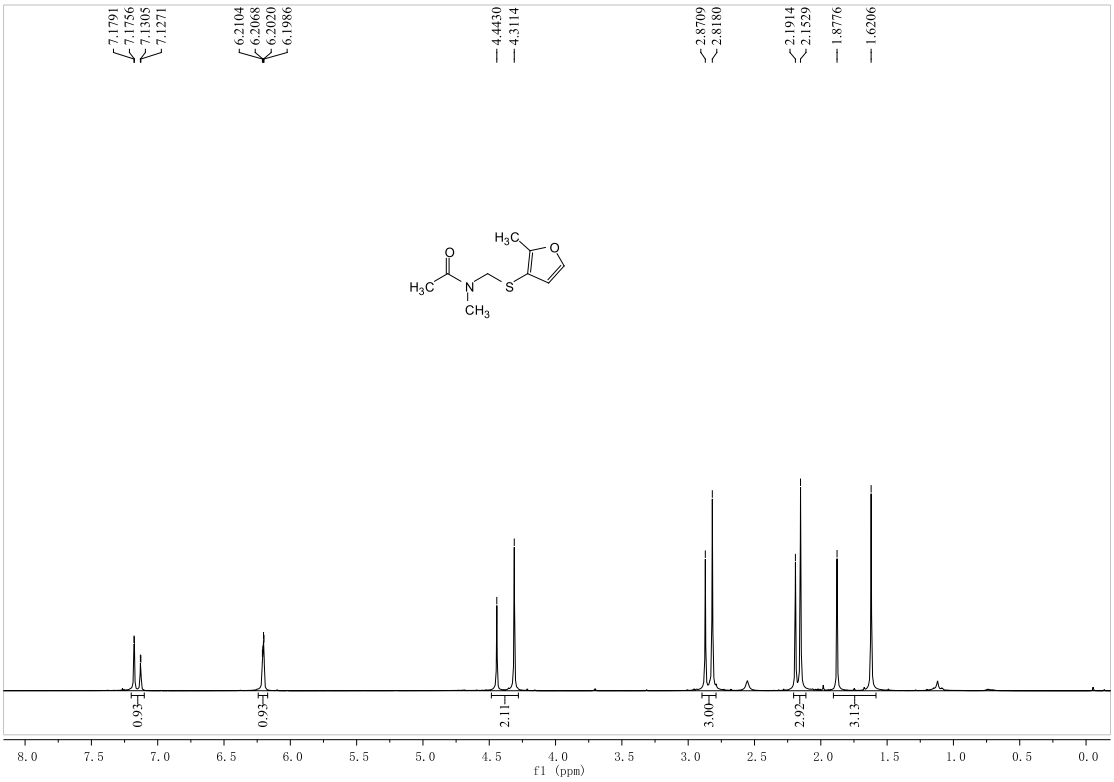


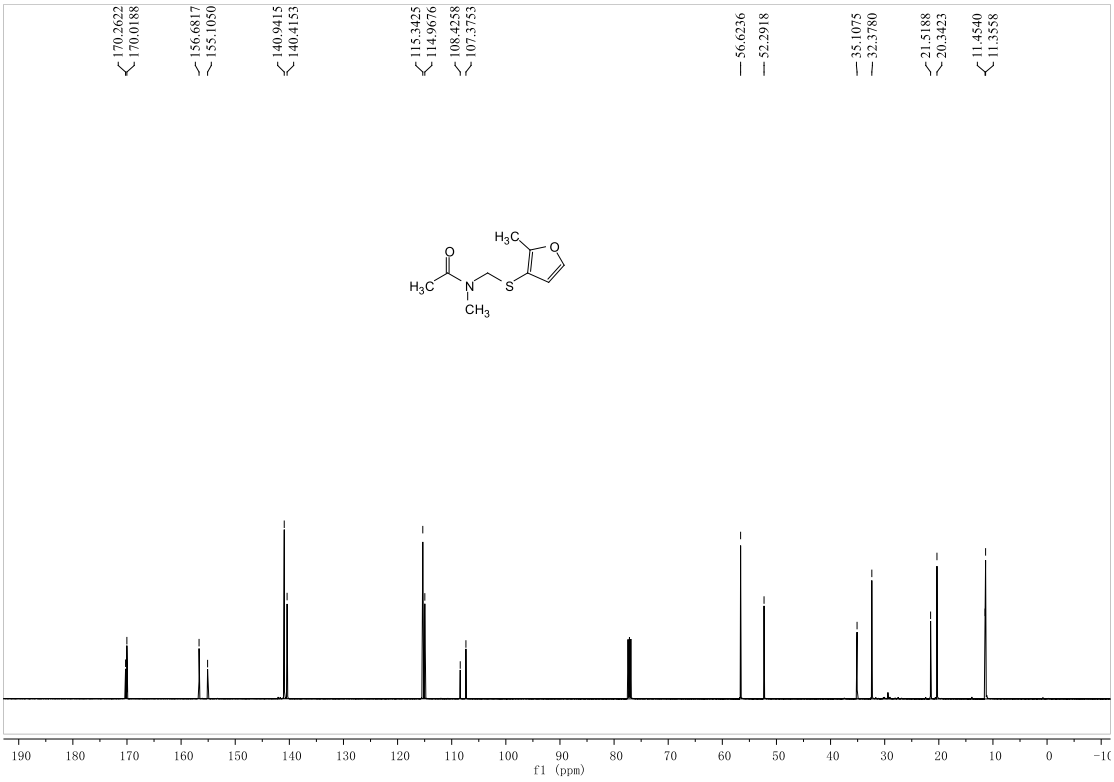
2-((2-methylfuran-3-yl)thio)-1,4-dioxane (3b)





N-methyl-N-(((2-methylfuran-3-yl)thio)methyl)acetamide (3c)





