

Radioisotope Dilution Technique

Detection of Compound

Isotopic dilution method

- An analytical technique that is used to identify a single substance, that is present in a mixture of chemically related compounds (A, B, or C) from which it can not be quantitatively separated
- This method is one of the reliable methods for determining the optical purity or enantiomer excess of a sample
- In this method, a known weight of the sample under examination is taken and it is mixed with a known weight of isotopically labeled racemic modification of the same compound of known **enantiomer** composition in solution
- The racemic form is separated by the crystallization process

Principle

- The basic principle behind this method in the context of enantiomeric purity is that a substance with an unknown enantiomer composition is diluted by the corresponding isotopically labeled substance with a known enantiomer composition
- Determining a dilution factor that can be correlated to the enantiomer composition of the unknown mixture requires measuring the isotope concentration of the labeled and unlabeled samples and isolating either a pure enantiomer or a pure racemate

- **It causes the labeled racemic form to be isolated again**
- **In solution, the racemic substance separates into molecules with (+) and (-) labels**
- **One of the enantiomers is isotopically diluted in the recovered *dl* pair if one of the labeled molecules mixes with the enantiomer molecule whose optical purity needs to be determined while the other is unaffected**
- **However, all the molecules in the recovered *dl* pair will be diluted if one mixes with another or with its opposite enantiomer in unlabelled racemic material**
- **Thus, a chemically pure enantiomer or pure racemate is obtained throughout this process**

- **By the measurement of the isotopic concentration in the labeled and unlabelled samples and reisolation of pure enantiomer or pure racemate, the optical purity of the original sample can be calculated**
- **Furthermore, knowing the weights of the original active material and the newly added labeled racemic material allows one to determine a dilution factor and show how active the recovered labeled racemic material will be**
- **Then, the experimental activity is compared with the expected activity**
- **If the experimental activity is lower than expected, there may have been some trace amounts of racemic material (unlabelled) in the reportedly pure enantiomer**

Application of Isotope dilution method

- **Determination of enantiomer excess**
- **Applicable for determining the mass and quantity of chemical substances**
- **In the determination of optical purity**
- **In the determination of the geological age of minerals**
- **For the analysis of the unknown radioactive samples**