

Contribute to BRENDA! Your enzyme data is important for BRENDA. Send us your paper, and we will do all the work to include your data into our database. [More...](#)

Please enter a search term

Enzyme, Ligand contains

add search field delete search field start search

**Text-based queries**

- Full-text Search
- Advanced Search
- Enzyme & Disease

**Structure-based queries**

- Ligand Structure Search
- Metabolic Pathways
- Enzyme Structures

**Explorer**

- Enzyme Classification
- TaxTree
- Protein folding: CATH / SCOPe
- Ontologies

**Visualization**

- Word Maps
- Genomes
- Functional Parameter Statistics
- Metabolic Pathways

**Prediction**

- Membrane Helices
- Localization Prediction
- EnzymeDetector

**Supporting & External**

- BRENDA Tissue Ontology
- Biochemical Reactions
- MetaboMAPS

**News**

**NEW Release online!** - February 1, 2021  
Release 2021.1 online including 76 new and 623 updated enzyme classes.

for Release 2021.1

# BRENDA Tutorial

## Introduction to the Enzyme Information System

## Facts about BRENDA (BRaunschweig ENzyme DAtabase)

- one of the most comprehensive enzyme information repositories
- BRENDA is a member of de.NBI (German Network for Bioinformatics Structure, since 2015)
- BRENDA is an ELIXIR Core Data Resource (since 2018)
- all enzymes, classified by the Enzyme Nomenclature (IUBMB)
- data of molecular biology, biochemistry, medical research, and biotechnology
- furthermore BRENDA includes data from interconnected databases containing results from text mining methods and bioinformatic approaches
- BRENDA is freely available to the scientific community
- more than 80,000 visits of the BRENDA website each month
- major updates of the data in BRENDA are performed twice a year

# History and major developments of BRENDA

- BRENDA was created at the former German National Research Center for Biotechnology (GBF, now HZI, Helmholtz Zentrum für Infektionsforschung, Braunschweig, Germany) in 1987
- BRENDA was originally published as a series of book
  - 1st Edition 1990-1997 (Enzyme Handbook)
  - 2nd Edition 2001-2013 (Handbook of Enzymes)
- BRENDA moved to the University of Cologne, Germany
- First online version in 1998 via the SRS system at the EBI
- First website of BRENDA in Cologne
- Transfer of BRENDA into a fully relational database system
- BRENDA moved back to Braunschweig in 2007
- BRENDA is now maintained and further developed at the BRICS - TU Braunschweig

# Facts about BRENDA

The main categories are based on the **Enzymes** and the **Metabolites / Ligands**

Enzyme-related data encompasses information on:

- Enzyme and ligand nomenclature
- Organism
- Reaction and specificity
- Kinetic properties
- Structure and role of the ligands
- Stability information
- Ligand-enzyme information
- Enzyme sequence and structure
- Mutants and disease
- Occurrence, isolation, and preparation
- Pathways



BRENDA is the most comprehensive information system on:

- 8083 EC Numbers (Nov. 2020)
- more than 2 Mill. different enzymes
- more than 5 Mill. enzyme data, manually annotated from ~160,000 literature references

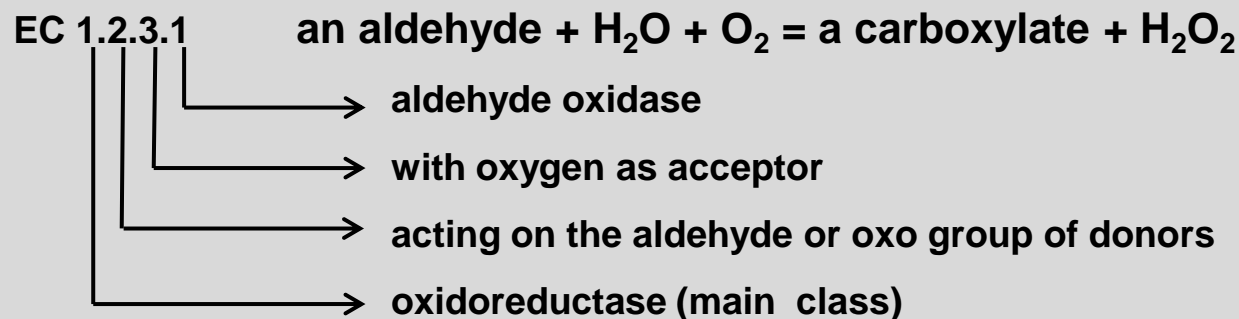
**Enzyme Commission numbers (EC Numbers) are defined according to the catalyzed reaction** by the IUBMB (International Union of Biochemistry and Molecular Biology)

Format: **Four** numbers separated by periods, e.g. 1.2.3.1

Main Enzyme Classes:

- 1 Oxidoreductases
- 2 Transferases
- 3 Hydrolases
- 4 Lyases
- 5 Isomerases
- 6 Ligases
- 7 Translocases

Numbers represent from left to right a progressively finer classification scheme



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(A)

(B)

