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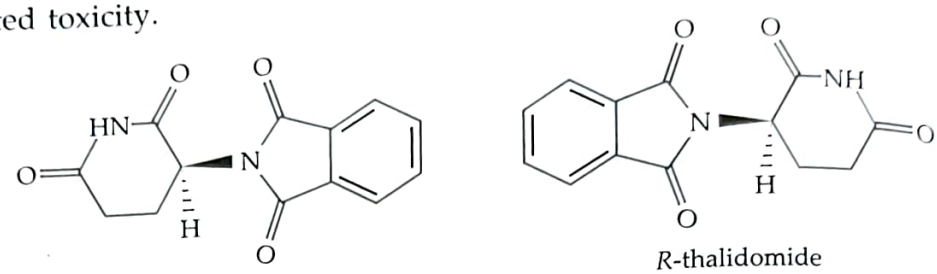
Few examples of chiral drugs, whose enantiomers have vastly different properties.

1. The *R*- and *S*-enantiomers of thalidomide are well-known examples of enantiomer related toxicity.



S-thalidomide

R-thalidomide

Figure 8 The structures of (S)-thalidomide and (R)-thalidomide.

The R-enantiomer is an effective sedative with a soothing effect that relieves anxiety and causes drowsiness, whereas the S-enantiomer is known to cause teratogenic birth defects. Teratogenic foetuses have parts that are deficient, redundant, misplaced, or grossly misshapen. In fact, S-Thalidomide has been linked to over 2000 cases of serious birth defects in children born to mothers who used the racemic mixture during their pregnancy.

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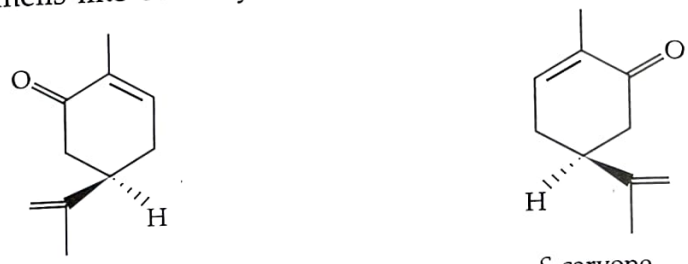


R-carvone
spearmint oil

S-carvone
caraway oil

Figure 9 The structures of R-carvone (which smells like spearmint) and S-carvone (which smells like caraway seeds).

3. In the case of ibuprofen (pain killer drug), the (S)-enantiomer has the desired pharmacological activity while the (R)-enantiomer is completely inactive.

S-Ibuprofen

R-Ibuprofen

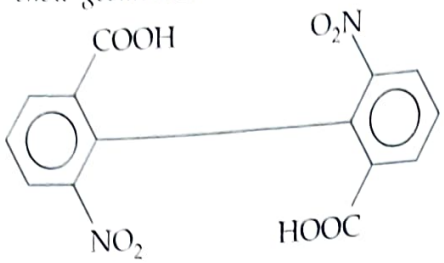
Figure 10 The structures of S- and R-Ibuprofen

Example 21 *Choose/fill correct answer :*

(*i*) *Chiral molecules are those which are :*

(*a*) *not superimposable on their mirror image.* (*b*) *are superimposable on their mirror image.*

(*c*) *show geometrical isomerism.* (*d*) *unstable molecules.*

(*ii*) 

will show _____ *isomerism.*

[UPTU, Ist Sem., 2009-10]

Solution. (*i*) (*a*) ; (*ii*) optical.

Review Questions

1. Which of the following compounds would show optical isomerism : [UPTU, 2008-09]
   (*i*) $H_2N\,CH_2\,COOH$ (*ii*) $(CH_3)_2\,CHCHO$ (*iii*) $H_2NCH\,(CH_3)_2$ (*iv*) $CH_3 - CH\,(OH)\,COOH$
2. Write short notes on : (*i*) Meso compound (*ii*) Racemisation [UPTU, 2007-08]
3. Define : (*i*) Enantiomers and Diastereoisomers. (*ii*) Which of the following compounds are optically active, and why, n-propanol, allenes, *n*-butanol and 2-chlorobutane. [U.P. Tech., 1st Sem., 2006-07, 2011-12]
4. What is optical activity ? Give the stereoisomers of Tartaric acid. How do you account for lack of optical activity in meso-forms and racemic mixtures. [U.P. Tech., 2nd Sem., 2006-07]
5. (*a*) Discuss stereochemistry of tartaric acid.
   (*b*) What will happen if one of the OH groups of tartaric acid is replaced by NH_2 group ? [U.P. Tech., Ist Sem., 2009-10]
6. 0.5 gm of an optically active compound was dissolved in 2 mL of a solvent at 25°C. The solution was kept in a cell of length 10 cm and observed rotation was + 10°. Calculate specific rotation of its enantiomer. [UPTU, Jan. 2008]
7. Differentiate between racemic mixture and meso compounds. [UPTU, May, 2008]
9. What is the condition essential for optical activity ?
10. Define optical isomerism. Why do allenes show optical isomerism in spite of the fact that they do not contain a chiral carbon ? [UPTU, 2nd Sem., 2011-12]

Dynamic Stereochemistry

Stereochemistry deals with structure of molecules in three dimensions (Greek : *stereos, solid*). It is one of the important part of the science of organic chemistry.

Dynamic stereochemistry deals with the structures of reactants and product molecules in three dimensions as chemical transformations take place.

> *It is concerned with stereochemical studies of any rate process, be it a conformational transformation involving interconversion of conformers or a chemical reaction involving bond-breaking and bond-making processes.*

It helps in (*a*) correlating conformation and reactivity and in (*b*) stereoselective synthesis.

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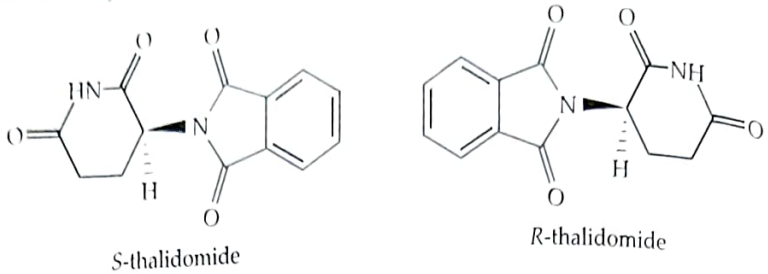

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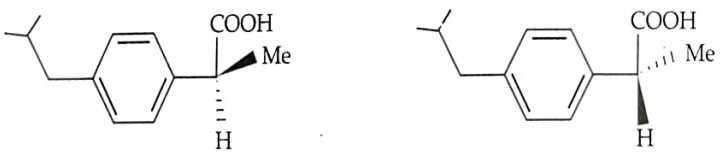

S-Ibuprofen *R*-Ibuprofen

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