

Synthesis, *in silico*, and *in vitro* pharmacological evaluation of norbornenylpiperazine derivatives as potential ligands for nuclear hormone receptors

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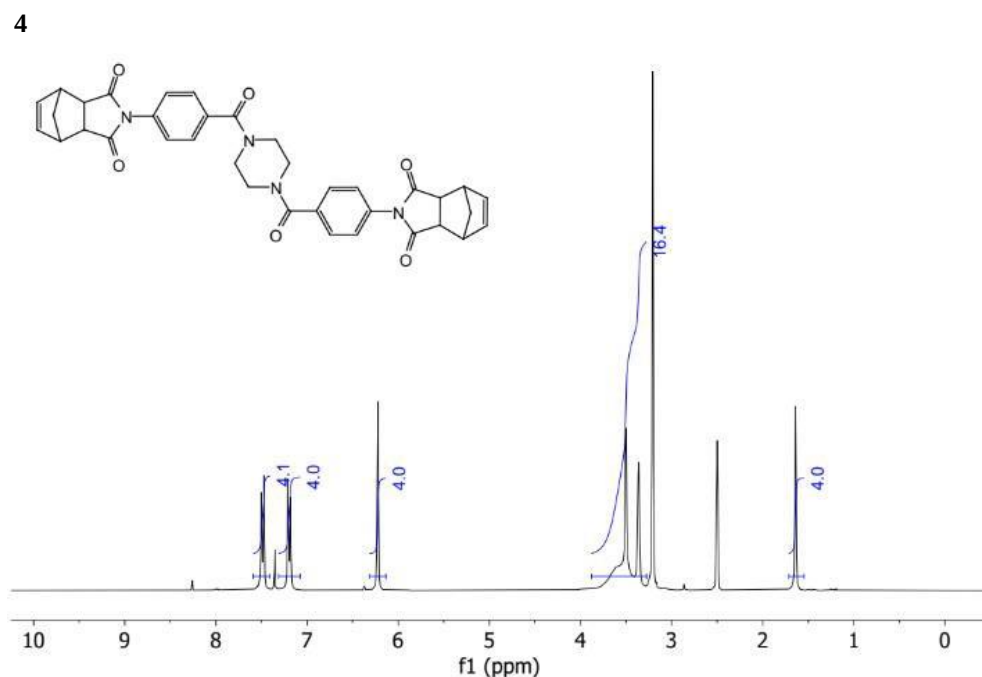
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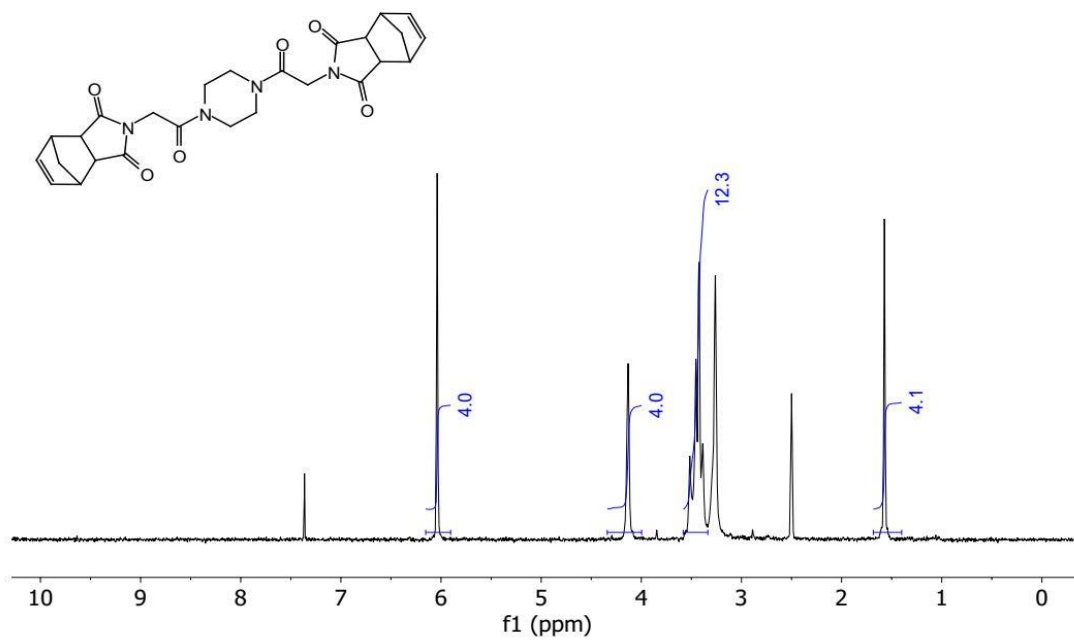
Doi: <http://dx.doi.org/10.7324/JAPS.2025.230239>

SUPPLEMENTARY MATERIALS

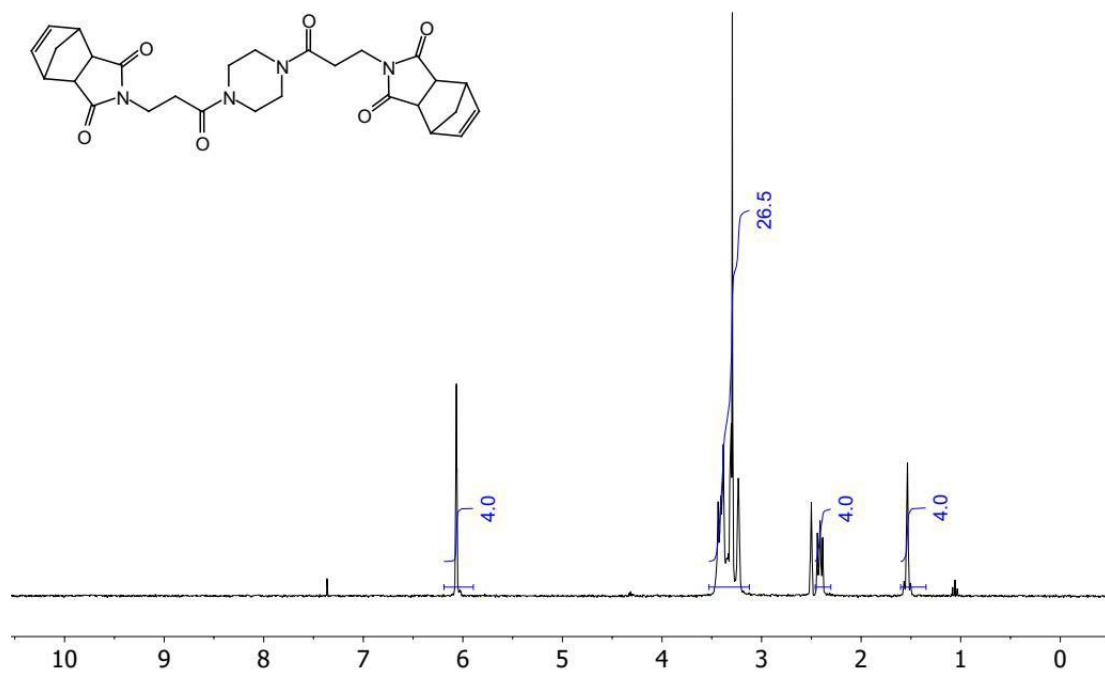
Figure S1. ¹HNMR spectrum of compounds 4a-4h.