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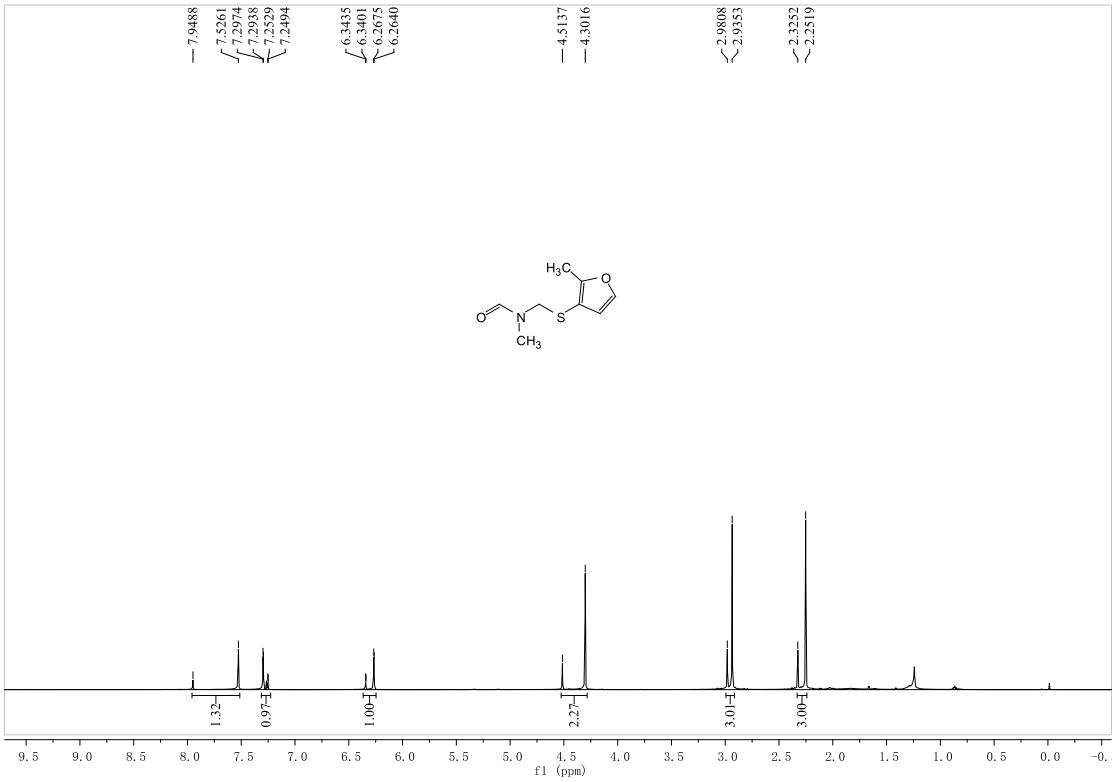
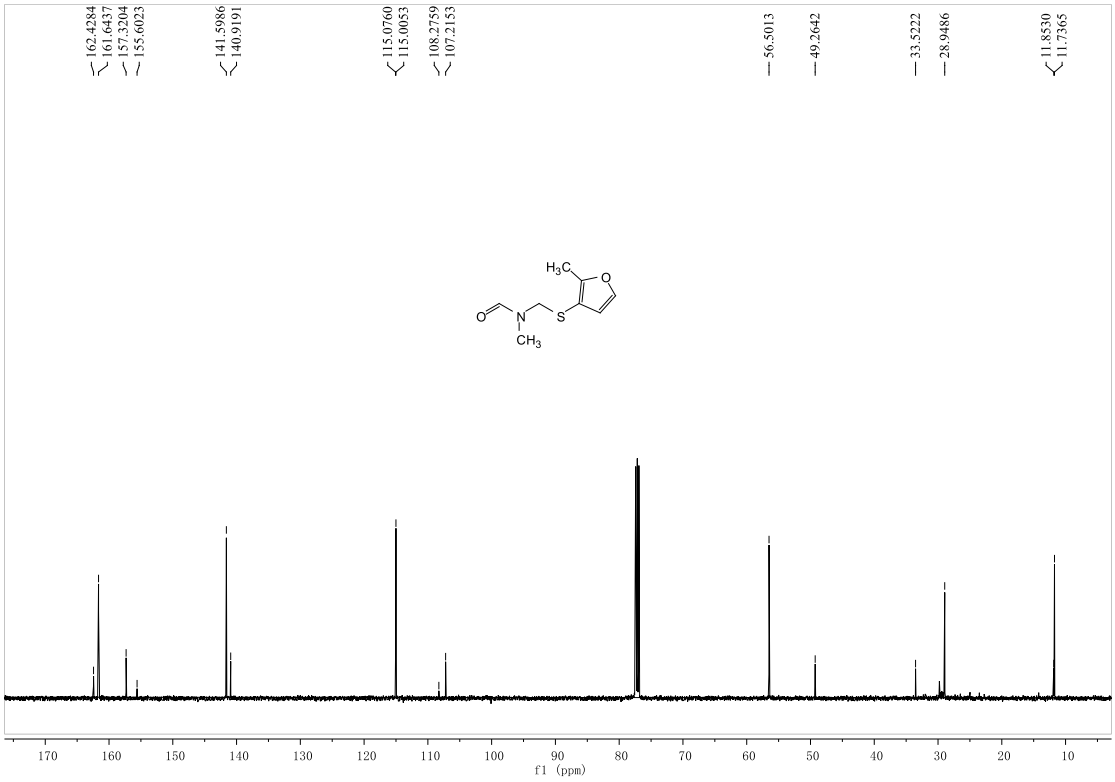
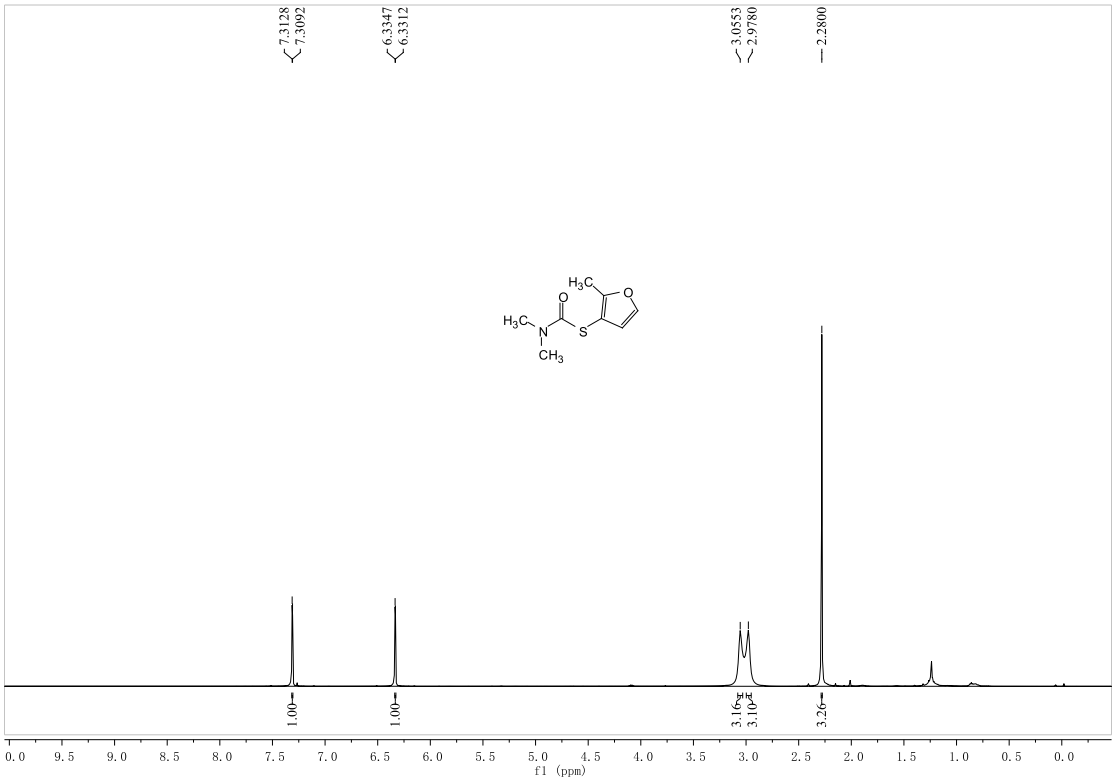
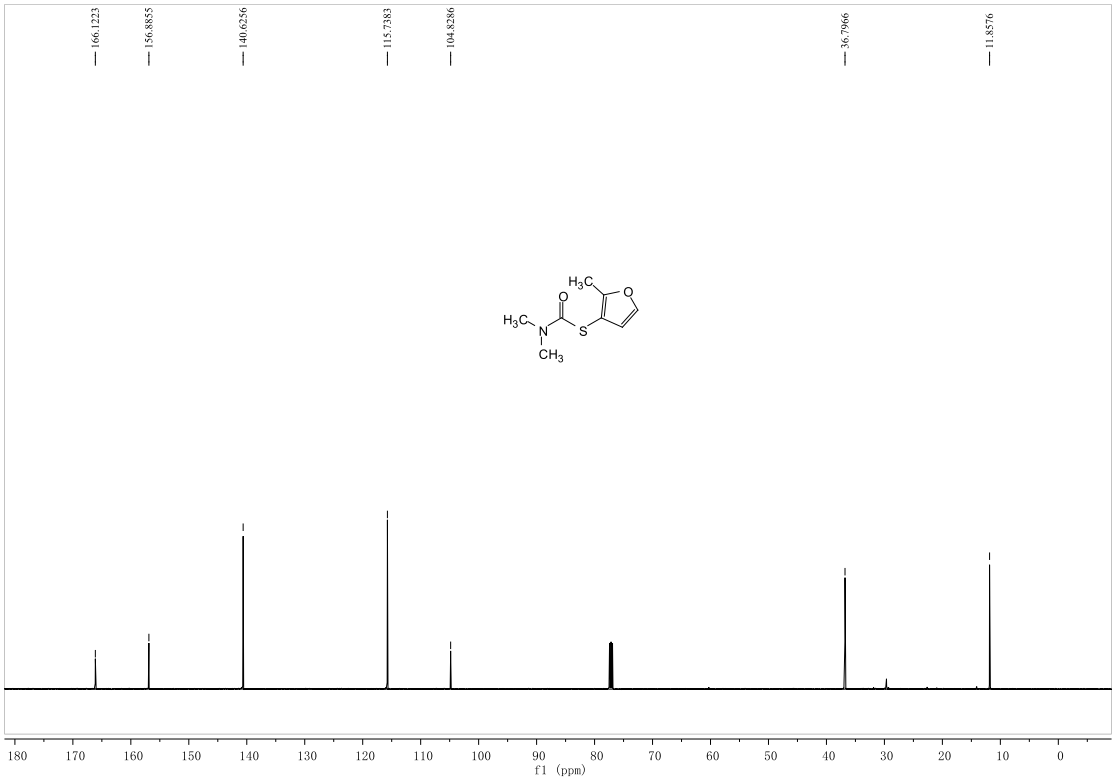


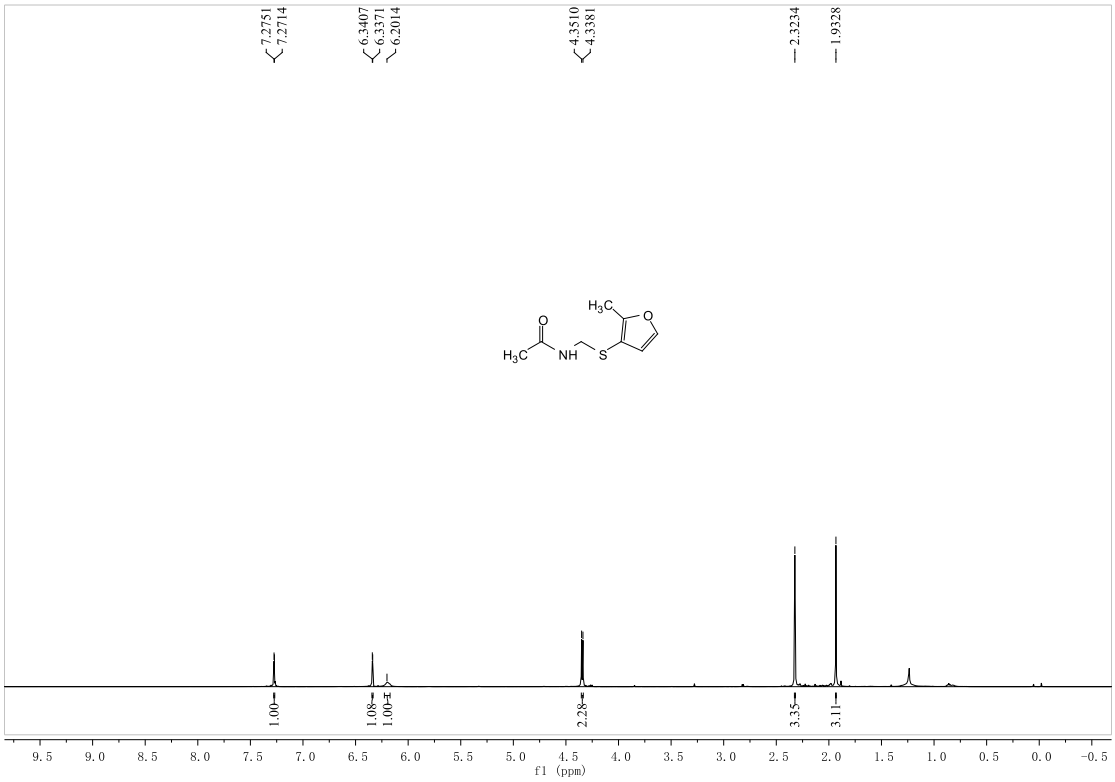


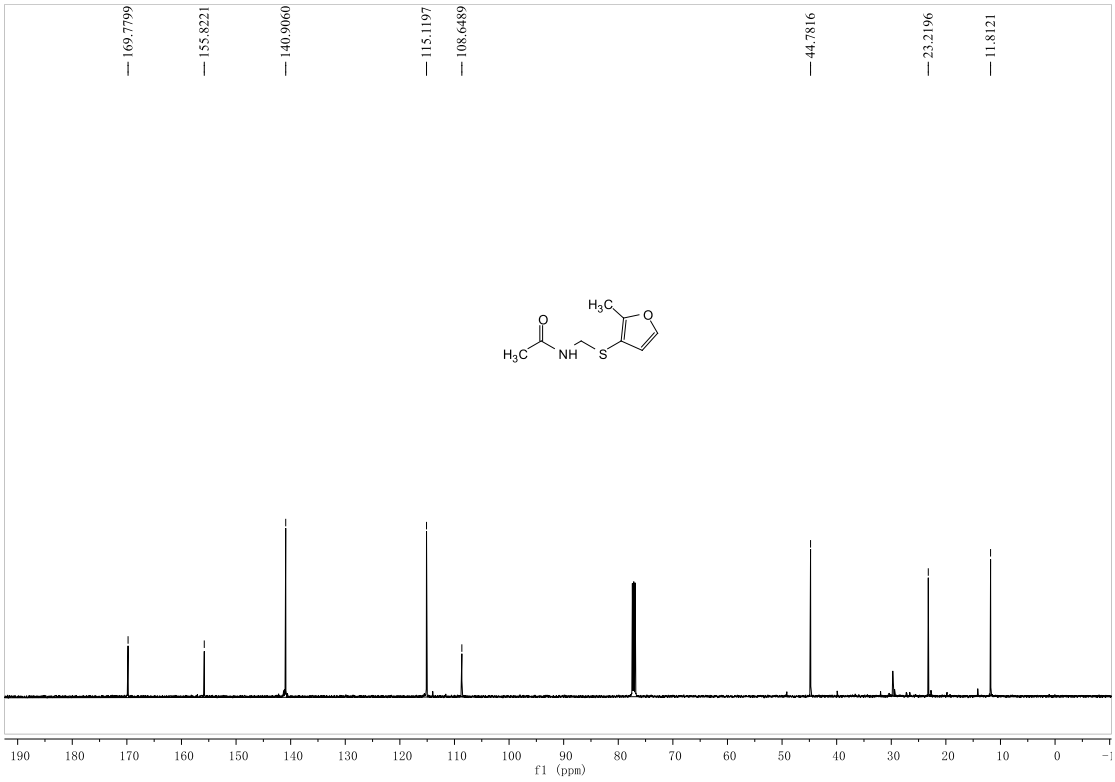
S-(2-methylfuran-3-yl)dimethylcarbamothioate (3e)



