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Editorial

Special Issue: Asymmetry and Symmetry in Organic Chemistry

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1. Introduction

In organic chemistry, the concepts of asymmetry and symmetry play crucial roles in understanding the properties and reactivity of molecules.

Asymmetry (chirality) refers to the lack of symmetry in a molecule, where the molecule and its mirror image cannot be superimposed onto each other. Chiral molecules are non-superimposable on their mirror images and exist in two distinct forms called enantiomers. The importance of asymmetry in organic chemistry is significant for several reasons:

– Biological activity—many biological molecules, such as amino acids, sugars, and pharmaceuticals, exhibit chirality. Enantiomers of these molecules often have different biological activities. For example, one enantiomer of a drug may be therapeutically effective, while another may be inactive or even have adverse effects. Understanding and controlling chirality is crucial in drug design and development.
– Stereochemistry—asymmetric carbon atoms, also known as chiral centers, are central to stereochemistry. They provide a way to differentiate molecules and predict their reactivity. The arrangement of substituents around a chiral center determines the molecule's stereochemistry, affecting its physical properties and interactions with other molecules.
– Selectivity in reactions—chiral molecules often exhibit different reactivity and selectivity in chemical reactions. Enzymes, for instance, are highly stereoselective catalysts, enabling them to recognize and react with specific enantiomers of the substrates. Asymmetric synthesis, the production of chiral compounds from achiral starting materials, relies on the control of chirality to selectively obtain a desired enantiomer.

Symmetry, on the other hand, refers to the property of a molecule that exhibits a certain degree of self-similarity or balance. Symmetry plays an important role in organic chemistry for several reasons:

– Spectroscopy and characterization—symmetry elements, such as rotation axes, planes of symmetry, and inversion centers, help identify molecular symmetry and predict spectroscopic properties. Techniques like infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy rely on symmetry considerations to interpret experimental data and elucidate molecular structures.
– Reaction mechanisms—symmetry considerations can provide insights into reaction mechanisms. Certain reactions, such as pericyclic reactions, are governed by symmetry rules, enabling predictions about allowed and disallowed pathways.

2. Contributions

The authors of [1] describes a synthesis of an axial–chiral spirobi-(dinaphthoazepin)ium salt in racemic and meso crystal structures. The spiro-compound was obtained from a racemic precursor and was separated into two diastereoisomers. On the one hand, the racemic crystals exhibited a low-symmetry crystal structure, while on the other hand, the meso crystals showed S_4 symmetry, which is rare in organic chemistry.

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The paper [2] constitutes a review concerning variously synthesized C_2-symmetric *N*-heterocyclic carbenes (NHC) and their use as ligands in asymmetric transition-metal catalysis. The article focuses on the architectures of chiral NHCs and on new possibilities of their application in asymmetric organic synthesis.

In the study [3], a series of novel hydrazone derivatives containing *cis*-(4-chlorostyryl) amide was synthesized and cytotoxic activity against a breast cancer cell line was evaluated. Some of those derivatives exhibited promising cytotoxic activities with IC_{50} values between 2.19–4.37 μM.

Contribution [4] describes a synthesis of chiral, enantiomerically pure aziridine phosphines and their use as chiral catalysts in the asymmetric intramolecular Rauhut–Currier reaction (a vinylogous Morita–Baylis–Hillman reaction). The desired chiral phenols achieved high chemical yields values with a high degree of enantioselectivity.

3. Conclusions

In summary, asymmetry and symmetry are essential concepts in organic chemistry. Asymmetry is crucial for chirality, optical activity, and stereochemistry, while symmetry aids in structural analysis, reaction mechanisms, and spectroscopic analysis. Understanding both concepts is fundamental for predicting molecular behavior, designing efficient synthesis routes, and unraveling the intricate world of organic compounds.

Conflicts of Interest: The author declares no conflict of interest.

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