



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 17, 2017 – 08:22 AM EDT

PDB ID : 3DFH  
Title : crystal structure of putative mandelate racemase / muconate lactonizing enzyme from Vibrionales bacterium SWAT-3  
Authors : Malashkevich, V.N.; Toro, R.; Wasserman, S.R.; Meyer, A.J.; Sauder, J.M.; Burley, S.K.; Almo, S.C.; New York SGX Research Center for Structural Genomics (NYSGXRC)  
Deposited on : unknown  
Resolution : 2.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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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
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20030345
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20030345

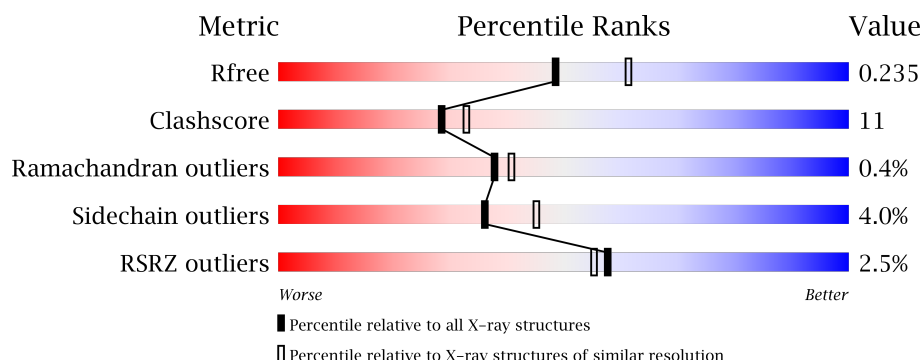
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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))
$R_{free}$	100719	4002 (2.20-2.20)
Clashscore	112137	4730 (2.20-2.20)
Ramachandran outliers	110173	4656 (2.20-2.20)
Sidechain outliers	110143	4657 (2.20-2.20)
RSRZ outliers	101464	4033 (2.20-2.20)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	394	<div> <div>0.1%</div> <div> <div></div> <div>75%</div> <div>14%</div> <div>• 9%</div> </div> </div>
1	B	394	<div> <div>2%</div> <div> <div></div> <div>72%</div> <div>16%</div> <div>• 9%</div> </div> </div>
1	C	394	<div> <div>4%</div> <div> <div></div> <div>74%</div> <div>15%</div> <div>• 9%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 8955 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 mandelate racemase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	359	Total	C	N	O	S	0	1	0
			2863	1825	494	528	16			
1	B	359	Total	C	N	O	S	0	0	0
			2857	1821	494	526	16			
1	C	359	Total	C	N	O	S	0	0	0
			2857	1821	494	526	16			

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP A5KUH4
A	2	SER	-	expression tag	UNP A5KUH4
A	3	LEU	-	expression tag	UNP A5KUH4
A	388	GLY	-	expression tag	UNP A5KUH4
A	389	HIS	-	expression tag	UNP A5KUH4
A	390	HIS	-	expression tag	UNP A5KUH4
A	391	HIS	-	expression tag	UNP A5KUH4
A	392	HIS	-	expression tag	UNP A5KUH4
A	393	HIS	-	expression tag	UNP A5KUH4
A	394	HIS	-	expression tag	UNP A5KUH4
B	1	MET	-	expression tag	UNP A5KUH4
B	2	SER	-	expression tag	UNP A5KUH4
B	3	LEU	-	expression tag	UNP A5KUH4
B	388	GLY	-	expression tag	UNP A5KUH4
B	389	HIS	-	expression tag	UNP A5KUH4
B	390	HIS	-	expression tag	UNP A5KUH4
B	391	HIS	-	expression tag	UNP A5KUH4
B	392	HIS	-	expression tag	UNP A5KUH4
B	393	HIS	-	expression tag	UNP A5KUH4
B	394	HIS	-	expression tag	UNP A5KUH4
C	1	MET	-	expression tag	UNP A5KUH4
C	2	SER	-	expression tag	UNP A5KUH4
C	3	LEU	-	expression tag	UNP A5KUH4