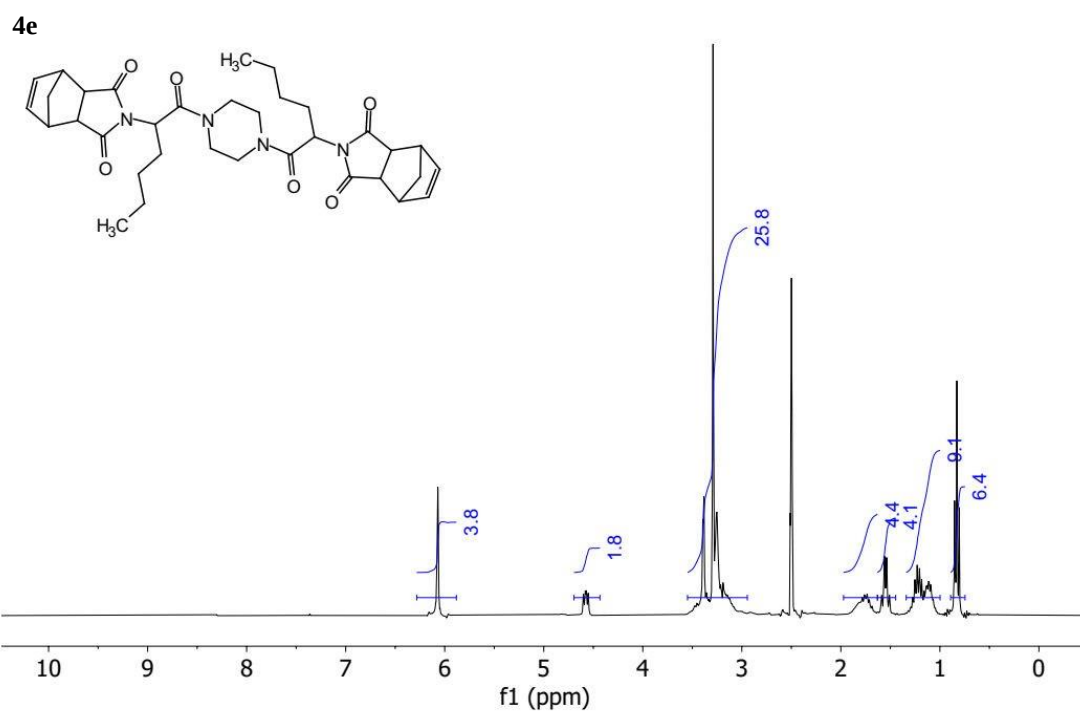
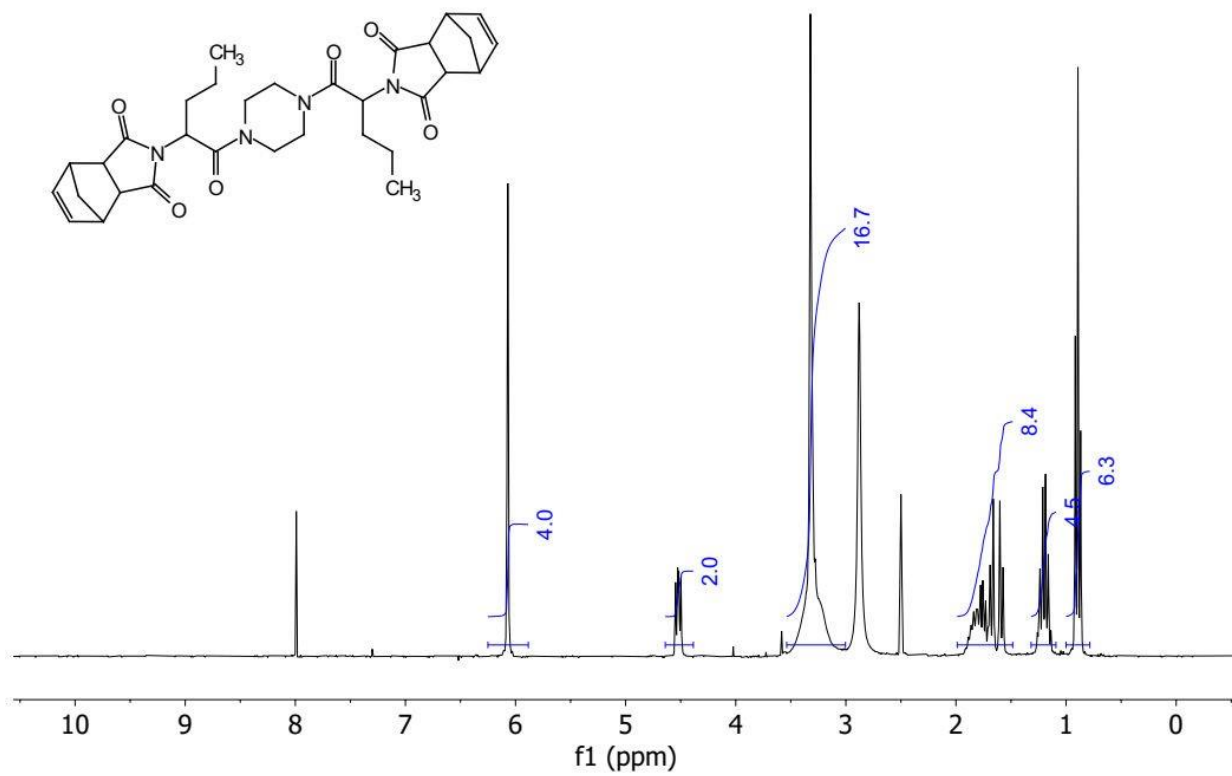
4b



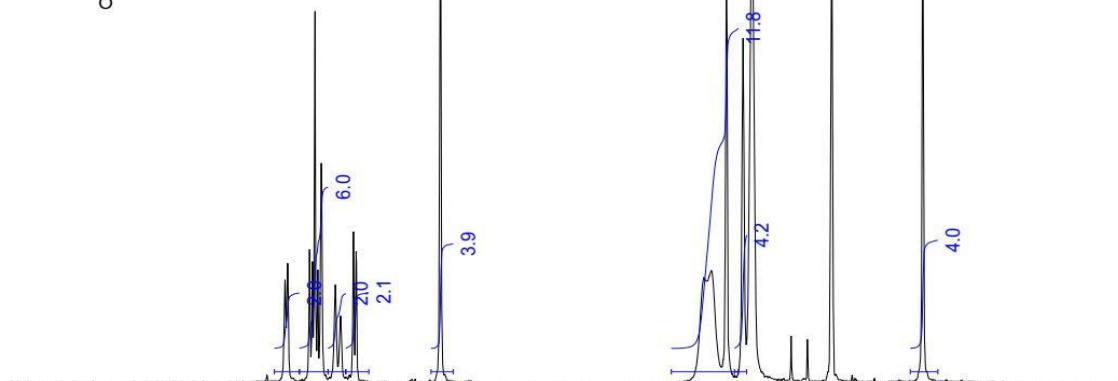
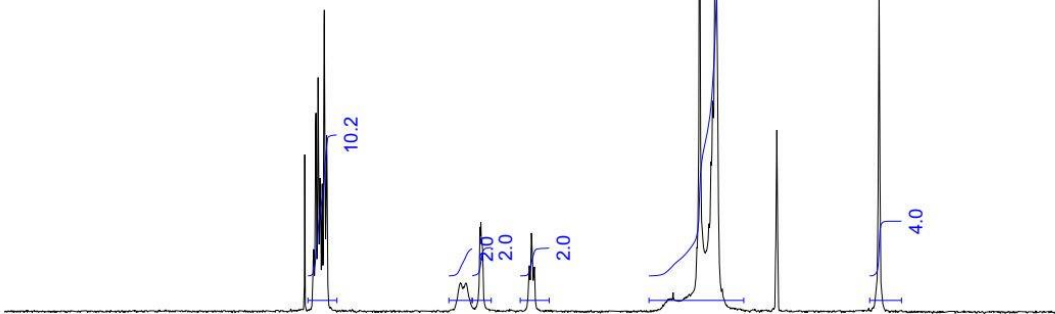
4c



4d



Chemical structure of compound 71, which is a symmetrical molecule. It consists of two phthalimide groups connected by a central piperazine ring. Each phthalimide group is substituted with a phenyl ring and a cyclohexyl ring.