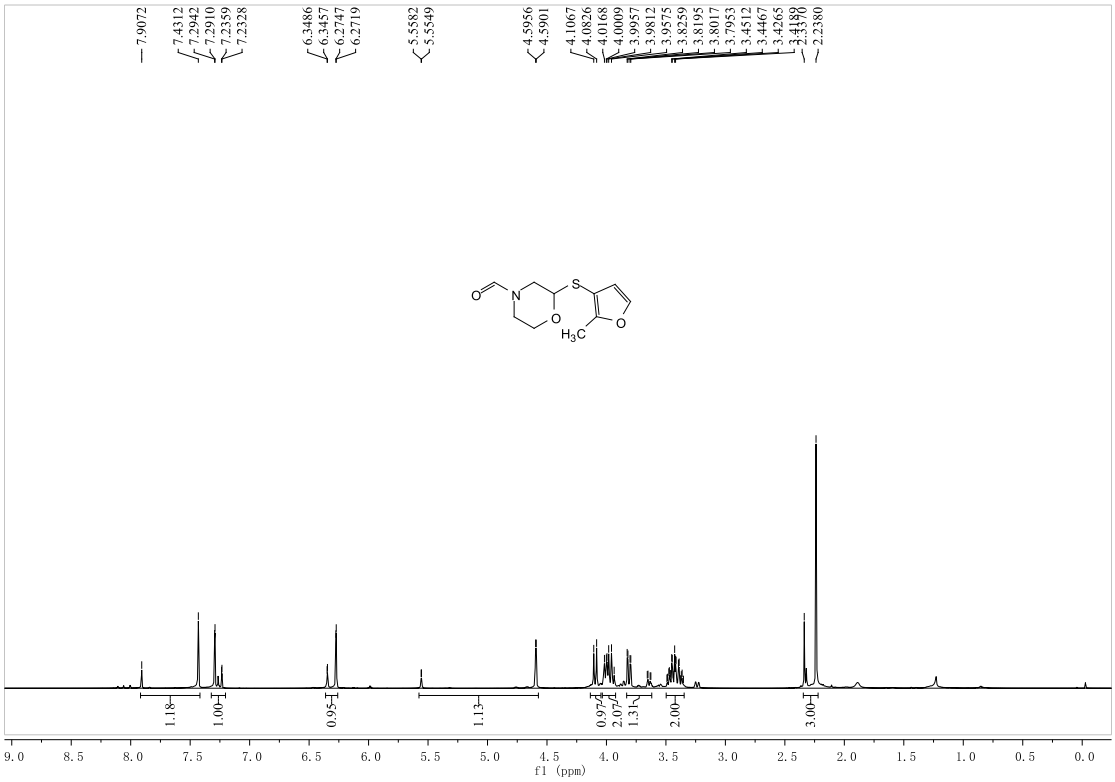


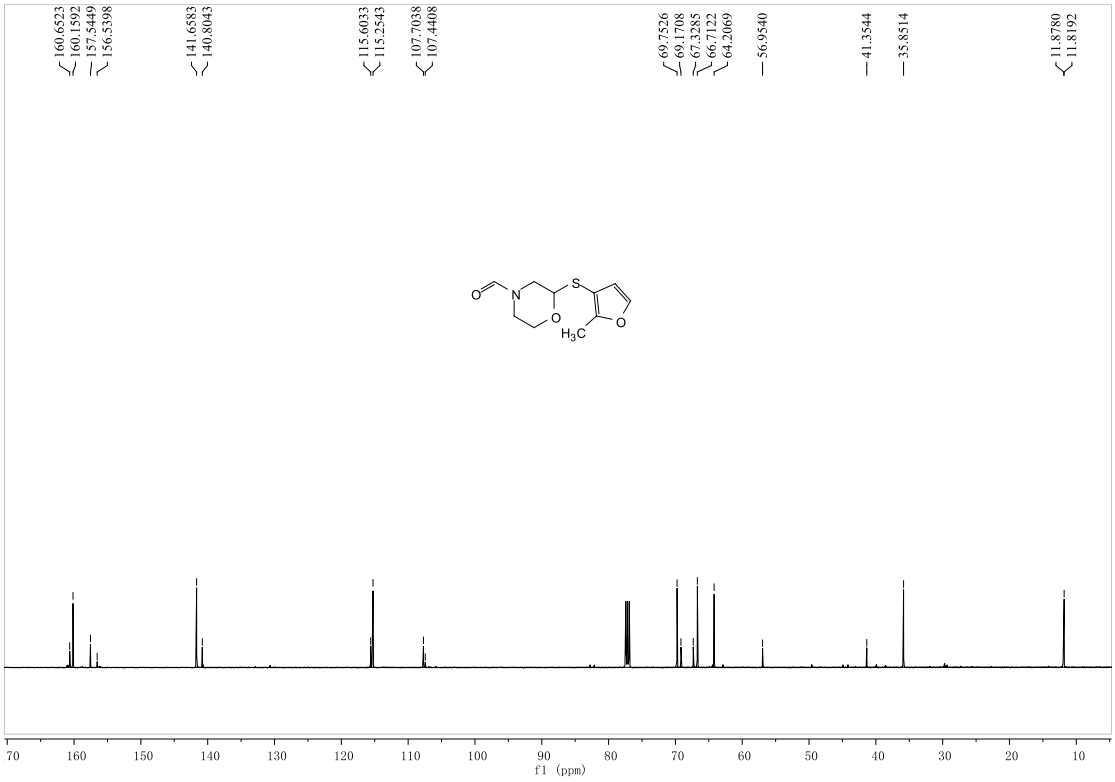
N-(((2-methylfuran-3-yl)thio)methyl)acetamide (3f)



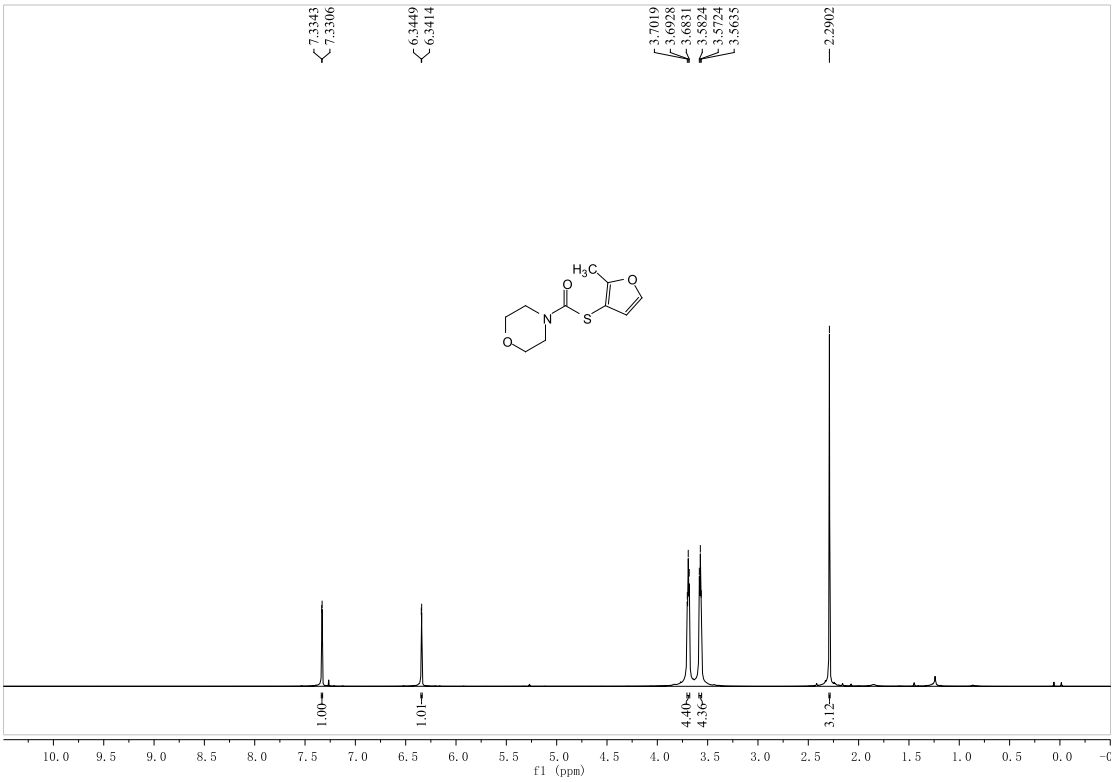


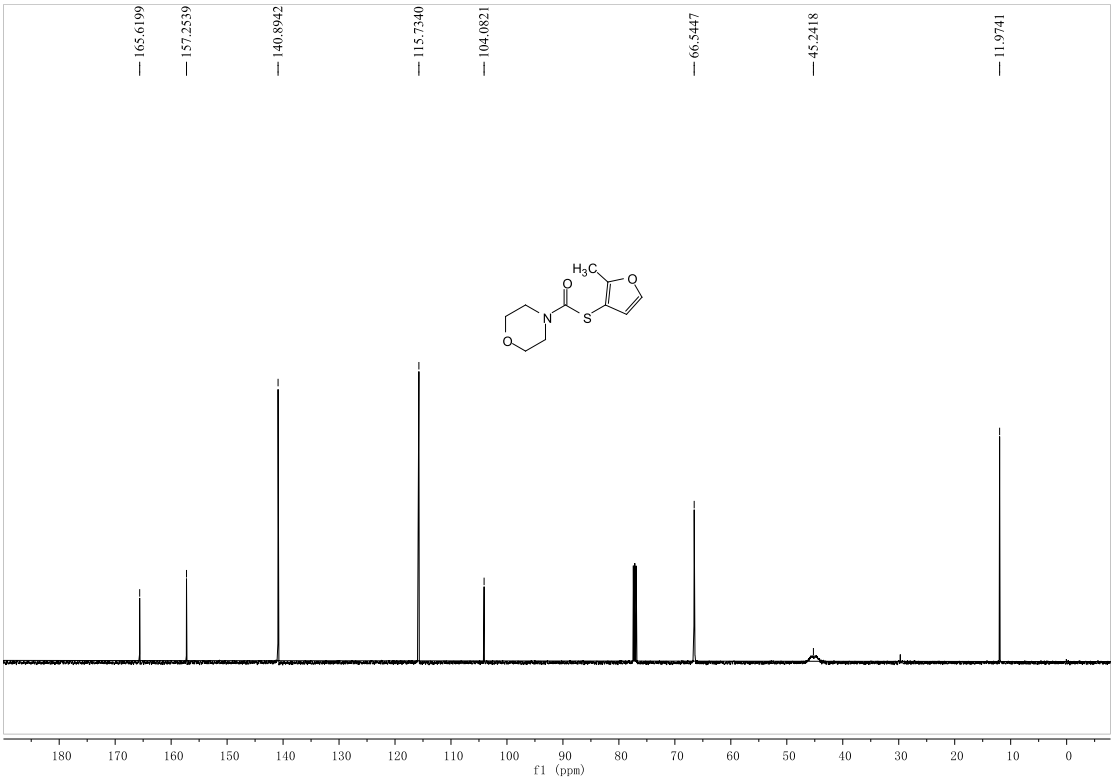
2-((2-methylfuran-3-yl)thio)morpholine-4-carbaldehyde (3g)



