



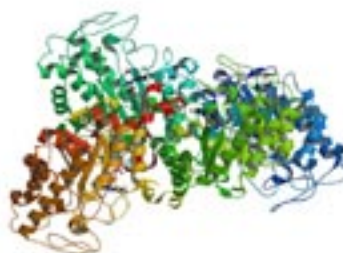
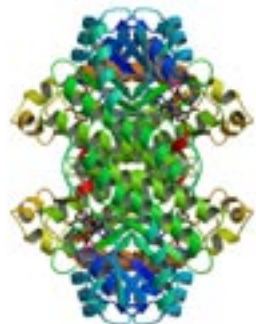
Johnson Matthey  
Catalysts

## Johnson Matthey introduces **X-Zyme** Biocatalysts

Enzymes are an important addition to the catalytic toolbox for the production of fine chemicals and pharmaceuticals. The synthetic scope and catalytic activity of enzymes often complement chemical catalysis making biocatalysis a valuable tool in organic chemistry for the synthesis of chiral compounds.

Johnson Matthey Catalysts is pleased to offer a continually expanding, novel family of biocatalysts which enhances the chiral capabilities of our chemo-catalyst technology offering. This combined portfolio of catalytic technologies allow us to design the most efficient synthetic route for our clients.

You now have one reliable resource for your chemo- and biocatalysis needs.



# Range of Enzyme Technology



## Enzyme Development

- Enzyme screening kits
- Custom Screening of enzymes and strains
- Optimization of biocatalysts by directed evolution
- Commercial enzymes

## Enzyme Production

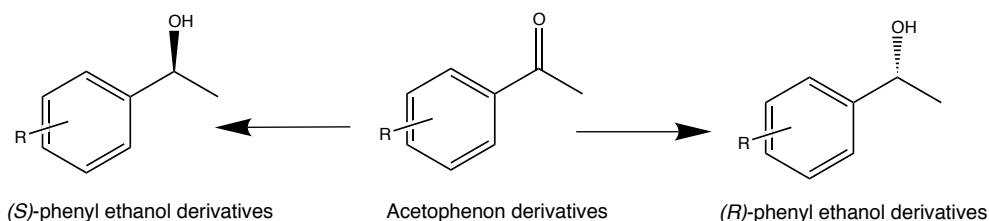
- Large scale production of enzyme
- Custom fermentation and fermentation development

## Process Development

Large scale production of chiral compounds, custom synthesis and technology transfer.

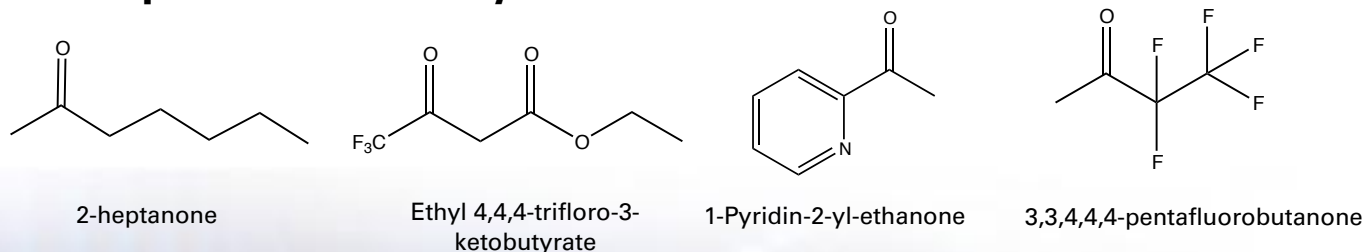
# Alcohol Dehydrogenases (ADH) for Biocatalytic Ketone Reduction

Application: Stereoselective reduction of ketones to produce enantiomerically-pure alcohols



- Broad range of ketones reduced with high stereoselectivity
- Both R and S alcohols can be produced
- Yields often near 100% of theoretical
- Mild conditions, few if any side product

## Examples of structurally diverse ketones:



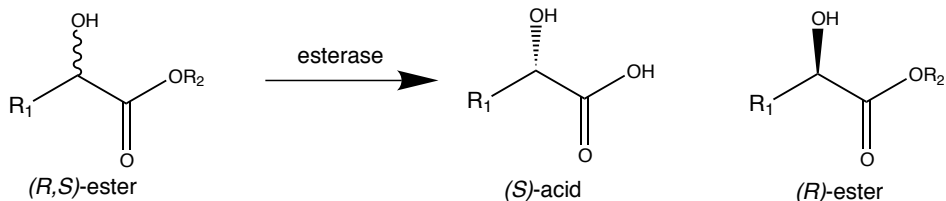
## Products include:

- 35 different commercially available ketoreductases, with an additional 50 available for screening
- Larger quantities available for reaction optimization, scale-up, and commercial production
- Enzymes sold in convenient screening set format for rapid identification of the best biocatalyst for a desired reduction