4h

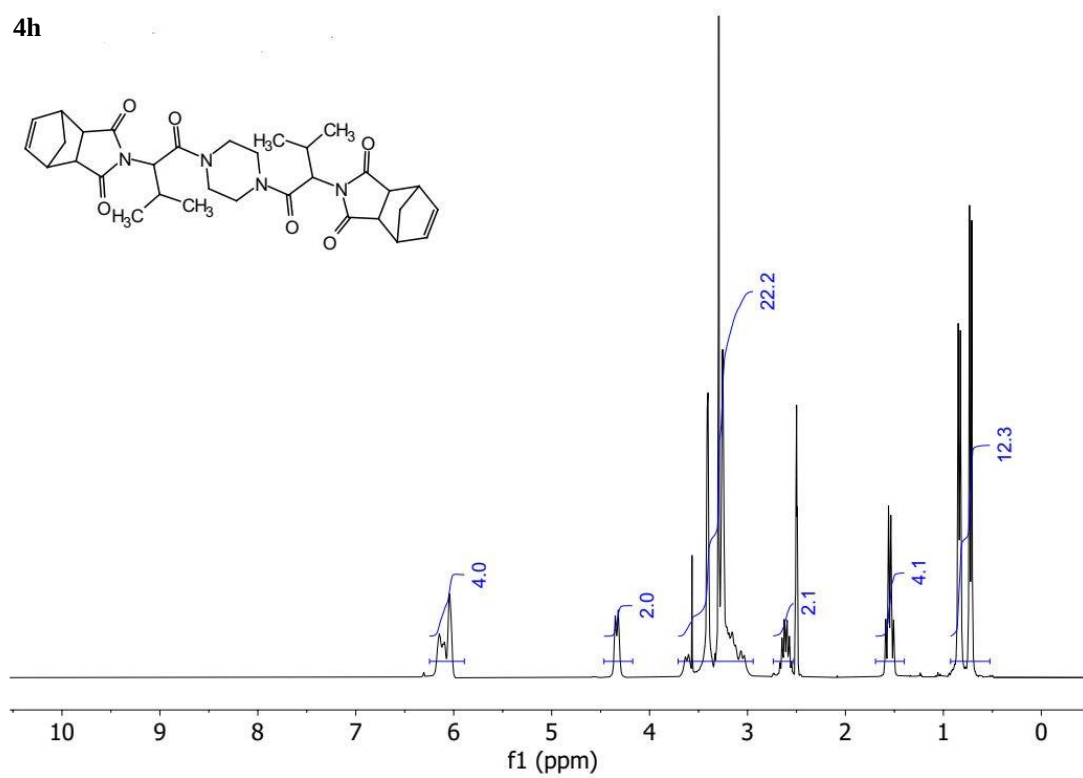
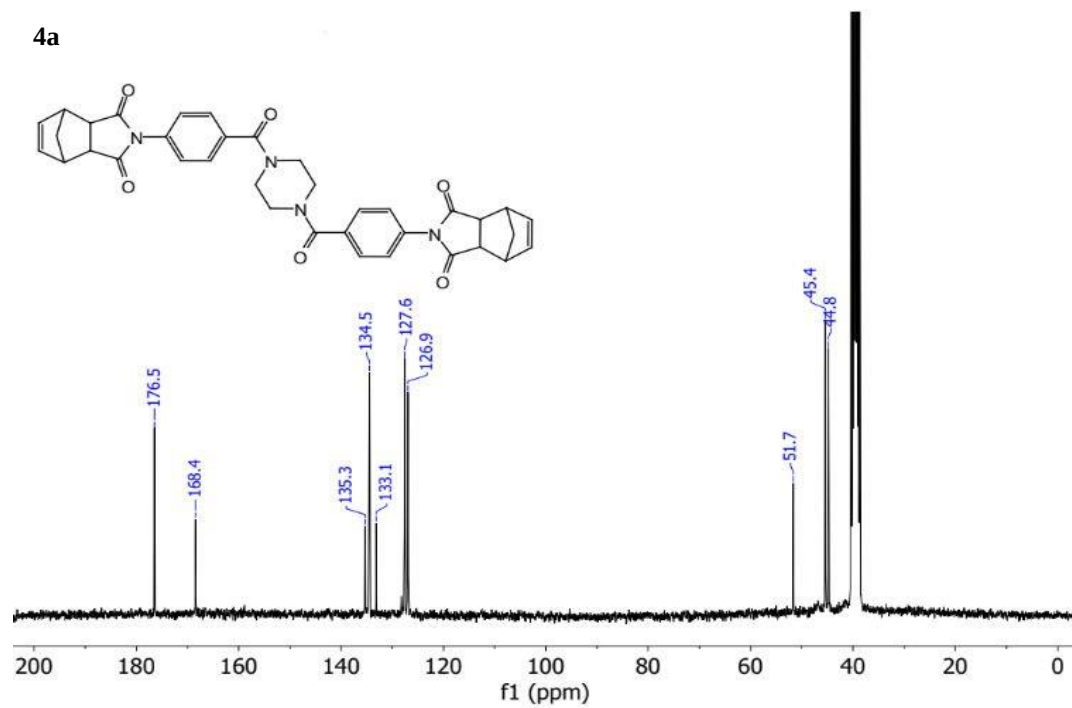
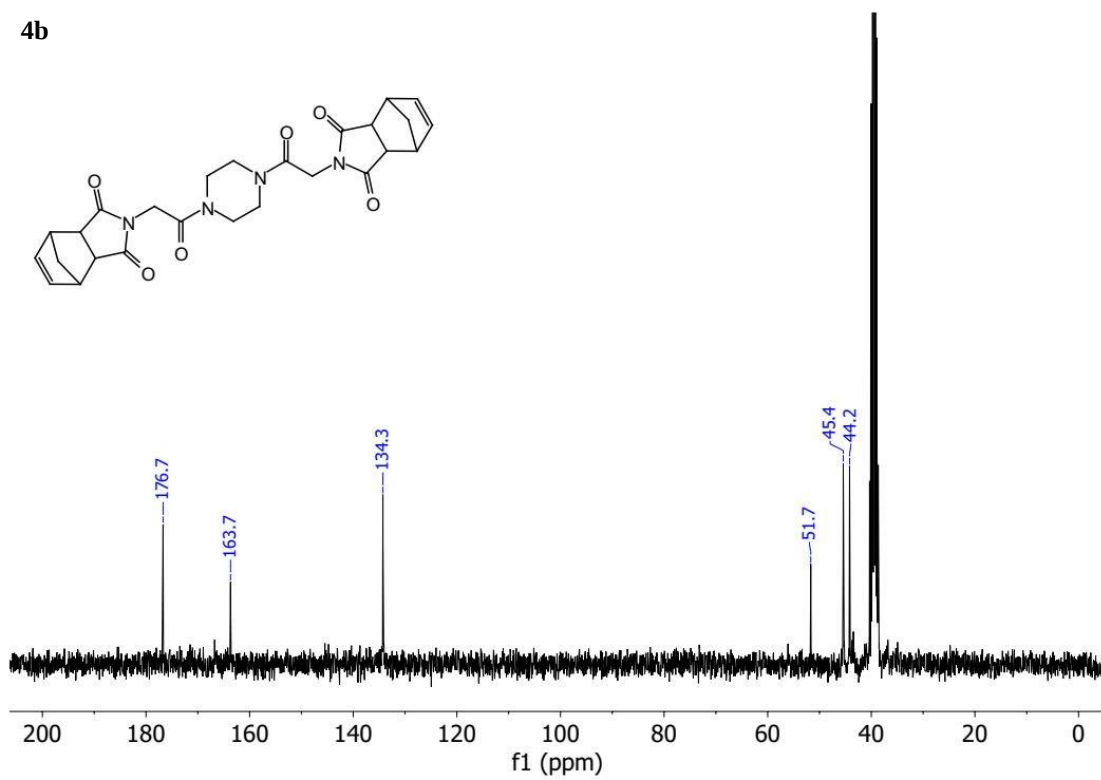


Figure S2. ^{13}C NMR spectrum of compounds 4a-4h (a-h).

