DESIGNING CHIRAL TAGS TO IMPROVE ABSOLUTE CONFIGURATION DETERMINATION BY ROTATIONAL SPECTROSCOPY

LUCA EVANGELISTI, *Dipartimento di Chimica G. Ciamician, Università di Bologna, Bologna, Italy*; CHANNING WEST, *Department of Chemistry, The University of Virginia, Charlottesville, VA, USA*; MARK D. MARSHALL, HELEN O. LEUNG, *Chemistry Department, Amherst College, Amherst, MA, USA*; BROOKS PATE, *Department of Chemistry, The University of Virginia, Charlottesville, VA, USA*.

Determining the absolute configuration (AC) of a chiral analyte is a challenging analytical problem. In 2013, Patterson, Schnell, and Doyle showed that molecular rotational spectroscopy can be used to determine AC through the phase of a coherent emission signal generated by special three-wave mixing cycles. An alternate approach to determine AC is to convert enantiomers into diastereomers. Diastereomers possess distinct geometries, and, therefore, produce distinct rotational spectra. The enantiomer-to-diastereomer approach is accomplished in rotational spectroscopy by creating weakly bound complexes of the analyte with an enantiopure chiral tag molecule in a pulsed jet expansion. The AC of cedrol ($C_{15}H_{26}O$) has previously been determined by rotational spectroscopy using propylene oxide (C_3H_6O) as the tag. The size difference of cedrol relative to propylene oxide results in diastereomer complexes possessing similar rotational constants. The difference in rotational constants between the diastereomer complexes is small enough that it approaches the confidence limit of the computational methods used (B3LYP D3BJ 6-311G++(d,p)). Therefore, full carbon structures of the complexes were required to confidently assign the AC. The current study exploits a structural motif of the complexes to increase confidence in the AC assignment without needing to experimentally determine the carbon structure. To a good approximation, the change in inertia between the diastereomer complexes arises from changing the position of the propylene oxide methyl group. By modifying propylene oxide, the AC of cedrol is determined without observing ^{13}C spectra in natural abundance. Two approaches are tested. The first method involves using a propylene oxide derivative with a -CF_3 group instead of a methyl group, which provides a larger inertia difference between the diastereomer complexes. The second approach involves using an isotopically labeled tag. Quantum calculations can predict isotopic shifts in rotational constants to a higher degree of accuracy than the constants themselves, allowing for higher confidence in the AC assignment.