Enzymes for biocatalysis

For smarter chemical synthesis

Biocatalysis

Biocatalysis involves the implementation of natural catalysts, such as enzymes, in place of chemical catalysts in synthetic process. Compared to chemical catalysts, enzymes offer:

- higher reaction rates
- milder reaction conditions
- high reaction specificity with no side products

This change can enable new, more sustainable routes for the production of intermediates and active pharmaceutical ingredients (APIs).

Biocatalysis has become an increasingly important tool for medical, process and polymer chemists, allowing the development of efficient and highly attractive synthetic process on an industrial scale. Use of enzymes in catalysis is a well-established technology within the chemical industry. An advantage of enzymes in organic synthesis is their remarkable selective properties, which provide commercial benefits including:

- high selectivity in production of single stereoisomers
- fewer side reactions
- less reprocessing and purification steps
- easier product separation
- less pollution

The combination of all of these advantages leads to a reduction in costs.

Enzyme catalysts work by lowering the activation energy (Ea) for a reaction, thus dramatically increasing the rate of the reaction. As a result, products are formed faster and reactions reach their equilibrium state more rapidly. Most enzyme reaction rates are millions of times faster than those of comparable uncatalyzed reactions. As with all catalysts, enzymes are not consumed by the reactions they catalyze, nor do they alter the equilibrium of these reactions. However, enzymes do differ from most other catalysts in that they are highly specific for their substrates.

Product name	EC number	Type	Source	Form	Optimum usage conditions	Activity	Applications
Novozym® 435	3.1.1.3	Non specific Lipase	*Aspergillus niger*	Immobi-lized	30–60°C, pH 5–9	10000 PLU/g	Stereoselective hydrolysis of esters, transes-terification and dynamic kinetic resolution of alcohols
Lipozyme® CalB L	3.1.1.3	Non specific Lipase	*Aspergillus niger*	Liquid	30–60°C, pH 5–9	5 KLU/g	Stereoselective hydrolysis of esters, transes-terification and resolution of alcohols
Novocor® AD L	3.1.1.3	Non specific Lipase	*Aspergillus oryzae*	Liquid	30–60°C, pH 5–9	6 KLU/g	Stereoselective hydrolysis of hin-dered esters of alcohols
Novozym® 40086	3.1.1.3	1, 3 Lipase	*Aspergillus oryzae*	Immobi-lized	30–50°C, pH 7–10	275 IUN/g	Stereoselective hydrolysis of esters and trans esterification
Palatase® 20000 L	3.1.1.3	1, 3 Lipase	*Aspergillus oryzae*	Liquid	30–50°C, pH 7–10	20000 LU-MM/g	Stereoselective hydrolysis of esters Stereo-selective hydrolysis of esters
Lipozyme® TL IM	3.1.1.3	1, 3 Lipase	*Aspergillus oryzae*	Immobi-lized	50–75°C, pH 6–8	250 IUN/g	Stereoselective hydrolysis of esters and trans esterification
Lipozyme® TL 100 L	3.1.1.3	1, 3 Lipase	*Aspergillus oryzae*	Liquid	20–50°C, pH 7–10	100 KLU/g	Stereoselective hydrolysis of esters and dicarboxylates
Novozym® 51032	3.1.1.3	Lipase	*Aspergillus oryzae*	Liquid	35–70°C, pH 7–10	15 KLU/g	Steroselective hydrolysis of estersw
Resinase® HT	3.1.1.3	Lipase	*Aspergillus oryzae*	Liquid	up to 90°C	50 KLU/g	Hydrolyzes esterbonds in glycerides
Lecitase® Ultra	3.1.1.3	Lipase	*Aspergillus oryzae*	Liquid	35–60°C	10 KLU/g	Lipase that hydrolyzes esterbonds in glycerides
Alcalase® 2.4 L FG	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Liquid	30–65°C, pH 7–9	2.4 AU-A/g	Stereoselective hydrolysis of amino esters and selective esters
Alcalase® 2.4 L, DX	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Liquid	30–65°C, pH 7–9	2.5 AU-A/g	Stereoselective hydrolysis of amino esters and selective esters
Alcalase® 2.5 L	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Liquid	30–65°C, pH 7–10	2.5 AU-A/g	Stereoselective hydrolysis of amino esters and selective esters
Savinase® 12 T	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Granulate	30–70°C, pH 8–10	12 KN-PU-S/g	Stereoselective hydrolysis of amino esters and selective esters
Savinase® 16 L	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Liquid	30–70°C, pH 8–10	16 KN-PU-S/g	Stereoselective hydrolysis of amino esters and selective esters
Esperase® 8.0 L	3.4.21.62	Serine endo-peptidase	Bacillus licheniformis	Liquid	30–70°C, pH 8–10	8 KNPU-E/g	Serine endoprotease that hydrolyzes inter-nal peptide bonds
Neutrase® 0.8 L	3.4.24.28	Metalloprotease	Bacillus amylolique faciens	Liquid	40–50°C, pH 7	0.8 AU-N/g	Metallo endoprotease that hydrolyz-es internal peptide bonds
rTrypsin®	3.4.21.4	Serin protease	Fusarium venenatum	Granulate	pH 7.8–8.0	800 USP/mg	Hydrolysis of amid end ester bonds of lysine and arginine at carboxyl terminal
Catazyme® 25 L	1.11.16	Catalase	*Aspergillus niger*	Liquid	25–40°C, pH 4–6	25000 CIU/g	Dismutates hydorgen peroxide into dioxygen and water
Toruzyme® 3.0 L	2.4.1.19	Cyclomalto dextrin glucantransferase	Bacillus licheniformis	Liquid	80–95°C, pH 5–6.5	3 KNU-CP/g	Cyclomaltodextrin glucanotrans-ferase that forms cyclomaltodextrin of various sizes from starch and similar substrates
BAN® 480 L	3.2.1.1	Alpha-amylase	Bacillus amylolique faciens	Liquid	55–75°C, pH 5–7	480 KNU-B/g	Endo-amylase that hydrolyzes (1.4)-alpha-D-glucosidic linkages in starch polysaccharides
Novozym® 51003	1.10.32	Laccase	*Aspergillus oryzea*	Liquid	–	1000 LA-MU/g	Oxidizes various phenols, anilines, benzen-ethiols, metal ion complexes, and other compounds into quinones or other oxidized compounds, with concomitant reduction of dioxygen to water

About Novozymes
Novozymes is the world leader in biological solutions. Together with customers, partners and the global community, we improve industrial performance while preserving the planet's resources and helping to build better lives. As the world's largest provider of enzyme and microbial technologies, our bioinnovation enables higher agricultural yields, low-temperature washing, energy-efficient production, renewable fuel and many other benefits that we rely on today and in the future. We call it Rethink Tomorrow.

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