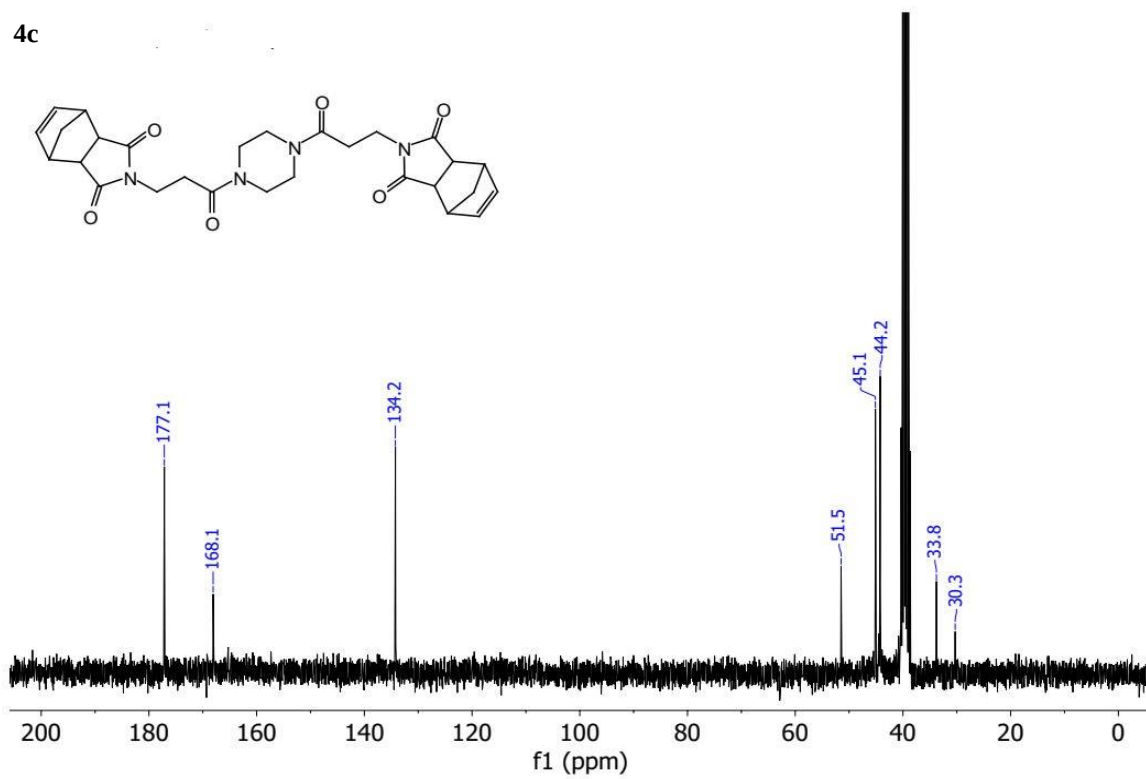
4a



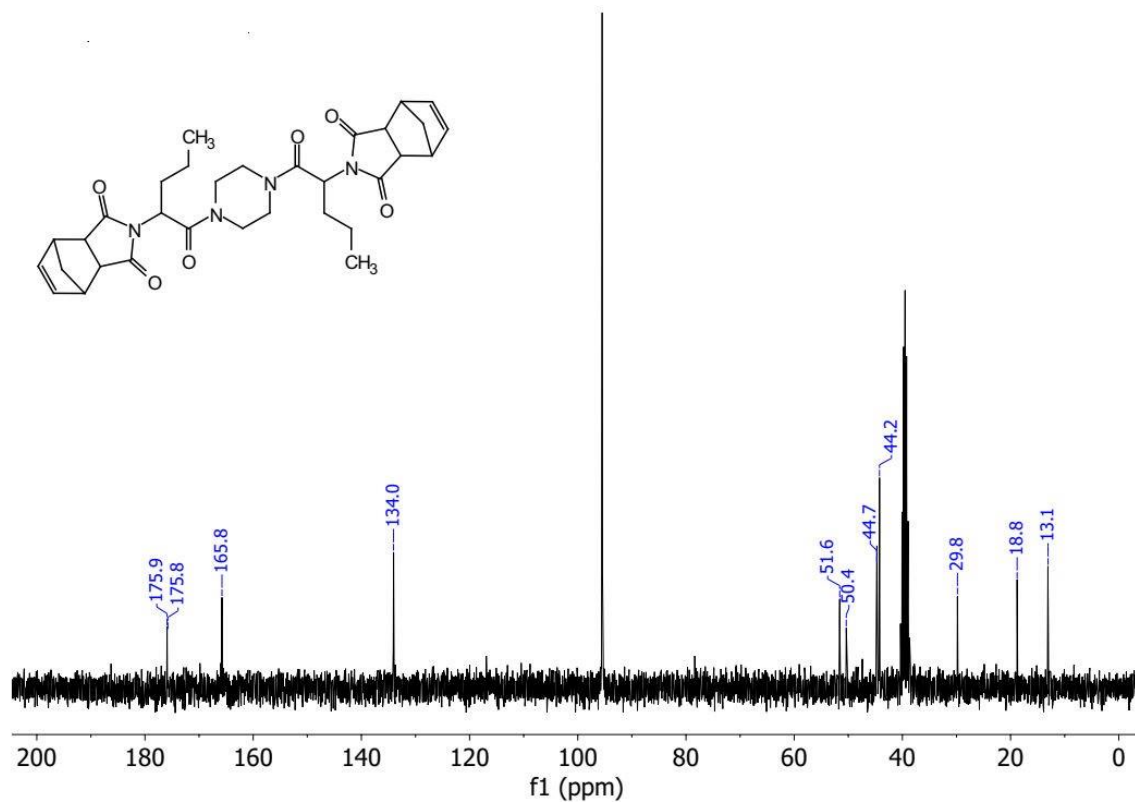
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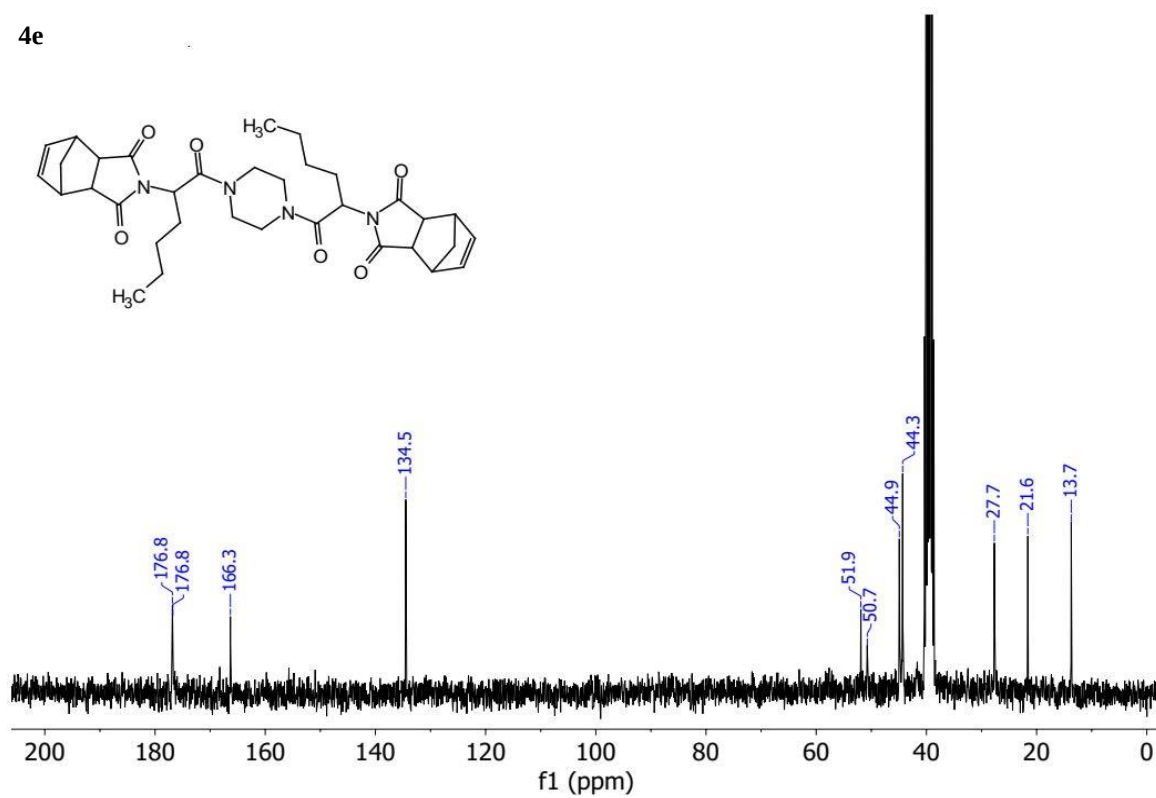
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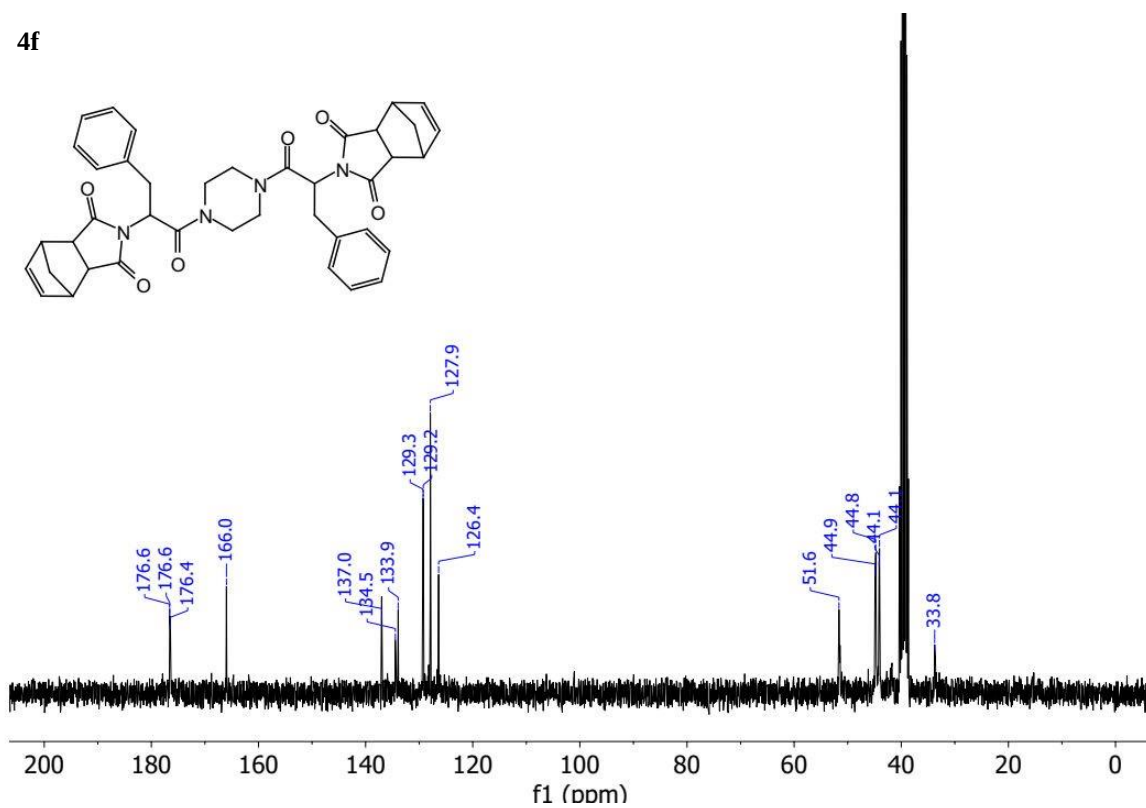
4d