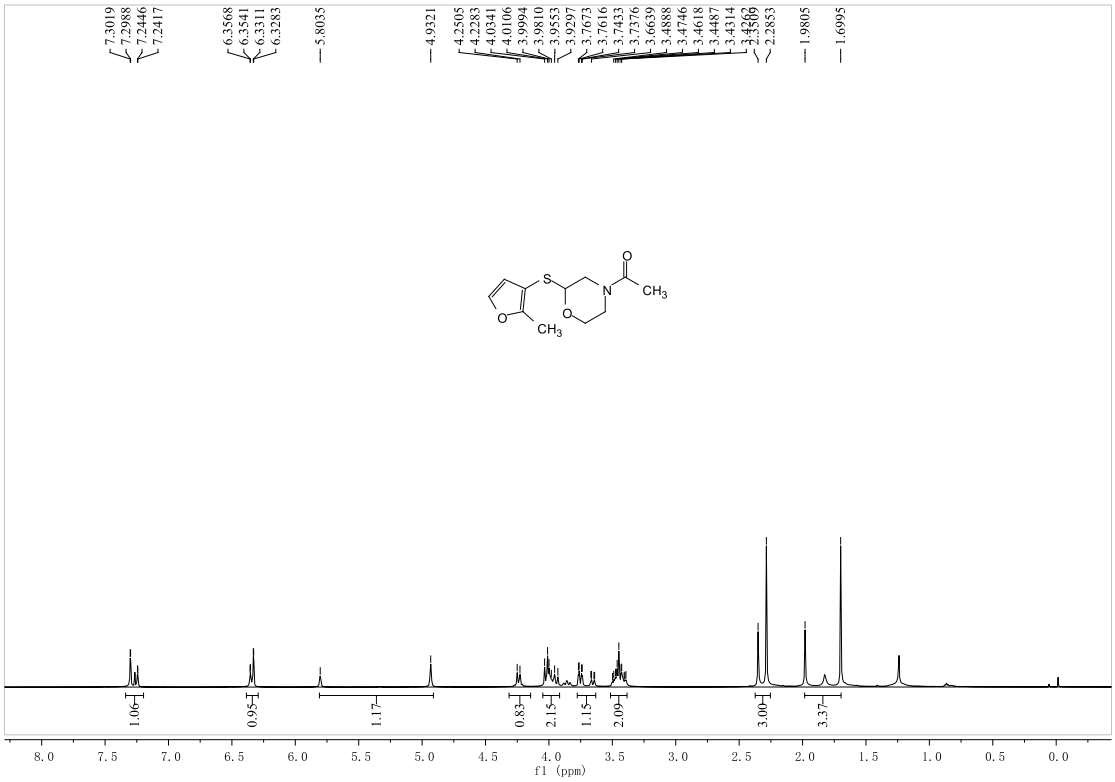


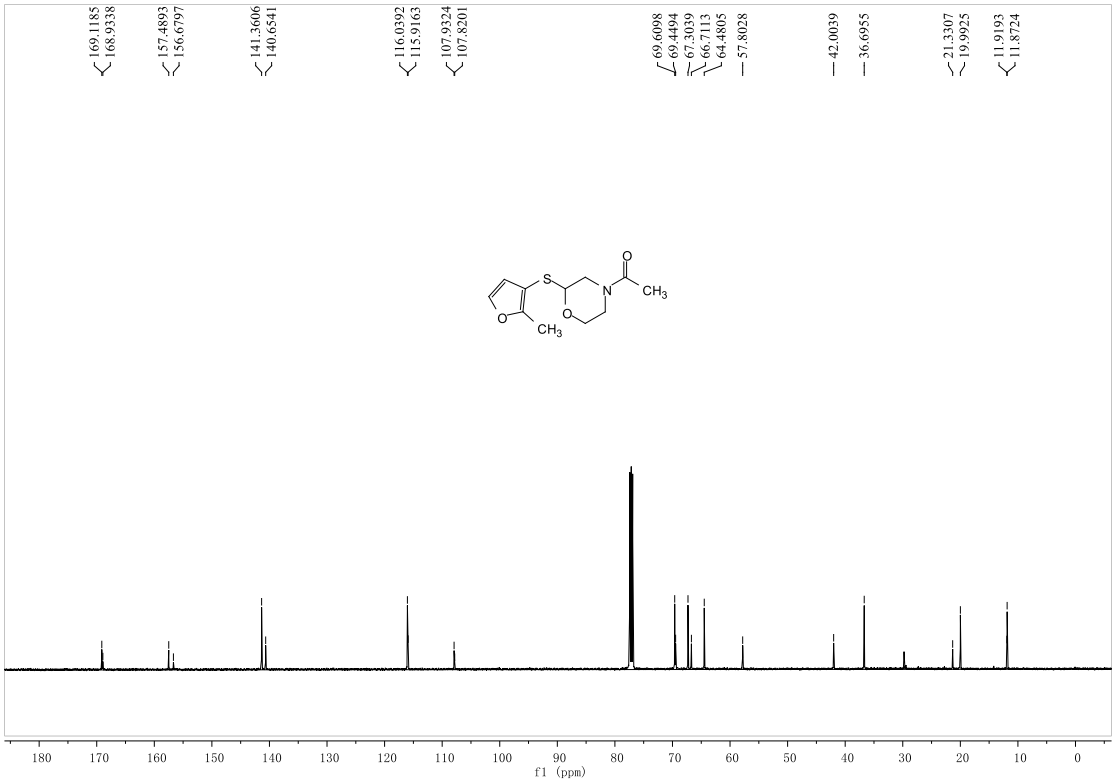
S-(2-methylfuran-3-yl)morpholine-4-carbothioate (3h)



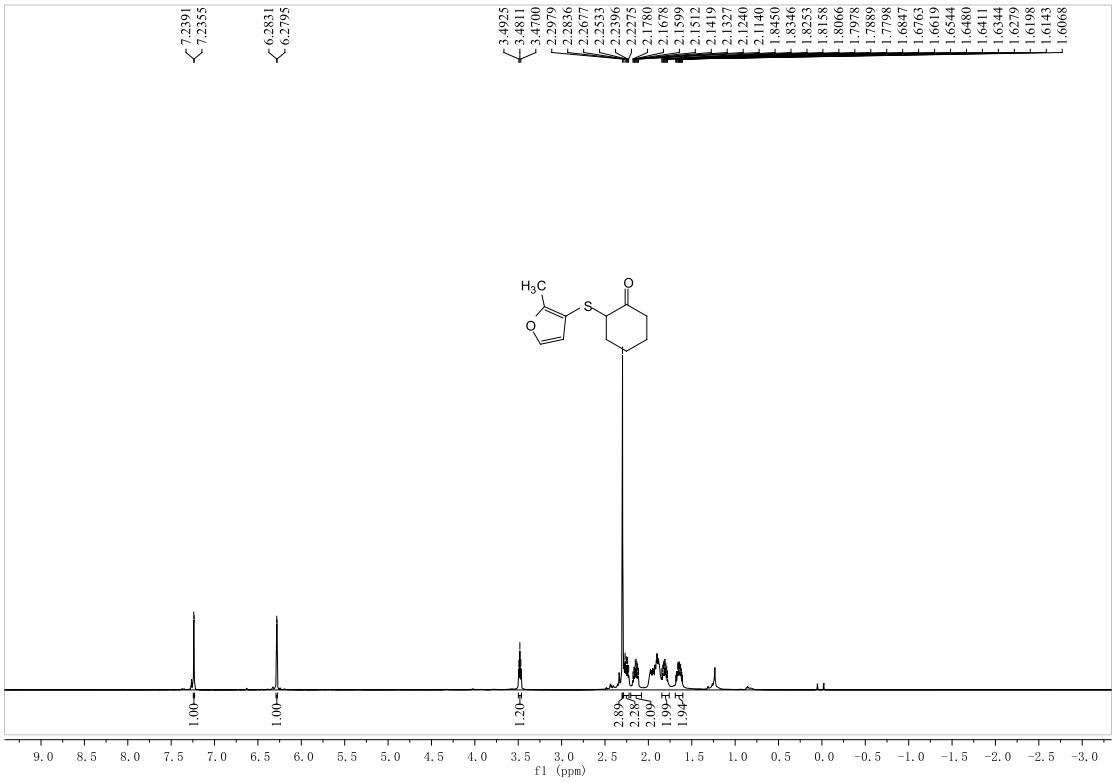


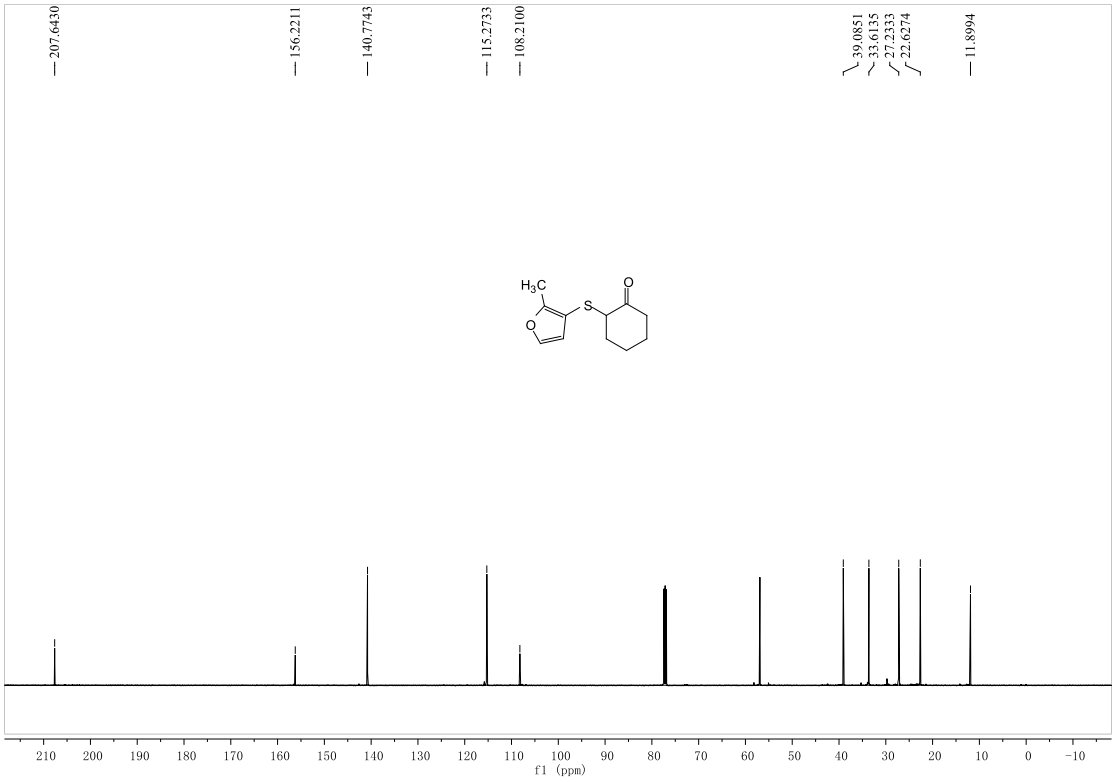
1-(2-((2-methylfuran-3-yl)thio)morpholino)ethan-1-one (3i)