<p><b>Text-based queries</b></p> <ul style="list-style-type: none"> <li>Full-text Search</li> <li>Advanced Search</li> <li>Enzyme &amp; Disease</li> </ul>	<p><b>Structure-based queries</b></p> <ul style="list-style-type: none"> <li>Ligand Structure Search</li> <li>Metabolic Pathways</li> <li>Enzyme Structures</li> </ul>	<p><b>Explorer</b></p> <ul style="list-style-type: none"> <li>Enzyme Classification</li> <li>TaxTree</li> <li>Protein folding: CATH / SCOPe</li> <li>Ontologies</li> </ul>
<p><b>Visualization</b></p> <ul style="list-style-type: none"> <li>Word Maps</li> <li>Genomes</li> <li>Functional Parameter Statistics</li> <li>Metabolic Pathways</li> </ul>	<p><b>Prediction</b></p> <ul style="list-style-type: none"> <li>Membrane Helices</li> <li>Localization Prediction</li> <li>EnzymeDetector</li> </ul>	<p><b>Supporting &amp; External</b></p> <ul style="list-style-type: none"> <li>BRENDA Tissue Ontology</li> <li>Biochemical Reactions</li> <li>MetaboMAPS</li> </ul>

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The main search options:

- Quick access (A)
- and more specific queries (B)
- Classic View (C)
- ...further details in the corresponding BRENDA tutorials

EC-Number Enzyme Name Organism Protein Full text Ligand Advanced Search

Search Display 10 entries

Nomenclature	Reaction & Specificity	Functional Parameters
<ul style="list-style-type: none"> <li>Enzyme Names</li> <li>EC Number</li> </ul>	<ul style="list-style-type: none"> <li>Pathway</li> <li>Catalysed Reaction</li> <li>Reaction Type</li> <li>Natural Substrates &amp; Products</li> <li>Substrates &amp; Products</li> <li>Inhibitors</li> <li>Cofactors</li> <li>Metals/Ions</li> <li>Activating Compounds</li> <li>Ligands</li> <li>Biochemical Reactions</li> </ul>	<ul style="list-style-type: none"> <li><math>K_M</math> Value</li> <li><math>k_{cat}/K_M</math> Value</li> <li><math>K_i</math> Value</li> <li>IC<sub>50</sub> Value</li> <li>pI Value</li> <li>Turnover Number</li> <li>Specific Activity</li> <li>pH Optimum</li> <li>pH Range</li> <li>Temperature Optimum</li> <li>Temperature Range</li> <li>Kinetic <b>ENzyme DATA</b></li> </ul>
Organism-related information		
<ul style="list-style-type: none"> <li>Organism</li> <li>Source Tissue</li> <li>Localization</li> </ul>		
Isolation & Preparation		
<ul style="list-style-type: none"> <li>Purification</li> <li>Cloned</li> <li>Expression</li> <li>Renatured</li> <li>Crystallization</li> </ul>		
Stability	Enzyme Structure	Disease, Protein Variants & Application
<ul style="list-style-type: none"> <li>pH Stability</li> <li>Temperature Stability</li> <li>General Stability</li> <li>Organic Solvent Stability</li> <li>Oxidation Stability</li> <li>Storage Stability</li> </ul>	<ul style="list-style-type: none"> <li>Sequence</li> <li>3D-Structure</li> <li>Molecular Weight</li> <li>Subunits</li> <li>Posttranslational Modification</li> <li>Protein-Specific Search</li> </ul>	<ul style="list-style-type: none"> <li>Disease/ Diagnostics</li> <li>Protein Variants</li> <li>Application</li> </ul>
		References

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Information

Getting started

Contribute

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member of **de-NBI**  
GERMAN NATIONAL INFRASTRUCTURE FOR BIOINFORMATICS RESEARCH

  
Core Data Resource

**UPDATE!**  
Release 2021.1 (January 2021)  
BRENDA professional

**BRENDA data and information fields „classic view“**

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evaluate BRENDA!

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**NEWS will be announced in a new box, with all upcoming data and information, new developments and tools etc.**



# Data sources & updates: Merge and process of data

## Text mining

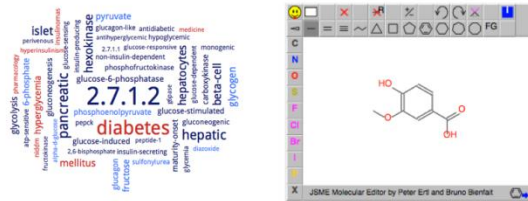
Enzyme



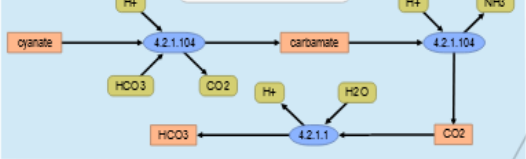
Tissue

Disease

## Visualization



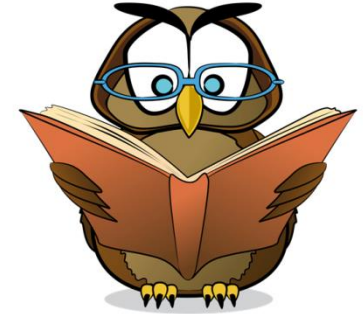
cyanate degradation



## Manual annotation

Data selection

Literature annotation



High Quality Data

## Data integration



EMBL



METACYC



PDB  
PROTEIN DATA BANK

**BRENDA**  
**BTO**  
Tissue  
Ontology

# BRENDA

The Comprehensive Enzyme  
Information System