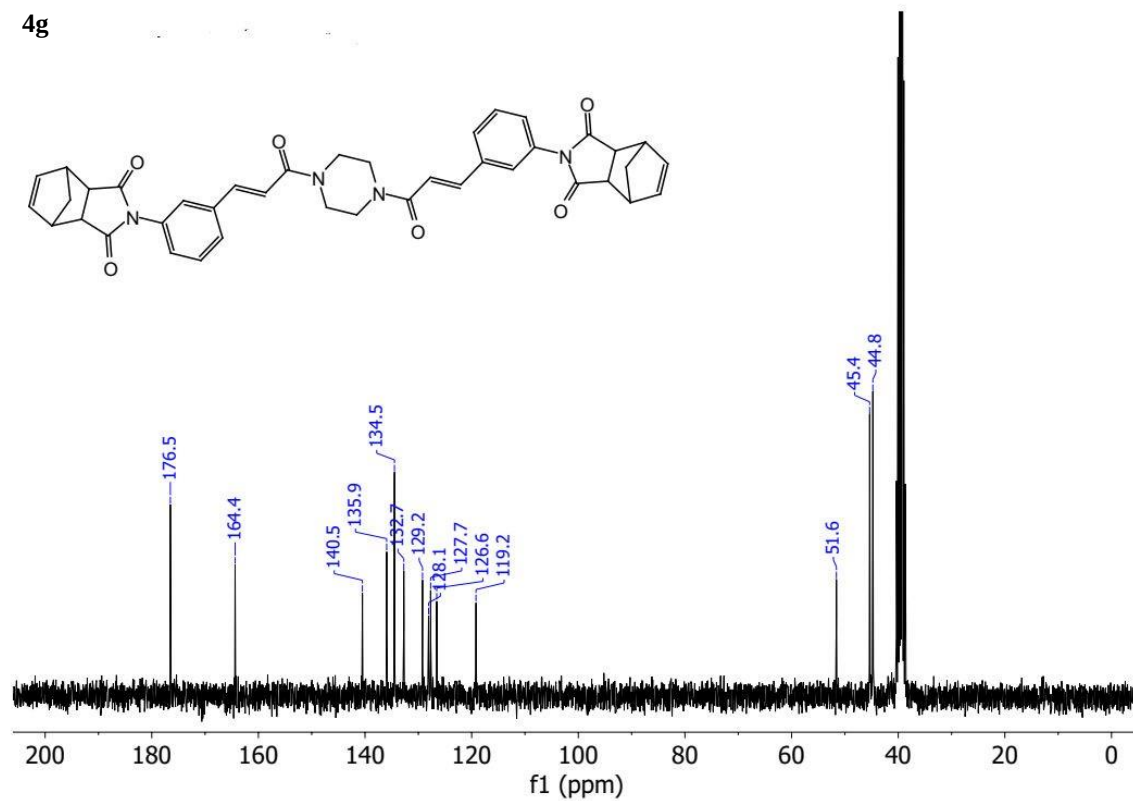
4e



4f



4g



4h

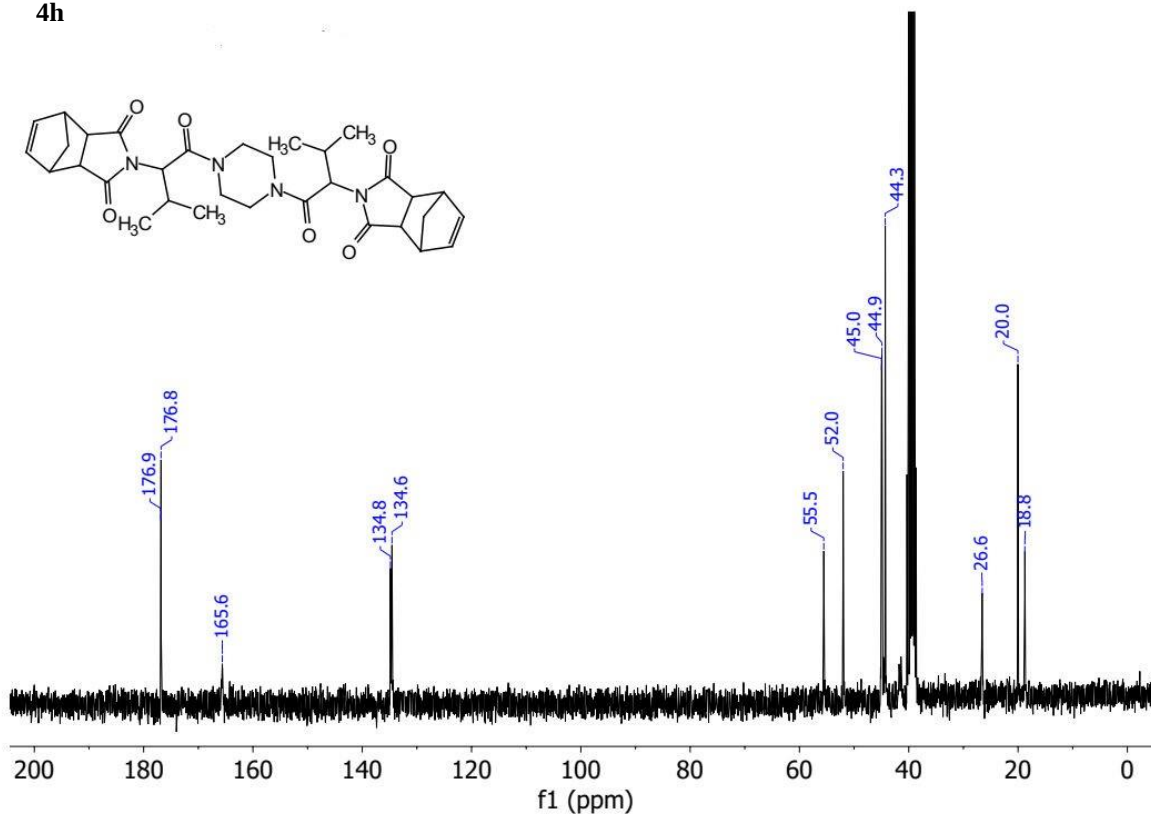
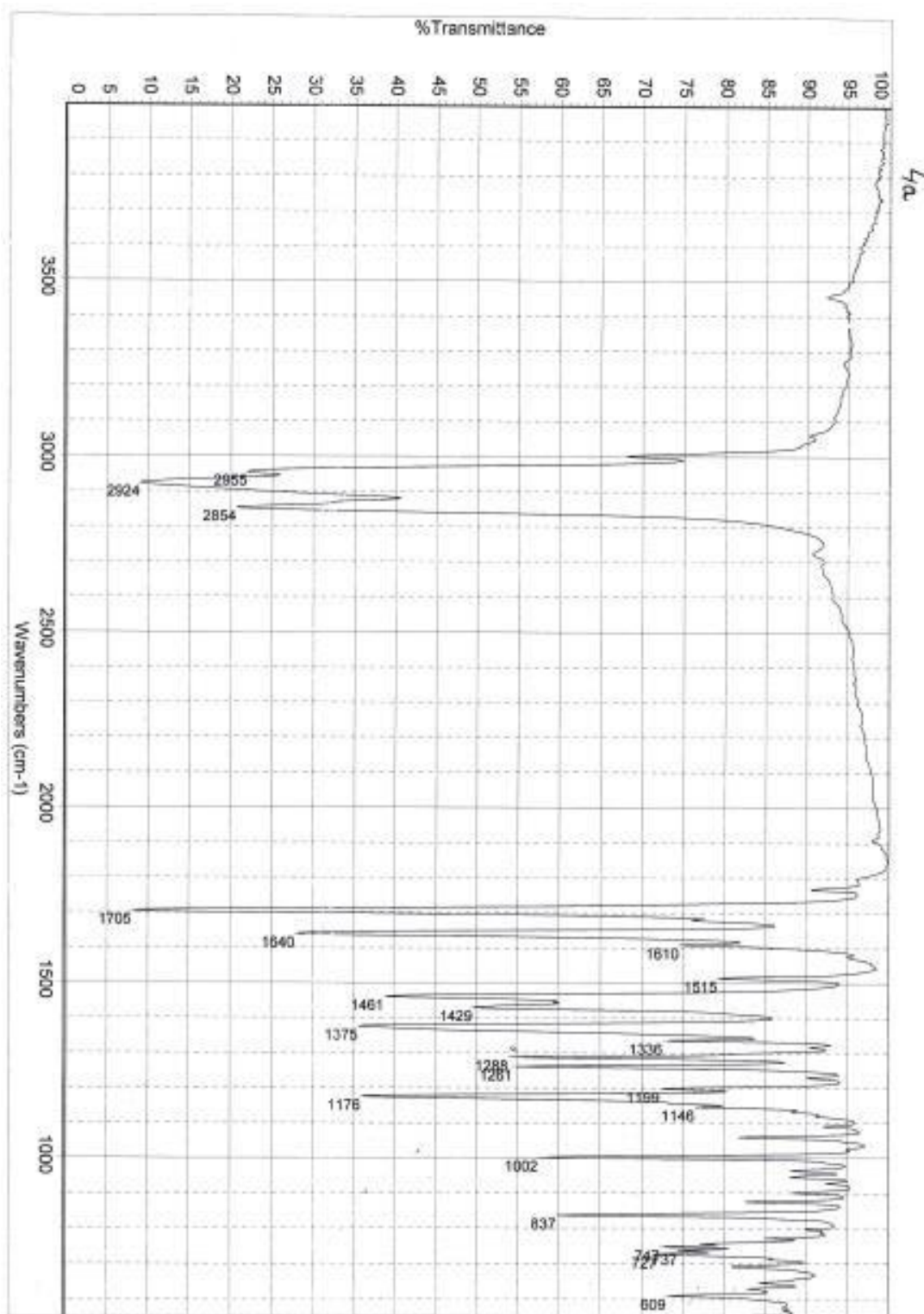
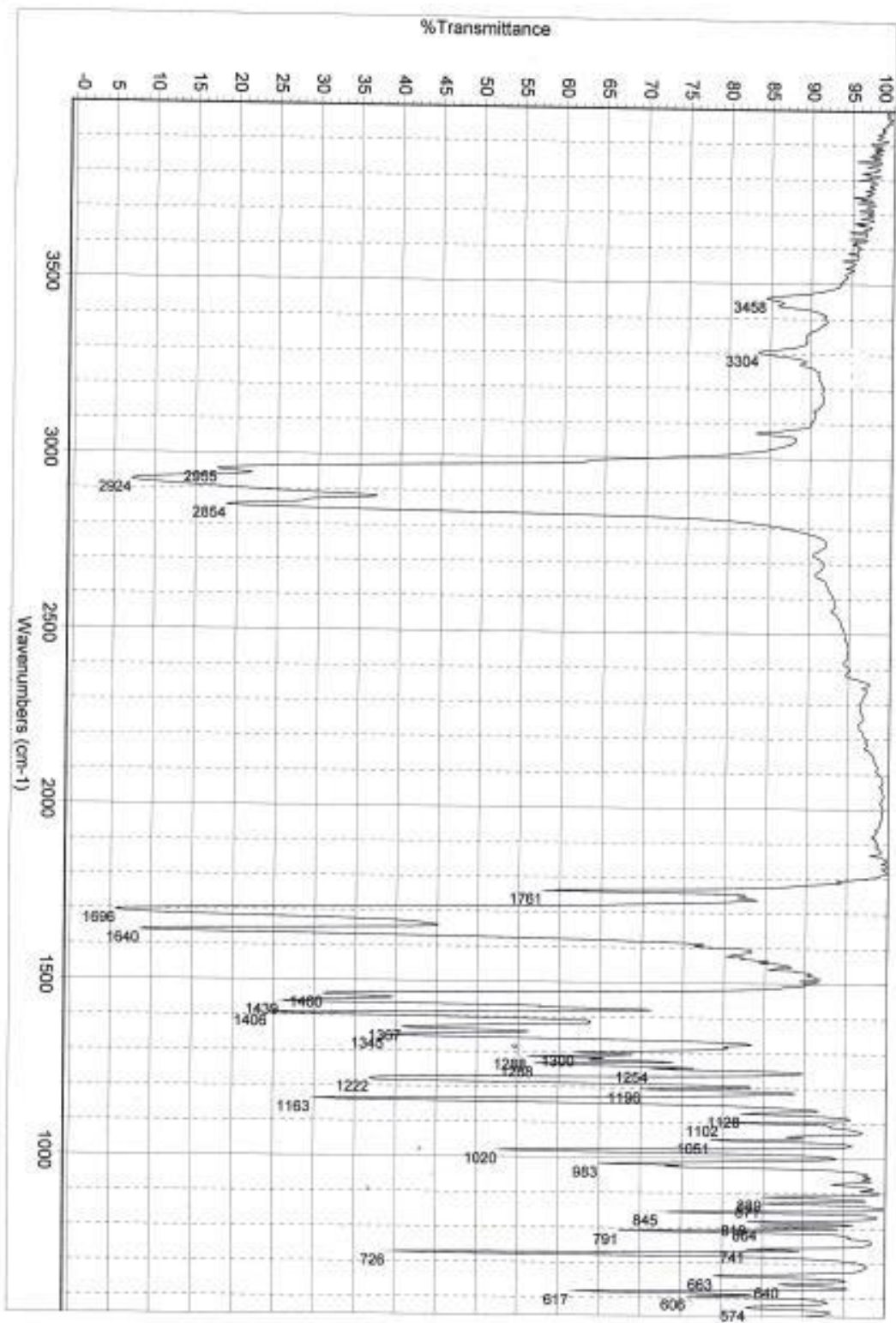