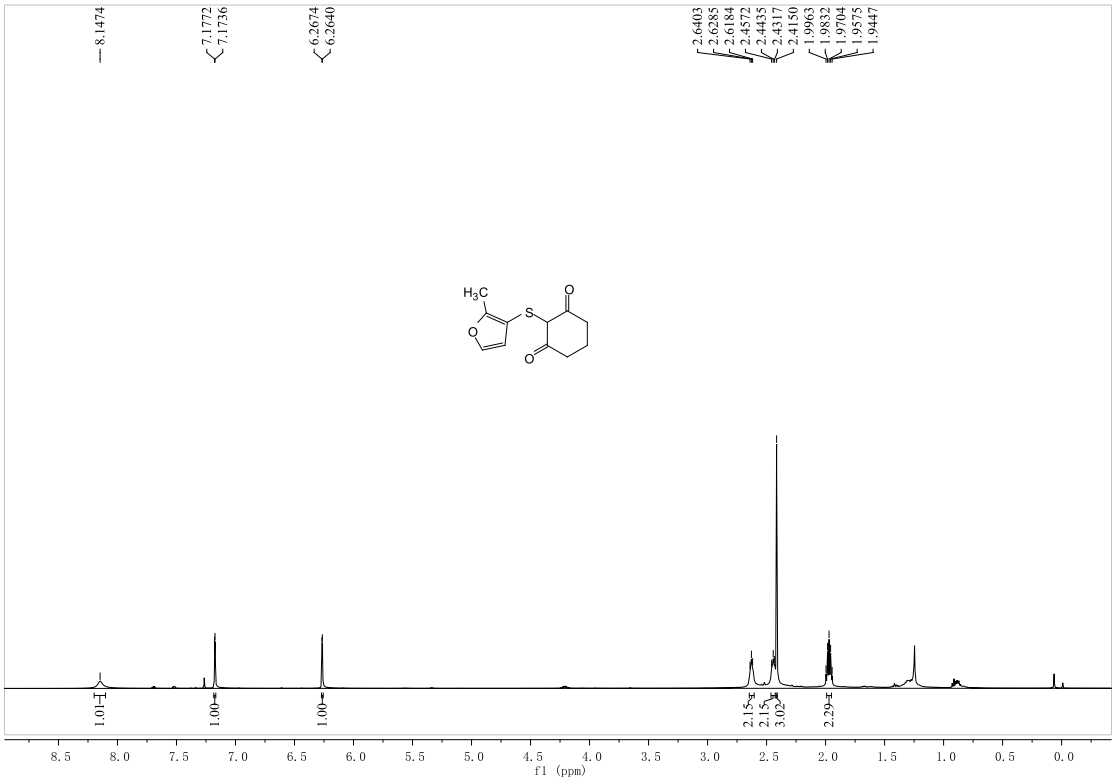


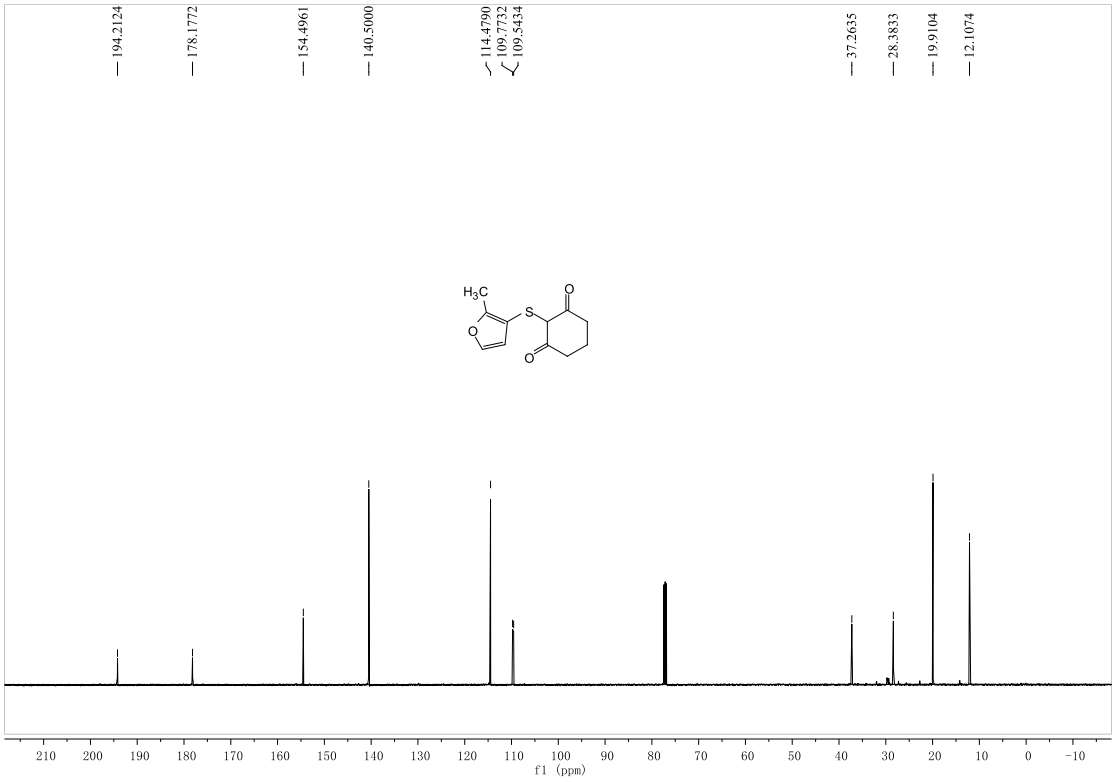
2-((2-methylfuran-3-yl)thio)cyclohexan-1-one (3j)



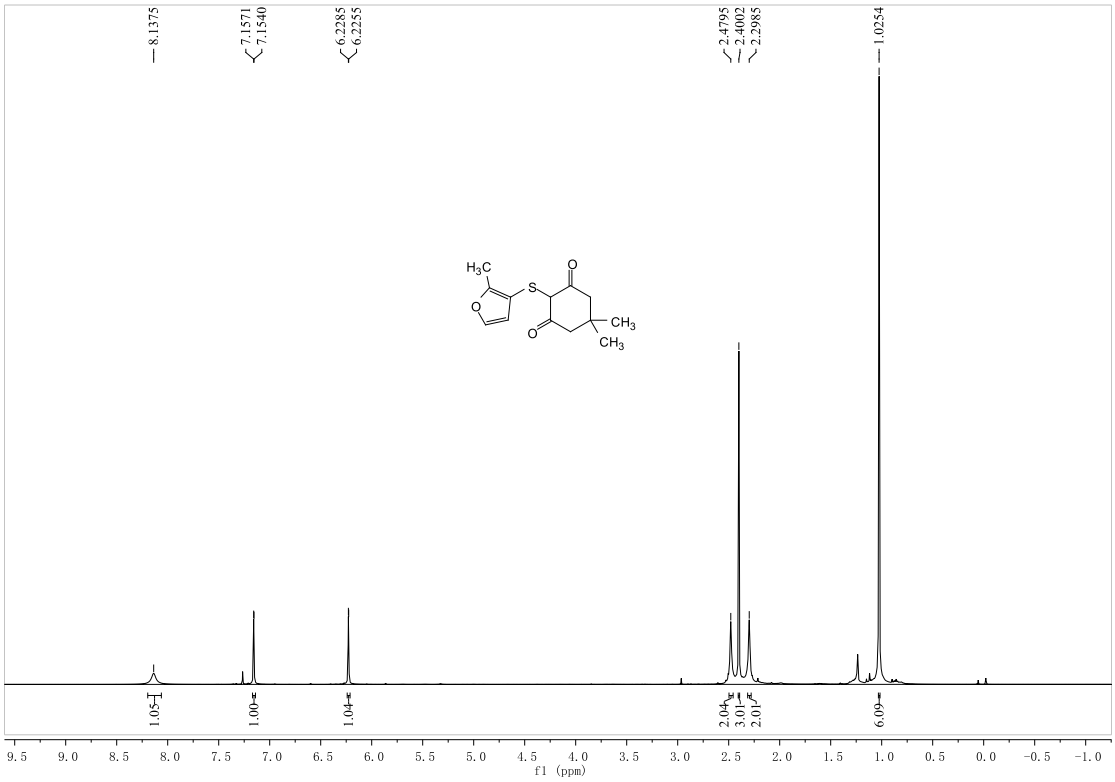


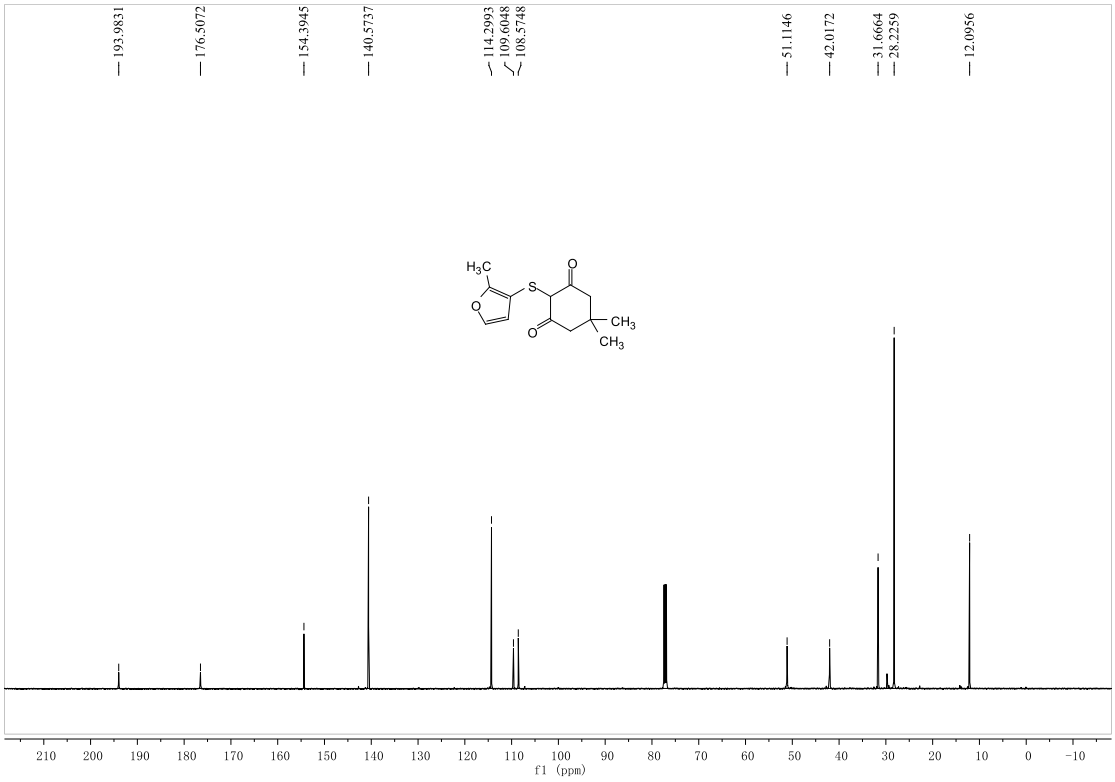
2-((2-methylfuran-3-yl)thio)cyclohexane-1,3-dione (3k)



