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Organic Chemistry: Current Research

Perspective

Enantiomers: An Overview

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DESCRIPTION

Enantiomers are molecules that exist in two forms that are mirror images of one another but cannot be overlaid. Enantiomers are chemically similar in every other way.

The R or S are the labels for stereocenters

The enantiomers of a chiral chemical are named using the "right hand" and "left hand" nomenclature. The arrangement at stereo center is termed S ("Sinister" Latin= "left") if the arrow points counterclockwise (left after leaving the 12 o'clock position).

Enantiomers have identical chemical and physical properties when present in a symmetric environment, with the exception of their ability to rotate plane-polarized light (+) by equal quantities but in opposite directions (although the polarized light can be considered an asymmetric medium). As a result, such compounds are classified as optically active, with different terminology for each enantiomer depending on the direction of rotation: a dextrorotatory molecule rotates light clockwise (+), whereas a levorotatory compound turns light counter-clockwise (–). A racemic mixture, also known as a racemate, is a mixture that has an equal number of both enantiomers. The amount of positive rotation in a racemic mixture is exactly countered by the same amount of negative rotation, therefore the net rotation is zero (the mixture is not optically active).

Enantiomers have the identical Gibbs free energy for all intents and purposes. The weak neutral current explanation, however, predicts that there is a minute variation in energy between enantiomers (on the order of 10^{12} eV or 10^{10} kJ/mol or less) due to parity violation of the weak nuclear force (the only force in nature that can "distinguish left from right"). This energy difference is much less than the energy changes induced by even a minor change in molecule conformation, and it is far too small to be measured with current technology, therefore it is chemically insignificant.

When enantiomer members interact with other enantiomer compounds, they frequently have diverse chemical responses. Because many biological compounds contain enantiomers, the effects of two enantiomers on biological organisms can differ significantly. When it comes to medications, for example, just one of the enantiomers is responsible for the intended physiological benefits (referred to as eutomer), whereas the other is less active, inactive, or even has detrimental effects (referred to as distomer).

Because of this discovery, medications with only one enantiomer ("enantiopure") can be produced to improve the drug's efficacy and, in some cases, reduce negative effects. One example is eszopiclone (Lunesta), which is a single enantiomer of zopiclone, an older racemic medication. This is an example of a chiral switch in action. Because one enantiomer appears to be responsible for all of the intended effects and the other appears to be ineffective, eszopiclone's dose is half that of zopiclone.

CONCLUSION

Non-enantiomeric precursors cause racemic mixtures in the chemical production of enantiomeric compounds. Separation of a racemic mixture into its enantiomeric components is impossible in the absence of an efficient enantiomeric environment (precursor, chiral catalyst, or kinetic resolution). Despite the fact that some racemic mixes spontaneously crystallize in the form of a racemic conglomerate, in which the enantiomers' crystals are physically segregated and can be mechanically separated (e.g., the enantiomers of tartaric acid, whose crystallized enantiomers were separated with tweezers by Pasteur). Most racemates, on the other hand, will form as crystals that include both enantiomers in a 1:1 ratio arranged in a regular lattice.

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