Chiral Analysis of Larger Molecules by Fourier Transform Molecular Rotational Resonance Spectroscopy

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Introduction
Chiral analysis of molecules with multiple chiral centers requires identifying the diastereomers and measuring their enantiomeric excess (ee). Molecular rotational spectroscopy can perform both of these analyses—with the ability to measure the ee being a new development in the past two years.* This work examines the ability of rotational spectroscopy to identify diastereomers, conformational isomers, and isotopologues for measurements with a dynamic range of 1000 or more using quantum chemistry estimates of the structure and dipole moment.

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Ambroxide (C_{16}H_{28}O): Heavy Atom Structure from the Analysis of Isotopologue Rotational Spectra

The molecular structure determination uses the assigned spectra of the 16 singly-substituted ^13C and the singly-substituted ^18O isotopologues. These spectra are analyzed using an automated fitting routine. The theoretical structure is from a B3LYP-d3 6-311++g(d,p) calculation.

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Cedrol (C_{15}H_{26}O) Structure

- 4 conformers identified
- 4 dimer conformers assigned
- Good agreement with theory (Data available)

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Dihydroartemisinic Acid (C_{15}H_{24}O_{2}): Identification of Conformers and Molecular Structure (^13C Atom Positions)

Conformer 1 | Theory | Exp | % Error | Conformer 2 | Theory | Exp | % Error
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A | 786.3 | 786.197 | 0.26 | A | 786.2 | 786.5(5) | 0.3
B | 313.3 | 313.8604(2) | 0.1 | B | 313.3 | 313.8604(2) | 0.1
C | 253.2 | 253.7 | 1.0 | C | 253.2 | 253.7 | 1.0

Theory: HF/6-311++g(d,p) | d3 (Grimme): <0.5% error on constants

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Conclusions
- Accurate structures obtained from low levels of theory
- Substitution structures confirm diastereomer structure for molecules with multiple chiral centers
- Conformers easily distinguished and fully resolved
- Baseline-resolved spectra at 1000:1 sensitivity can be measured

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