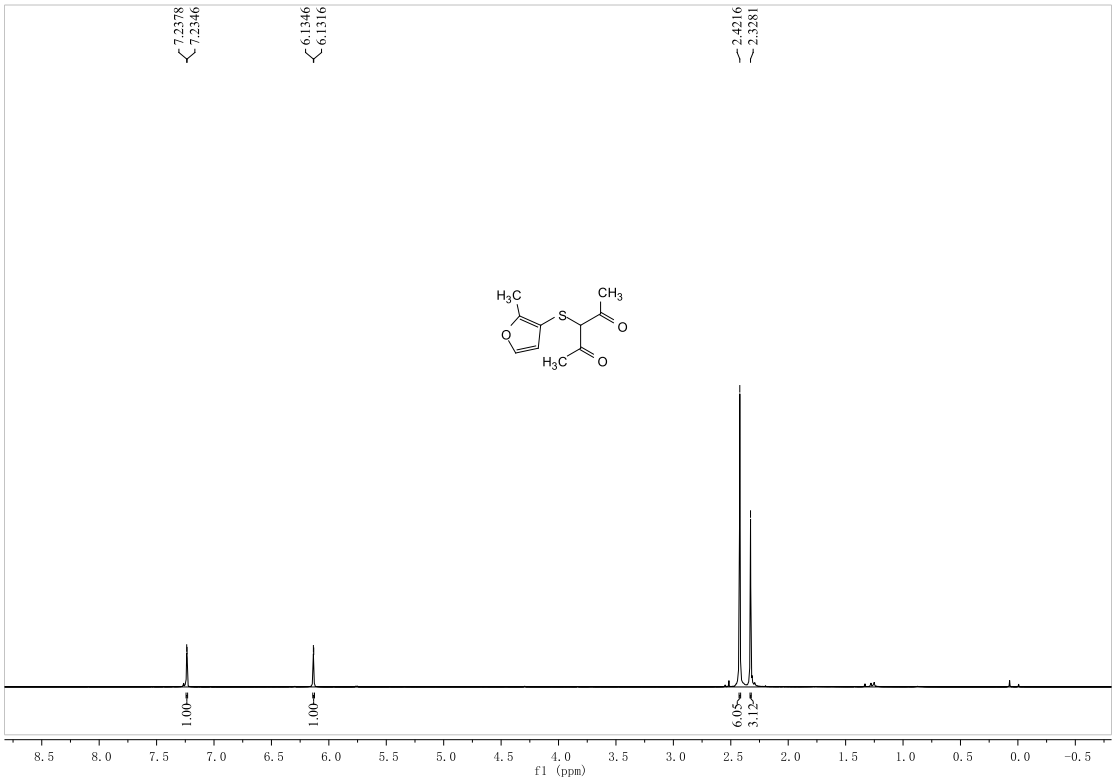


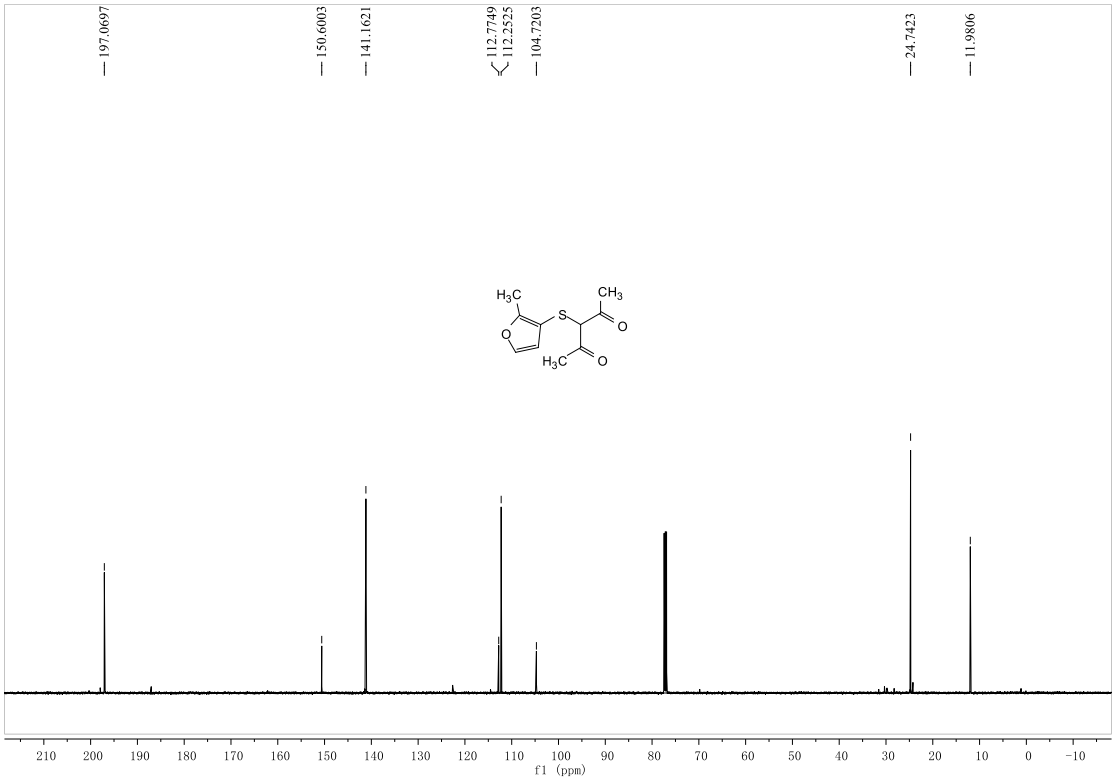
5,5-dimethyl-2-((2-methylfuran-3-yl)thio)cyclohexane-1,3-dione (3l)





3-((2-methylfuran-3-yl)thio)pentane-2,4-dione (3m)





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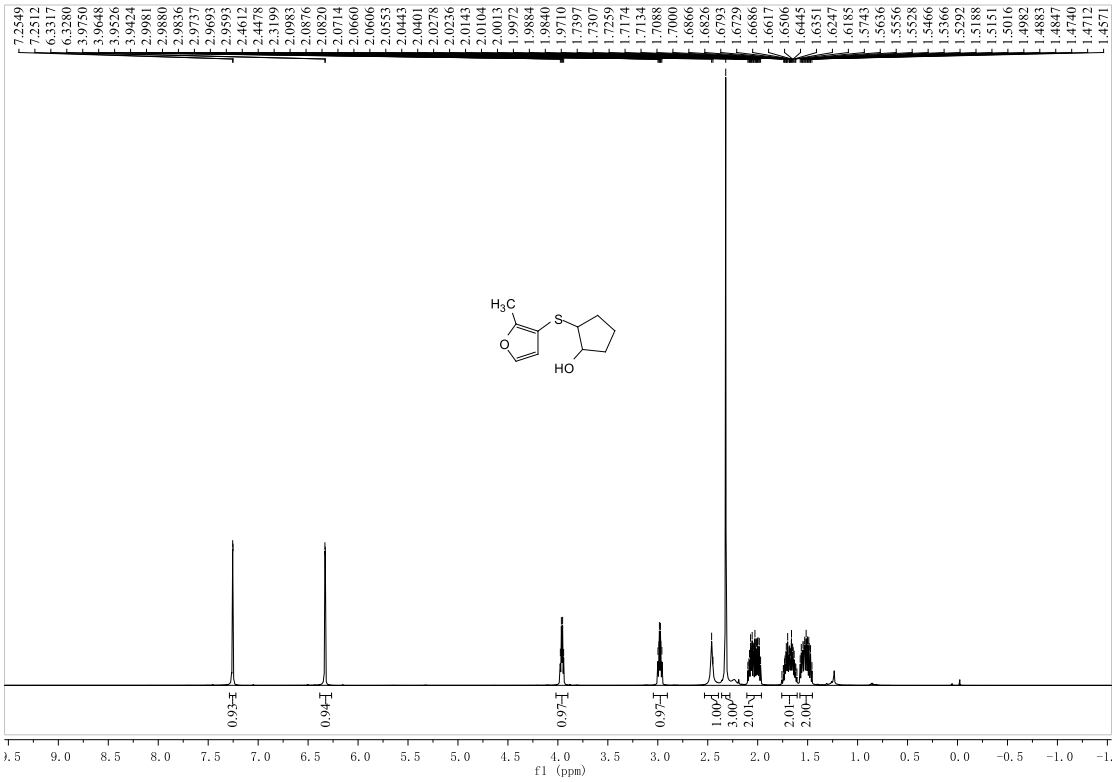