Figure S3. IR spectra of compounds 4a-4h.

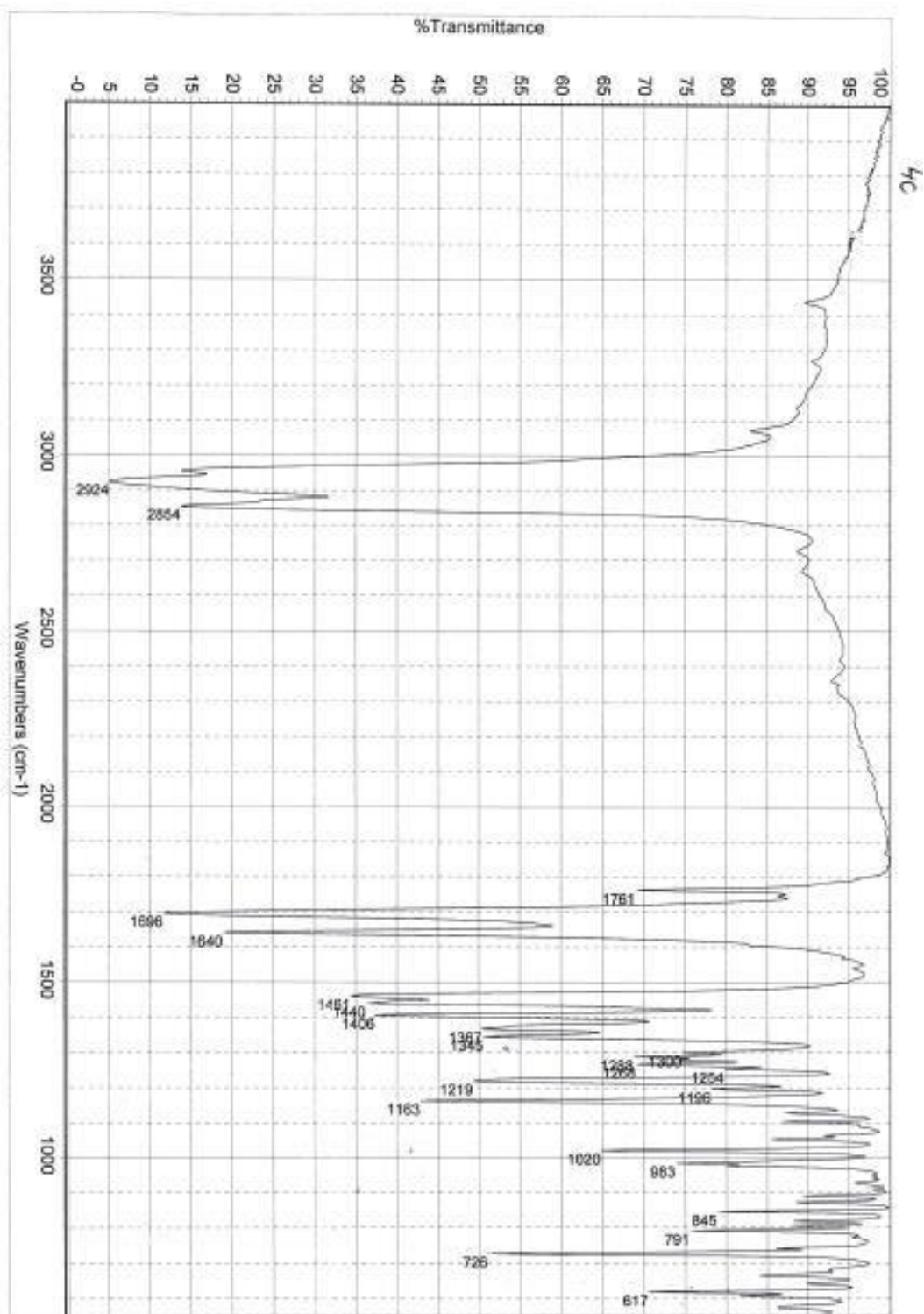
4a



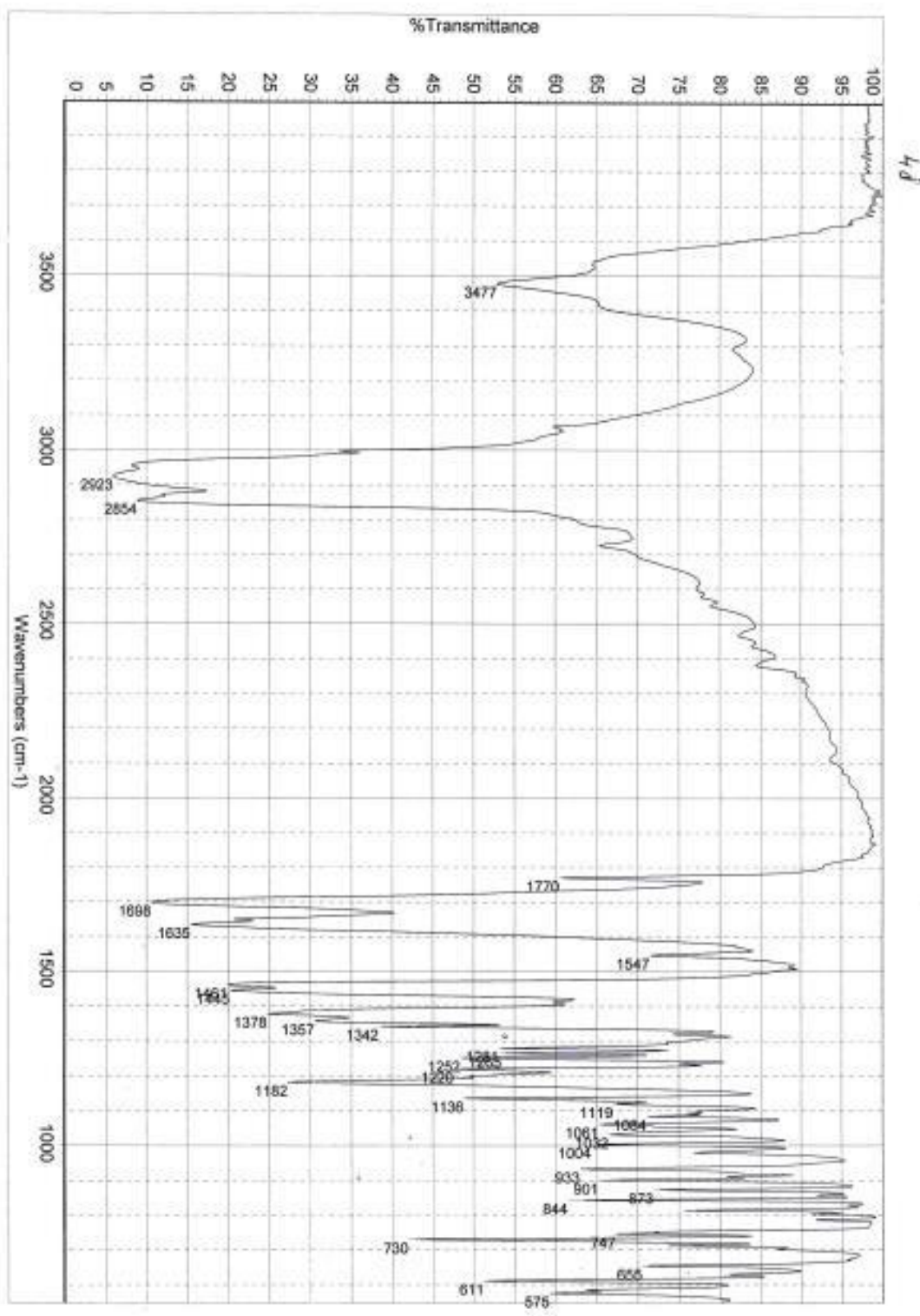
4b



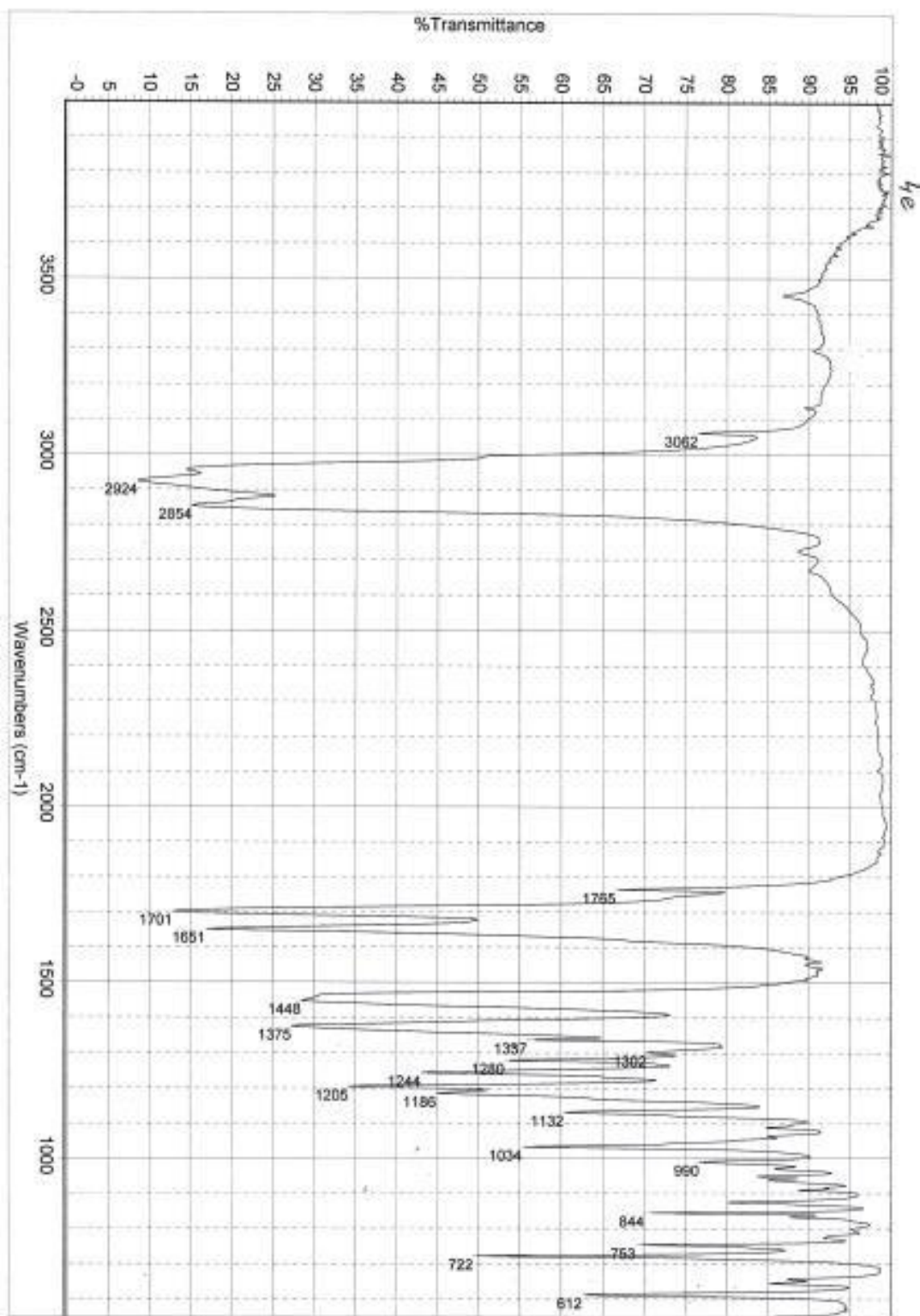
