



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 17, 2024 – 05:22 PM EDT

PDB ID : 3CO8  
Title : Crystal structure of alanine racemase from *Oenococcus oeni*  
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for Structural Genomics (NYSGXRC)  
Deposited on : 2008-03-27  
Resolution : 1.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 1.20.1  
EDS : 2.37.1  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.37.1

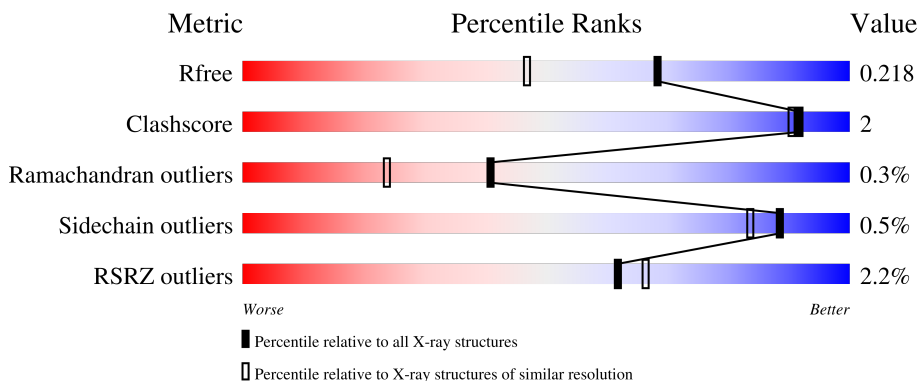
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.70 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	380	 3% 91% 5%
1	B	380	 3% 86% 5% 9%

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6204 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Alanine racemase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	360	2827	1819	479	518	3	8	0	0	0
1	B	345	2721	1748	461	501	3	8	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MSE	-	expression tag	UNP Q04HB7
A	1	SER	-	expression tag	UNP Q04HB7
A	2	LEU	-	expression tag	UNP Q04HB7
A	372	GLU	-	expression tag	UNP Q04HB7
A	373	GLY	-	expression tag	UNP Q04HB7
A	374	HIS	-	expression tag	UNP Q04HB7
A	375	HIS	-	expression tag	UNP Q04HB7
A	376	HIS	-	expression tag	UNP Q04HB7
A	377	HIS	-	expression tag	UNP Q04HB7
A	378	HIS	-	expression tag	UNP Q04HB7
A	379	HIS	-	expression tag	UNP Q04HB7
B	0	MSE	-	expression tag	UNP Q04HB7
B	1	SER	-	expression tag	UNP Q04HB7
B	2	LEU	-	expression tag	UNP Q04HB7
B	372	GLU	-	expression tag	UNP Q04HB7
B	373	GLY	-	expression tag	UNP Q04HB7
B	374	HIS	-	expression tag	UNP Q04HB7
B	375	HIS	-	expression tag	UNP Q04HB7
B	376	HIS	-	expression tag	UNP Q04HB7
B	377	HIS	-	expression tag	UNP Q04HB7
B	378	HIS	-	expression tag	UNP Q04HB7
B	379	HIS	-	expression tag	UNP Q04HB7

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: C<sub>8</sub>H<sub>10</sub>NO<sub>6</sub>P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	15	8	1	5	1	0	0
2	B	1	15	8	1	5	1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	319	319	319	0	0
3	B	307	307	307	0	0

### 3 Residue-property plots [i](#)


These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

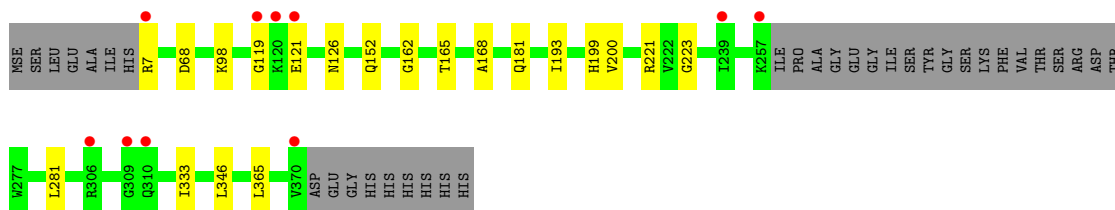
- Molecule 1: Alanine racemase

Chain A: 



- Molecule 1: Alanine racemase

Chain B: 



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	47.40Å 99.64Å 84.67Å 90.00° 103.26° 90.00°	Depositor
Resolution (Å)	38.08 – 1.70 38.08 – 1.70	Depositor EDS
% Data completeness (in resolution range)	96.3 (38.08-1.70) 96.5 (38.08-1.70)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.29 (at 1.70Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.247 , 0.259 0.200 , 0.218	Depositor DCC
$R_{free}$ test set	4092 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	13.4	Xtrriage
Anisotropy	0.344	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 42.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.021 for h,-k,-h-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6204	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	16.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.41% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PLP

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z  >5	RMSZ	# Z  >5
1	A	0.62	0/2882	0.72	1/3882 (0.0%)
1	B	0.61	0/2775	0.70	0/3739
All	All	0.61	0/5657	0.71	1/7621 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	118	LEU	N-CA-C	6.03	127.27	111.00

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2827	0	2852	7	0
1	B	2721	0	2728	12	0
2	A	15	0	7	1	0
2	B	15	0	7	0	0
3	A	319	0	0	0	0
3	B	307	0	0	2	0
All	All	6204	0	5594	18	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 2.