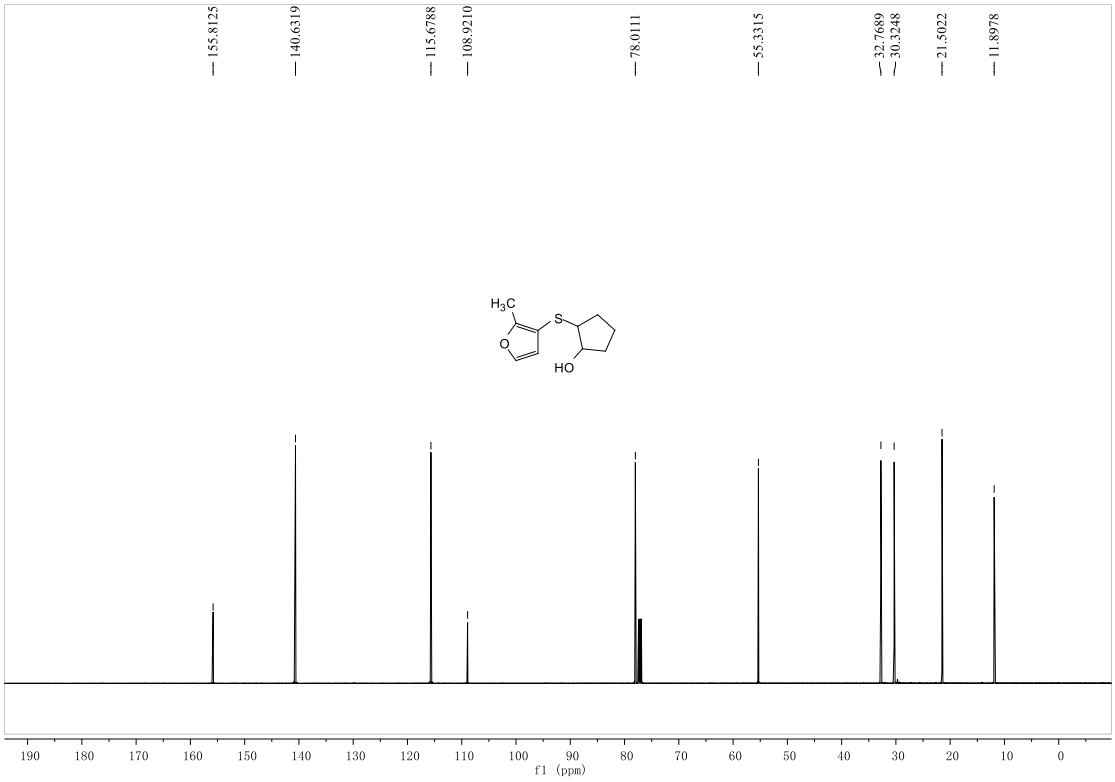

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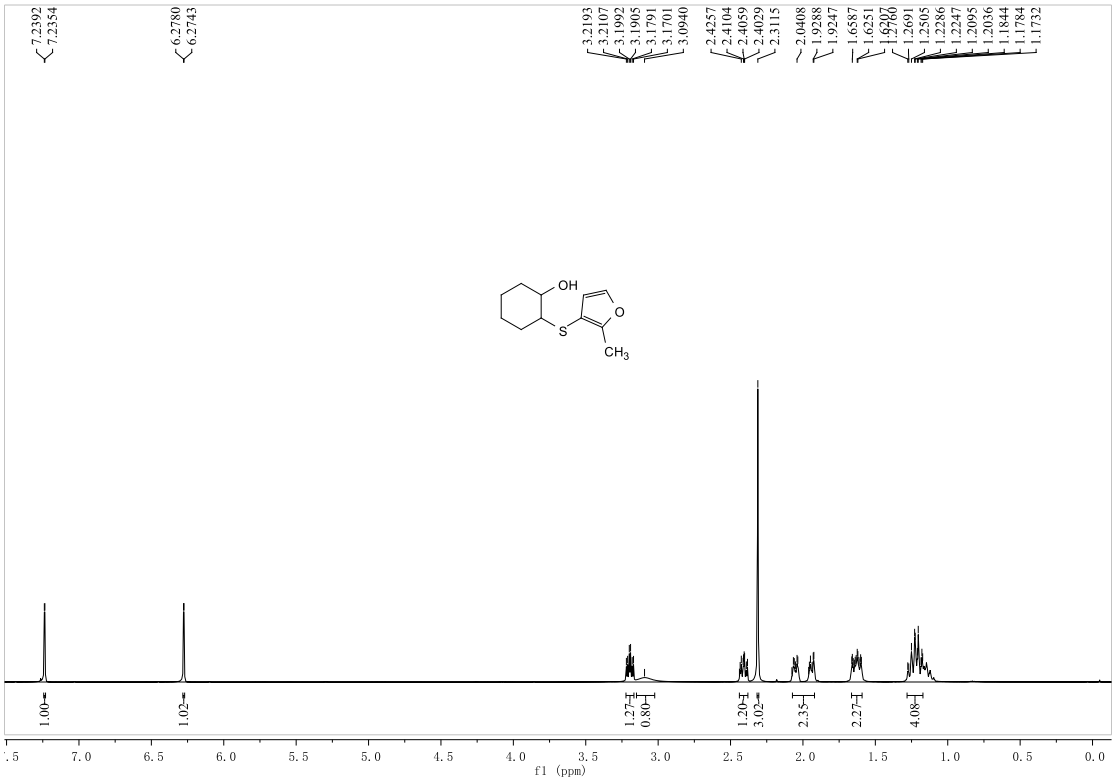

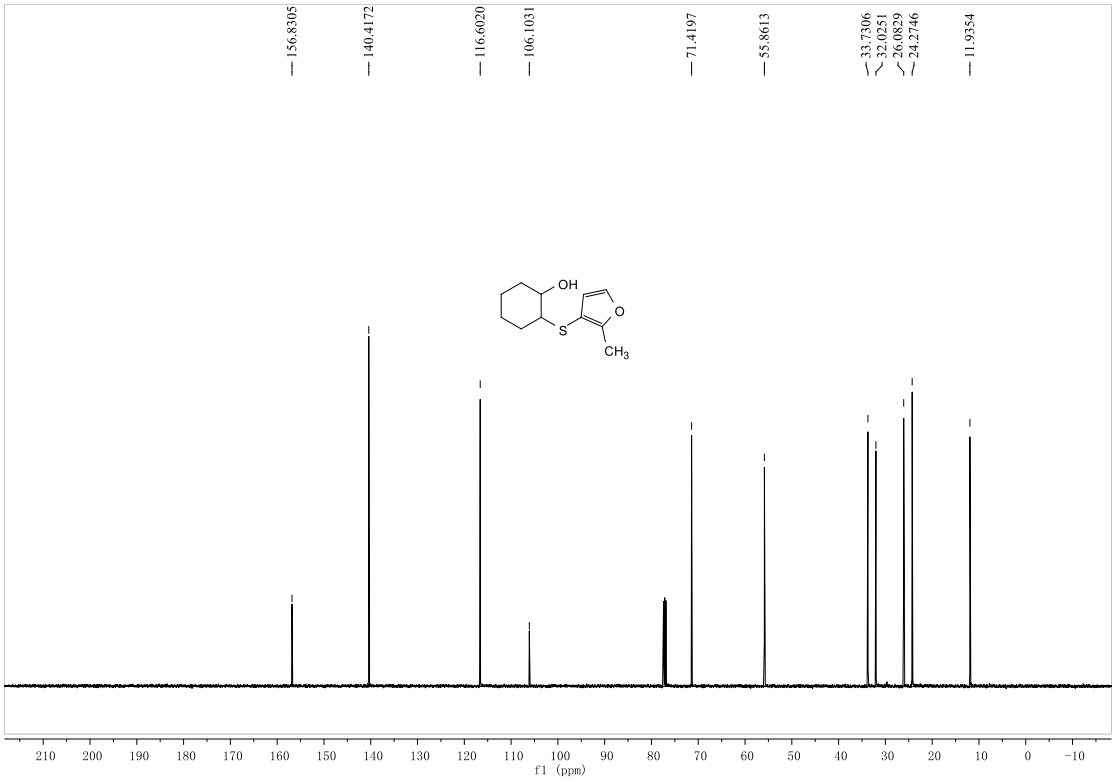

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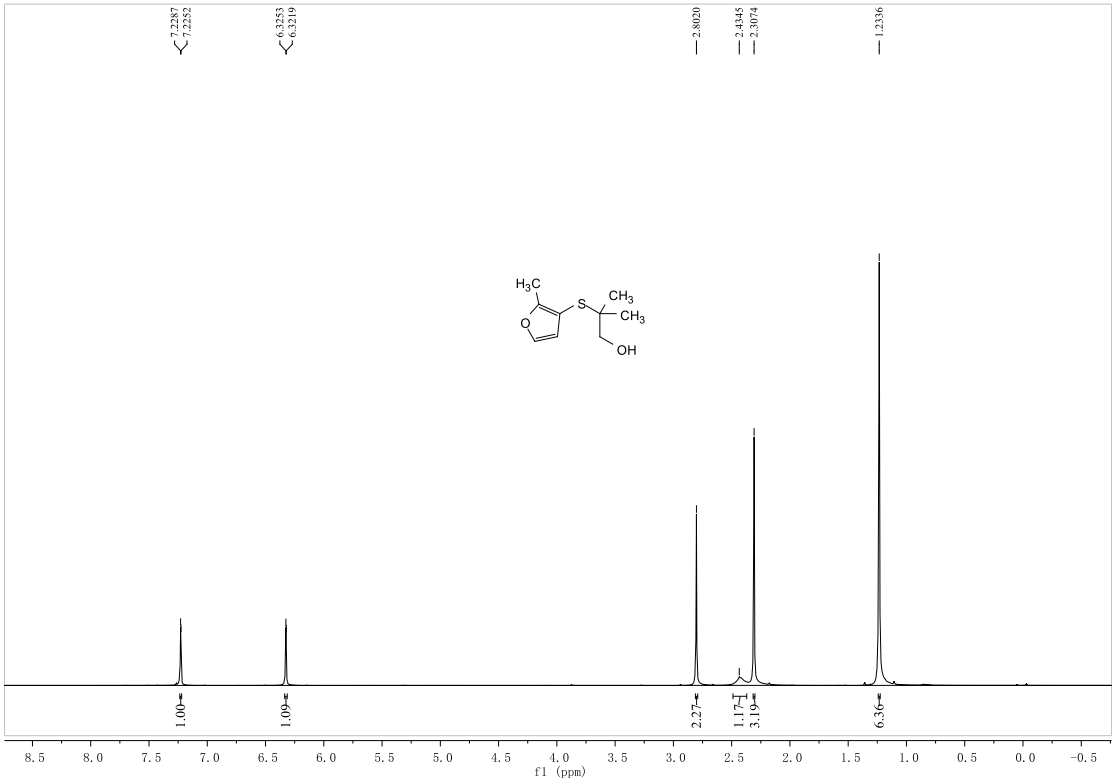