4c



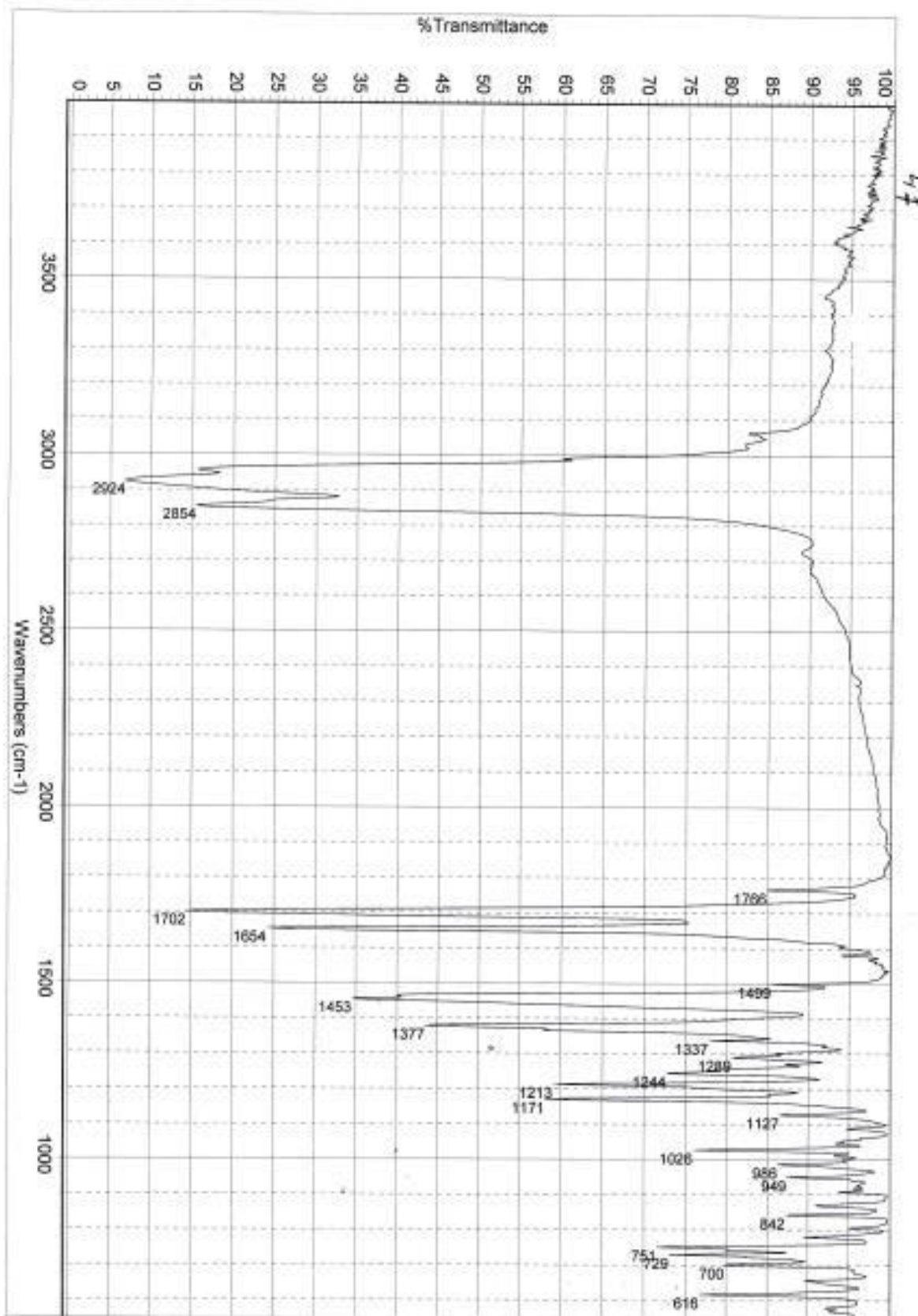
4d



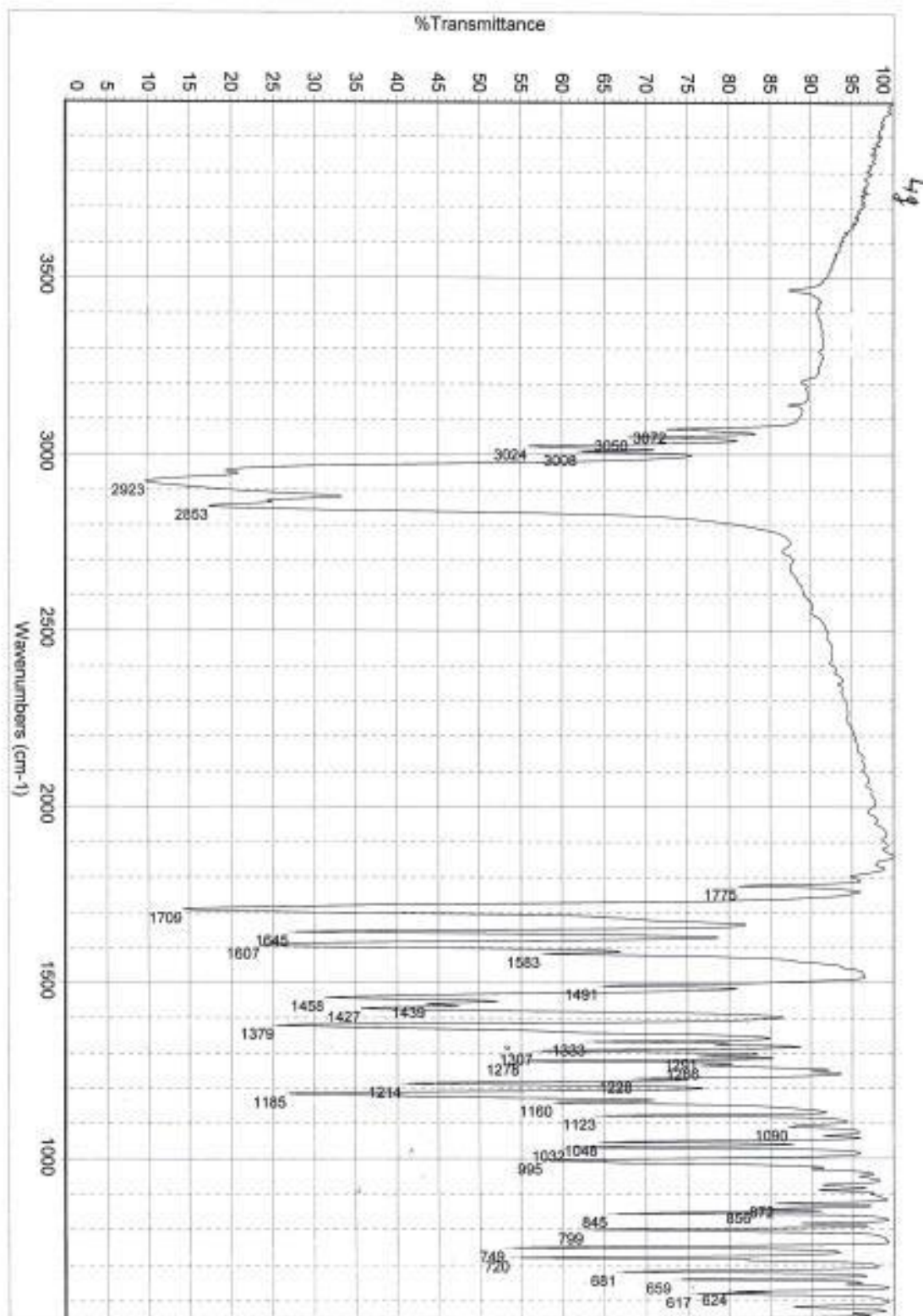
4e



4f



4g



4h

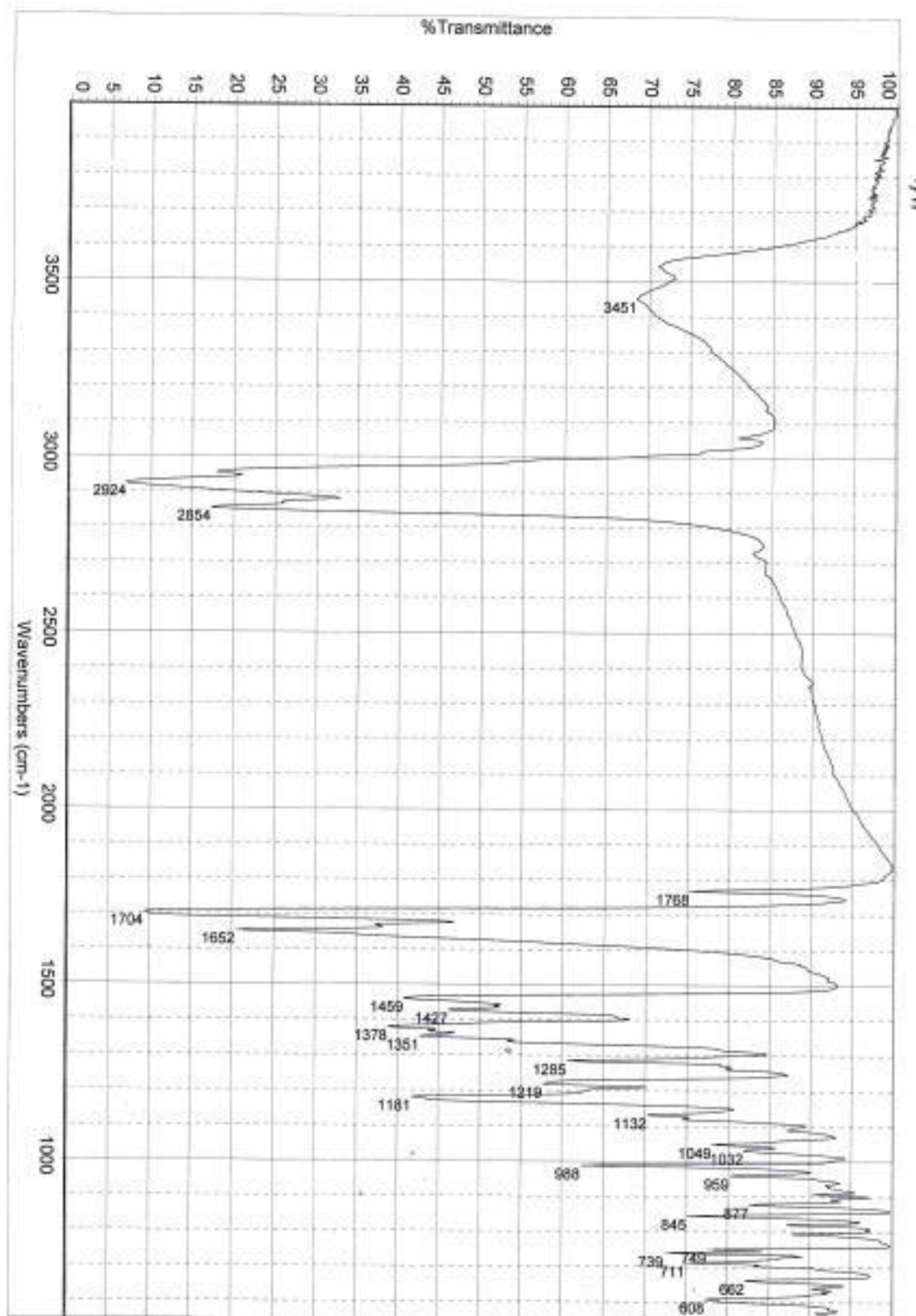


