Bilirubin oxidase

In enzymology, a **bilirubin oxidase, BOD or BOx,** (EC 1.3.3.5 (https://enzyme.expasy.org/EC/1.3.3.5)) is an enzyme encoded by a gene in various organisms that catalyzes the chemical reaction

$$2 \text{ bilirubin} + O_2 \rightleftharpoons 2 \text{ biliverdin} + 2\ H_2O$$

This enzyme belongs to the family of oxidoreductases, to be specific those acting on the CH-CH group of donor with oxygen as acceptor. The systematic name of this enzyme class is **bilirubin:oxygen oxidoreductase**. This enzyme is also called **bilirubin oxidase M-1**. This enzyme participates in porphyrin and chlorophyll metabolism. It is widely studied as a catalyst for oxygen reduction.[1]

Two structures of bilirubin oxidase from the ascomycete *Myrothecium verrucaria* have been deposited in the Protein Data Bank (accession codes 3abg (https://www.ebi.ac.uk/thornton-srv/databases/cgi-bin/pdbsum/GetPage.pl?pdbcode=3abg) and 2xll (https://www.ebi.ac.uk/thornton-srv/databases/cgi-bin/pdbsum/GetPage.pl?pdbcode=2xll)).[2][3]

The active site consists of four copper centers, reminiscent of laccase. These centers are classified as type I (cys, met, his, his), type II (3his), and two type III (2his).

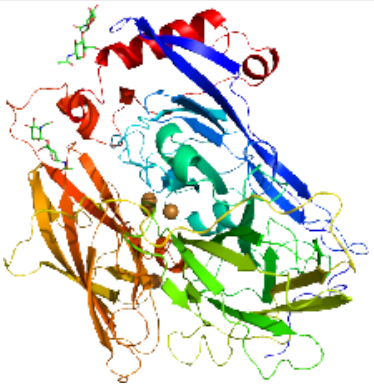
Further reading

- Murao S, Tanaka N (1981). "A new enzyme bilirubin oxidase produced by Myrothecium verrucaria MT-1" (https://doi.org/10.1271%2Fbbb1961.45.2383). *Agricultural and Biological Chemistry*. **45** (10): 2383–2384. doi:10.1271/bbb1961.45.2383 (https://doi.org/10.1271%2Fbbb1961.45.2383).
- Tanaka N, Murao S (1985). "Reaction of bilirubin oxidase produced by Myrothecium verrucaria MT-1" (https://doi.org/10.1271%2Fbbb1961.49.843). *Agricultural and Biological Chemistry*. **49** (3): 843–844. doi:10.1271/bbb1961.49.843 (https://doi.org/10.1271%2Fbbb1961.49.843).

References

1. Mano, Nicolas; Edembe, Lise (2013). "Bilirubin oxidases in bioelectrochemistry: Features and recent findings". *Biosensors and Bioelectronics*. **50**: 478–485. doi:10.1016/j.bios.2013.07.014 (https://doi.org/10.1016%2Fj.bios.2013.07.014). PMID 23911663 (https://pubmed.ncbi.nlm.nih.gov/23911663).
2. Mizutani K, Toyoda M, Sagara K, Takahashi N, Sato A, Kamitaka Y, et al. (July 2010). "X-ray analysis of bilirubin oxidase from Myrothecium verrucaria at 2.3 A resolution using a twinned crystal" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2898457). *Acta Crystallographica. Section F, Structural Biology and Crystallization Communications*. **66** (Pt 7): 765–70. doi:10.1107/S1744309110018828 (https://doi.org/10.1107%2FS1744309110018828). PMC 2898457 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2898457). PMID 20606269 (https://pubmed.ncbi.nlm.nih.gov/20606269).
3. Cracknell JA, McNamara TP, Lowe ED, Blanford CF (July 2011). "Bilirubin oxidase from Myrothecium verrucaria: X-ray determination of the complete crystal structure and a rational surface modification for enhanced electrocatalytic O2 reduction". *Dalton Transactions*. **40** (25): 6668–75. doi:10.1039/c0dt01403f (https://doi.org/10.1039%2Fc0dt01403f). PMID 21544308 (https://pubmed.ncbi.nlm.nih.gov/21544308).

bilirubin oxidase



Cartoon representation of the X-ray structure of bilirubin oxidase from *Myrothecium verrucaria* based on PDB accession code 2xll (https://www.ebi.ac.uk/thornton-srv/databases/cgi-bin/pdbsum/GetPage.pl?pdbcode=2xll). The protein ribbon is rainbow colored with the N-terminus in blue and the C-terminus in red. The four copper atoms are shown as spheres and the glycans shown as sticks.

Identifiers	
EC no.	1.3.3.5 (https://www.qmul.ac.uk/sbcs/iubmb/enzyme/EC1/3/3/5.html)
CAS no.	80619-01-8 (http://www.commonchemistry.org/ChemicalDetail.aspx?ref=80619-01-8&title=)
Databases	
IntEnz	IntEnz view (https://www.ebi.ac.uk/intenz/query?cmd=SearchEC&ec=1.3.3.5)
BRENDA	BRENDA entry (http://www.brenda-enzymes.org/enzyme.php?ecno=1.3.3.5)
ExPASy	NiceZyme view (https://enzyme.expasy.org/EC/1.3.3.5)
KEGG	KEGG entry (https://www.genome.jp/dbget-bin/www_bget?enzyme+1.3.3.5)
MetaCyc	metabolic pathway (https://biocyc.org/META/substring-search?type=NIL&object=1.3.3.5)
PRIAM	profile (http://priam.prabi.fr/cgi-bin/PRIAM_profiles_

	CurrentRelease.pl?EC=1.3.3.5)
PDB structures	RCSB PDB (https://www.rcsb.org/search?q=rcsb_polymer_entity.rcsb_ec_lineage.id:1.3.3.5) PDBe (https://www.ebi.ac.uk/pdbe/entry/search/index?ec_number:1.3.3.5) PDBsum (https://www.ebi.ac.uk/thornton-srv/databases/cgi-bin/enzymes/GetPage.pl?ec_number=1.3.3.5)
Gene Ontology	AmiGO (http://amigo.geneontology.org/amigo/term/GO:0047705) / QuickGO (https://www.ebi.ac.uk/QuickGO/term/GO:0047705)
Search	
PMC	articles (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=pubmed&term=1.3.3.5%5BEC/RN%20Number%5D%20AND%20pubmed%20pmc%20local%5Bsb%5D)
PubMed	articles (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=pubmed&term=1.3.3.5%5BEC/RN%20Number%5D)
NCBI	proteins (https://www.ncbi.nlm.nih.gov/protein?term=1.3.3.5%5BEC/RN%20Number%5D)