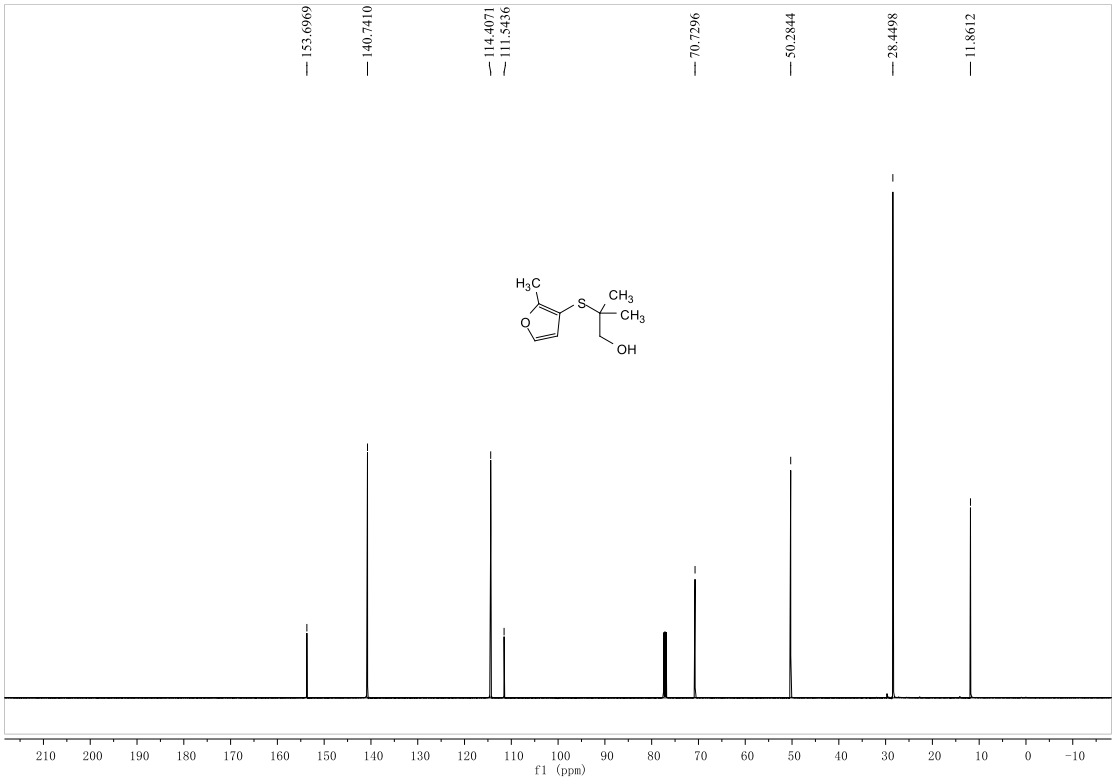

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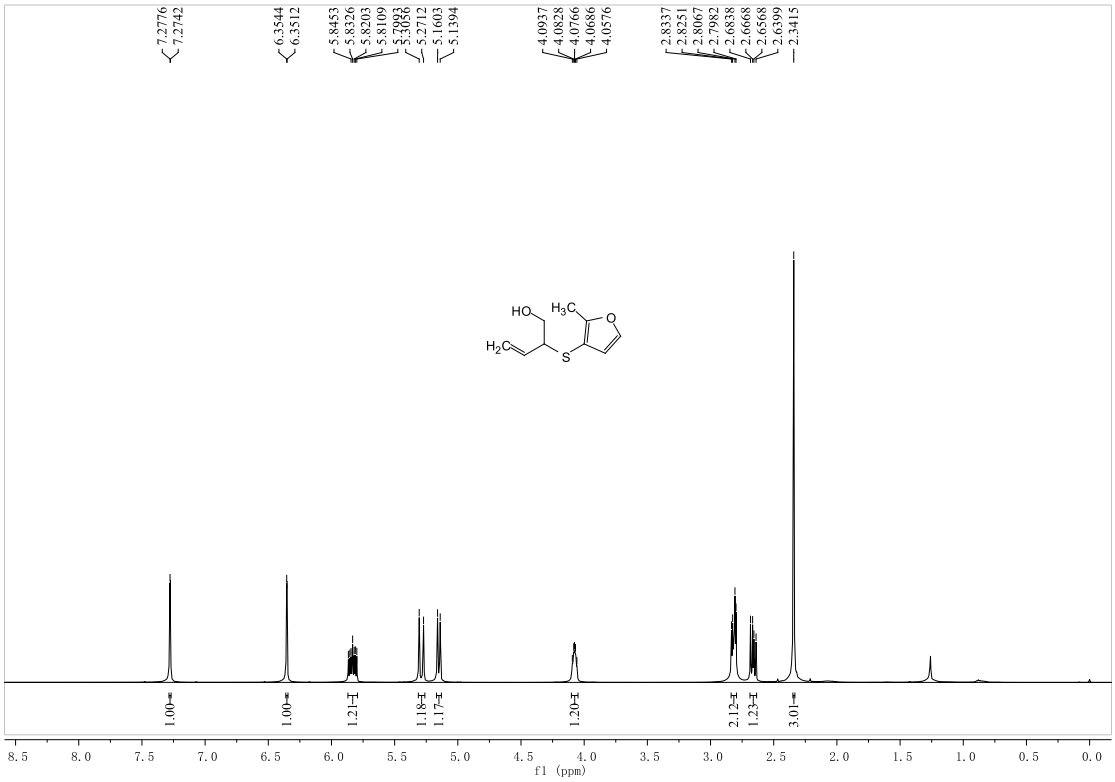

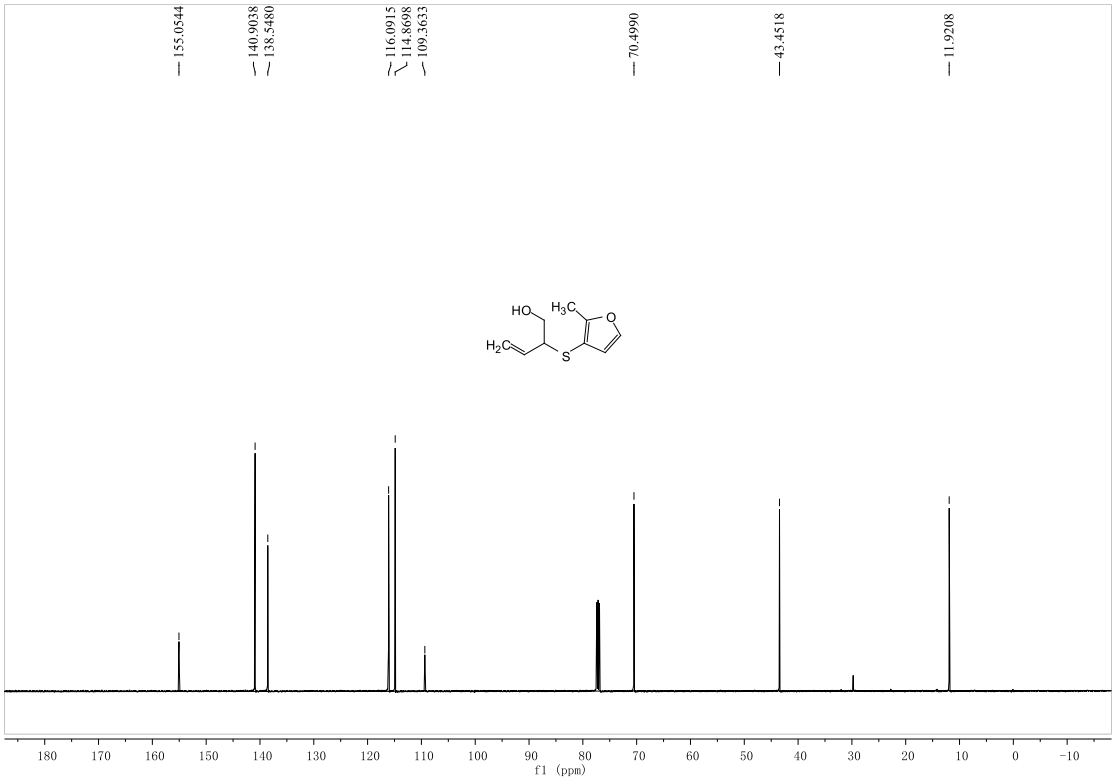

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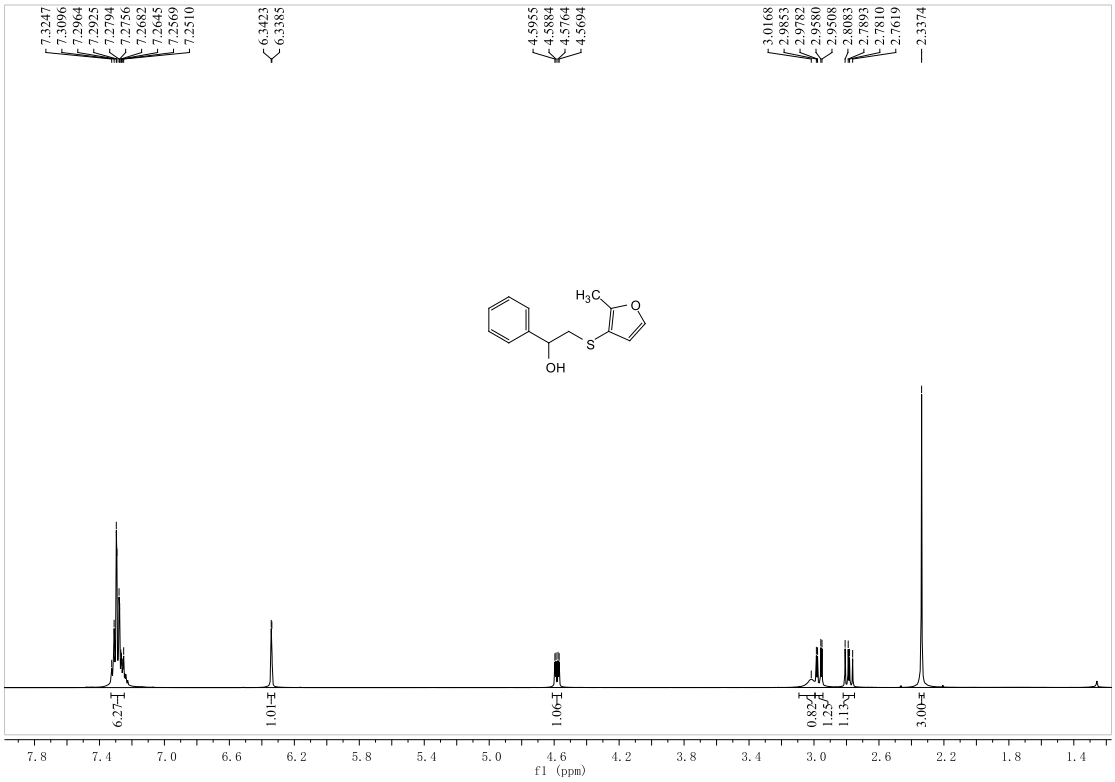

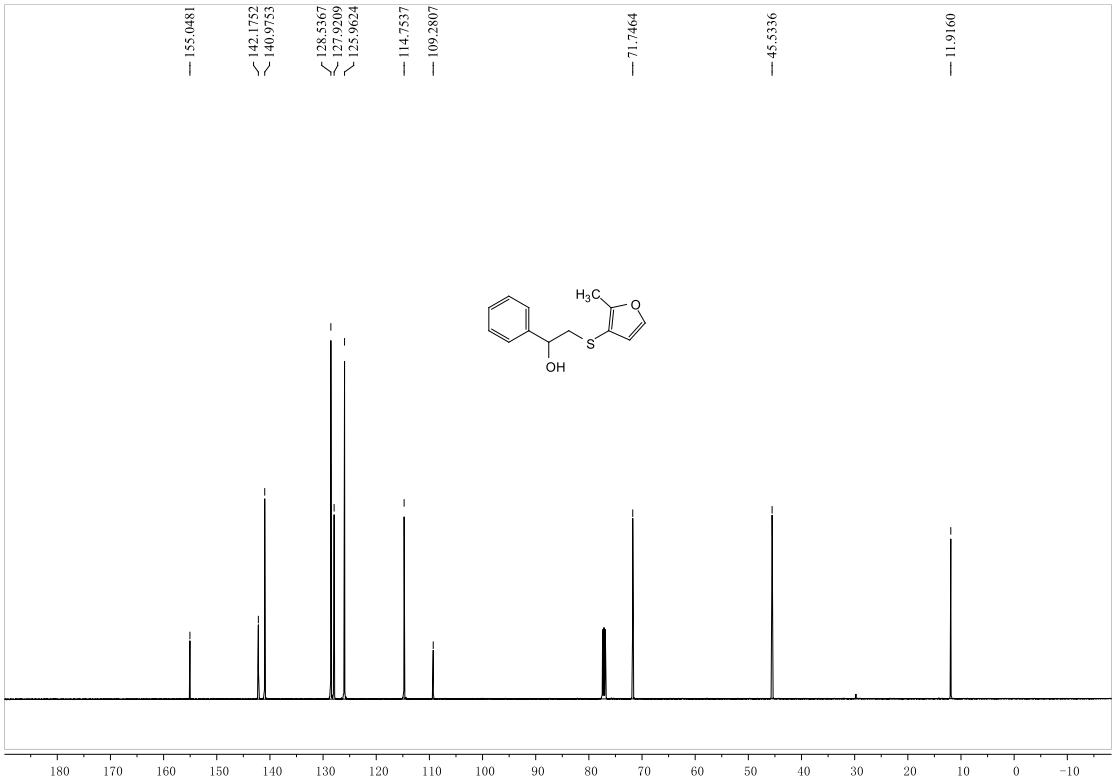

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