## Esterases

### for Biocatalytic Resolutions of Chiral Acids, Esters, and Alcohols

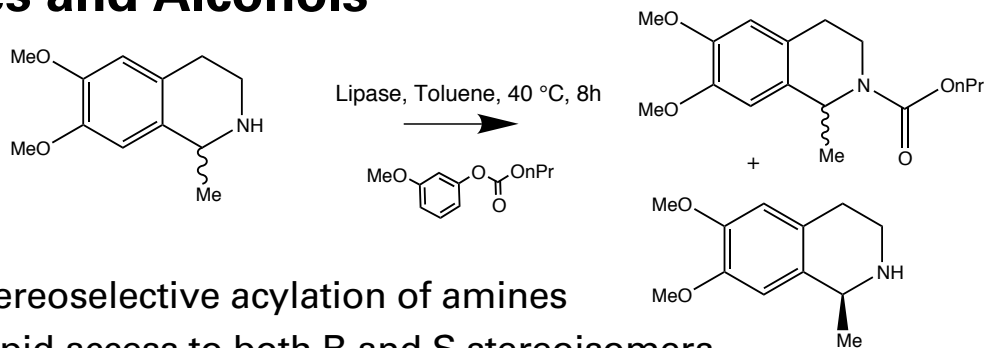
Application: Resolution of **carboxylic acids and esters**



- Stereoselective hydrolysis of esters
- Stereoselective esterification of carboxylic acids
- Can be carried out in organic solvents or aqueous mixtures
- Mild conditions, tolerant of wide range of functionality

## Lipases

### for the Production of Enantiomerically Pure Amines and Alcohols

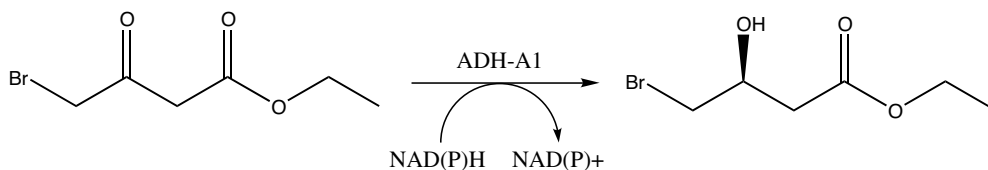


- Stereoselective acylation of amines
- Rapid access to both  $R$  and  $S$  stereoisomers
- Can be carried out in organic solvents or aqueous mixtures

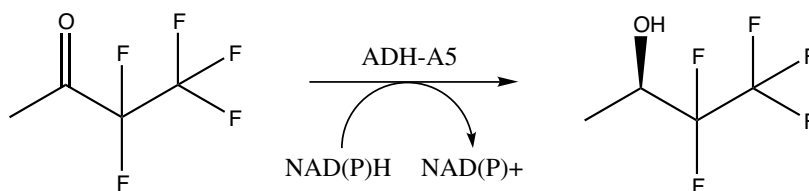
### Esterase and Lipase Products include:

- 50 esterases and 12 lipases commercially available enzymes with an additional 900 available for screening
- Enzymes sold in convenient screening set format for rapid identification of the best enzyme for a desired resolution

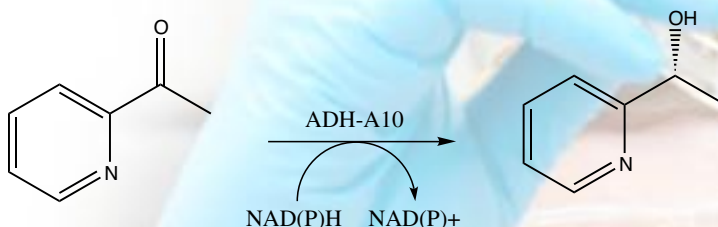
## Example Reactions



Asymmetric reduction of ethyl 3-ketobutyrates to ethyl (R)-3-hydroxybutyrates. (S)-specific ADH for the reduction to the opposite enantiomer is also available.



Asymmetric reduction of 3,3,4,4,4-pentafluorobutanones to (R)-3,3,4,4,4-pentafluorobutan-2-ols. (S)-specific ADH for the reduction to the opposite enantiomer is also available.



Asymmetric reduction of 2-acetylpyridines to (R)-2-(1-hydroxyethyl)pyridines. (S)-specific ADH for the reduction to the opposite enantiomer is also available.

# Enzyme Kits

## Alcohol Dehydrogenase

Application: A broad range of carbonyl compounds (including aldehydes, aliphatic, aromatic, cyclic ketones, diketones, ketoacetals and ketoesters) can be asymmetrically reduced to their corresponding chiral alcohols with high enantioselectivity using these enzymes.

## Aldehyde Dehydrogenase

Application: Aldehyde dehydrogenases catalyse the oxidation of aldehydes to their corresponding carboxylic acids with NAD<sup>+</sup>/NADP<sup>+</sup> as cofactor.

## Aldehyde Reductase

Application: Aldehyde Reductases catalyse the reduction of aldehydes to their corresponding primary alcohols with NADH/NADPH as cofactor.

## Ene Reductase

Application: Stereoselective reduction of alkenes.

## Esterases

Application: Enantioselective hydrolysis of esters of primary, secondary and tertiary alcohols.

## Lipase

Application: Enantioselective hydrolysis and interesterification of esters of primary and secondary alcohols, enantioselective synthesis/hydrolysis of amides.

## Cofactor Regeneration Kit

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Refer to our website at

[www.jmcatalysts.com/pharma](http://www.jmcatalysts.com/pharma) for

the latest information on available products.