Figure S4. Mass spectral analysis of compound 4b.

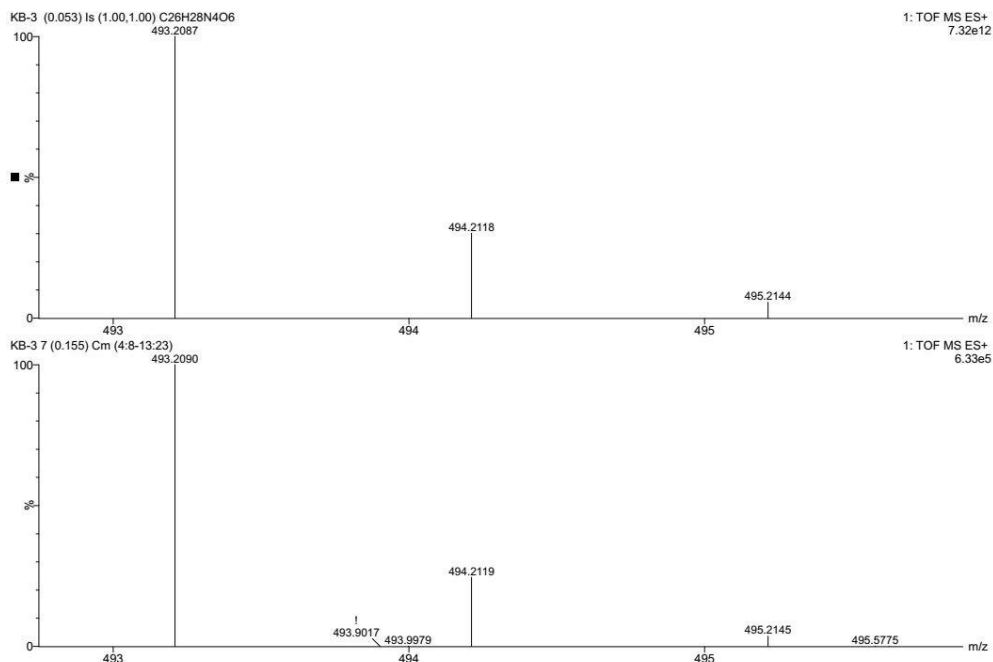


Figure S5. Mass spectral analysis of compound 4d.