All (18) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:168:ALA:H	1:B:181:GLN:HE22	1.15	0.89
1:A:152:GLN:HE22	1:A:193:ILE:HD13	1.62	0.65
1:B:199:HIS:HD1	1:B:221:ARG:HH11	1.48	0.62
1:A:281:LEU:HD21	1:A:330:VAL:HG21	1.82	0.61
1:A:199:HIS:HD2	1:A:221:ARG:HD3	1.65	0.60
1:B:199:HIS:HD1	1:B:221:ARG:HD3	1.67	0.58
1:B:168:ALA:H	1:B:181:GLN:NE2	1.97	0.52
1:B:152:GLN:HE22	1:B:193:ILE:HD13	1.75	0.50
1:A:6:HIS:HD2	1:B:68:ASP:OD1	1.96	0.49
1:B:121:GLU:HG3	3:B:646:HOH:O	2.13	0.48
1:B:126:ASN:HD22	1:B:162:GLY:HA3	1.80	0.47
1:A:221:ARG:NE	2:A:401:PLP:N1	2.54	0.46
1:B:7:ARG:NH2	1:B:365:LEU:HD23	2.31	0.45
1:B:98:LYS:HG3	3:B:646:HOH:O	2.17	0.45
1:A:94:PRO:O	1:A:98:LYS:HG2	2.18	0.43
1:B:333:ILE:HD11	1:B:346:LEU:HD22	2.02	0.42
1:B:165:THR:HG22	1:B:200:VAL:HG12	2.02	0.41
1:A:294:GLN:O	1:A:349:HIS:HE1	2.04	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	356/380 (94%)	346 (97%)	10 (3%)	0	100	100
1	B	341/380 (90%)	330 (97%)	9 (3%)	2 (1%)	25	11
All	All	697/760 (92%)	676 (97%)	19 (3%)	2 (0%)	41	24



All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	119	GLY
1	B	223	GLY

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	305/315 (97%)	303 (99%)	2 (1%)	84	77
1	B	295/315 (94%)	294 (100%)	1 (0%)	92	89
All	All	600/630 (95%)	597 (100%)	3 (0%)	88	83

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	314	ASP
1	A	365	LEU
1	B	281	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	6	HIS
1	A	23	GLN
1	A	152	GLN
1	A	199	HIS
1	A	310	GLN
1	A	349	HIS
1	B	45	HIS
1	B	126	ASN
1	B	152	GLN
1	B	157	HIS
1	B	181	GLN
1	B	294	GLN

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Mol	Chain	Res	Type
1	B	310	GLN
1	B	349	HIS

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

### 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	PLP	B	401	1	15,15,16	2.66	9 (60%)	21,22,23	1.41	3 (14%)
2	PLP	A	401	1	15,15,16	2.64	9 (60%)	21,22,23	1.45	3 (14%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PLP	B	401	1	-	0/6/6/8	0/1/1/1
2	PLP	A	401	1	-	0/6/6/8	0/1/1/1

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	PLP	C2A-C2	4.16	1.57	1.50
2	B	401	PLP	C2-N1	4.12	1.41	1.33
2	A	401	PLP	C2A-C2	4.05	1.56	1.50
2	A	401	PLP	C2-N1	3.95	1.40	1.33
2	A	401	PLP	C5-C4	3.88	1.44	1.40
2	B	401	PLP	C4A-C4	3.76	1.59	1.51
2	A	401	PLP	C4A-C4	3.68	1.59	1.51
2	B	401	PLP	C5-C4	3.64	1.44	1.40
2	B	401	PLP	C6-N1	3.27	1.41	1.34
2	A	401	PLP	C5A-C5	3.11	1.59	1.50
2	B	401	PLP	C5A-C5	3.09	1.59	1.50
2	A	401	PLP	C6-N1	3.09	1.40	1.34
2	A	401	PLP	C3-C4	2.98	1.45	1.40
2	B	401	PLP	C3-C4	2.41	1.44	1.40
2	B	401	PLP	C3-C2	2.21	1.43	1.41
2	A	401	PLP	P-O4P	2.11	1.67	1.60
2	A	401	PLP	C3-C2	2.07	1.43	1.41
2	B	401	PLP	P-O4P	2.06	1.66	1.60

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	PLP	O2P-P-O4P	3.33	115.34	106.67
2	B	401	PLP	O4P-C5A-C5	-3.29	103.18	109.36
2	A	401	PLP	O4P-C5A-C5	-3.28	103.21	109.36
2	B	401	PLP	O2P-P-O4P	3.24	115.11	106.67
2	A	401	PLP	C5A-C5-C6	-2.27	115.66	119.36
2	B	401	PLP	C5A-C5-C6	-2.03	116.05	119.36

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	PLP	1	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	352/380 (92%)	0.11	5 (1%) 75 79	5, 13, 26, 36	0
1	B	337/380 (88%)	0.18	10 (2%) 50 54	7, 14, 26, 31	0
All	All	689/760 (90%)	0.15	15 (2%) 62 66	5, 14, 26, 36	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	119	GLY	6.9
1	B	306	ARG	3.6
1	A	180	ARG	3.3
1	B	120	LYS	3.0
1	A	370	VAL	2.7
1	A	118	LEU	2.6
1	B	7	ARG	2.5
1	B	309	GLY	2.5
1	B	257	LYS	2.5
1	B	370	VAL	2.5
1	B	119	GLY	2.4
1	B	121	GLU	2.4
1	B	239	ILE	2.1
1	B	310	GLN	2.1
1	A	240	ASP	2.0

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
2	PLP	A	401	15/16	0.95	0.12	10,23,26,26	0
2	PLP	B	401	15/16	0.96	0.14	10,16,18,18	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.