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Chain	Residue	Modelled	Actual	Comment	Reference
C	388	GLY	-	expression tag	UNP A5KUH4
C	389	HIS	-	expression tag	UNP A5KUH4
C	390	HIS	-	expression tag	UNP A5KUH4
C	391	HIS	-	expression tag	UNP A5KUH4
C	392	HIS	-	expression tag	UNP A5KUH4
C	393	HIS	-	expression tag	UNP A5KUH4
C	394	HIS	-	expression tag	UNP A5KUH4

- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Na 1 1	0	0
2	A	1	Total Na 1 1	0	0
2	C	1	Total Na 1 1	0	0

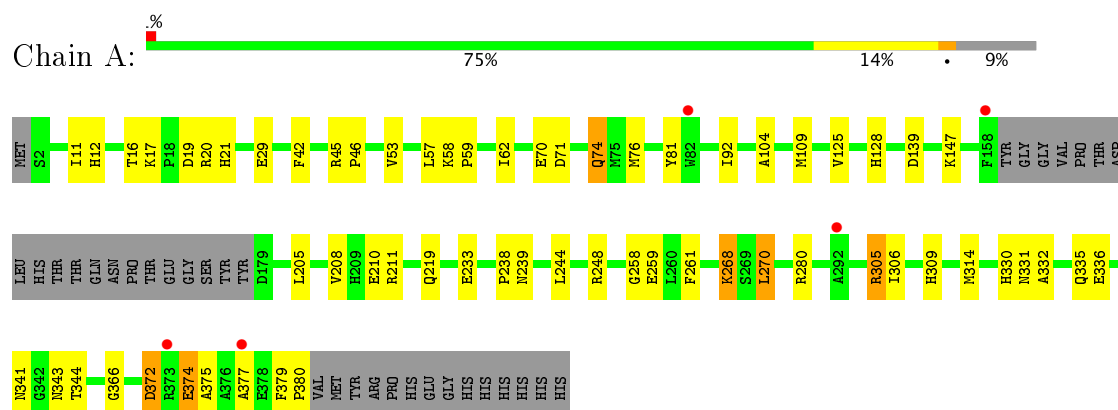
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	135	Total O 135 135	0	0
3	B	113	Total O 113 113	0	0
3	C	127	Total O 127 127	0	0

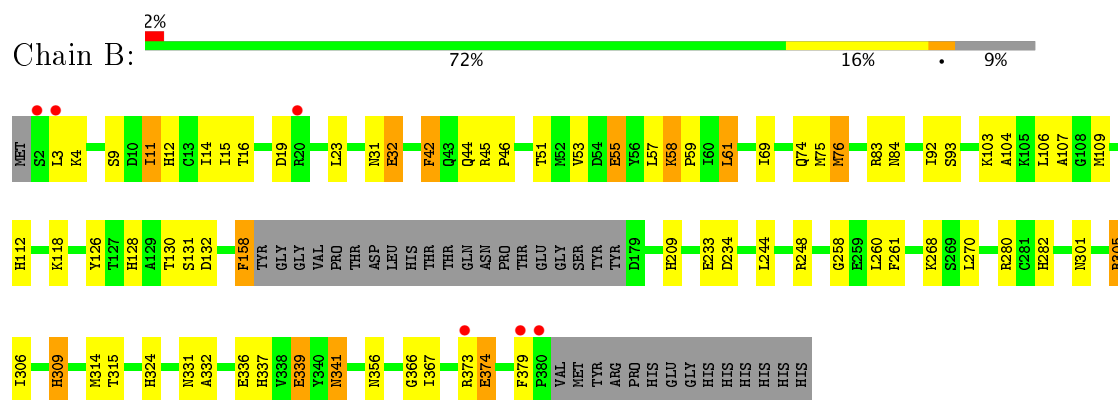
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

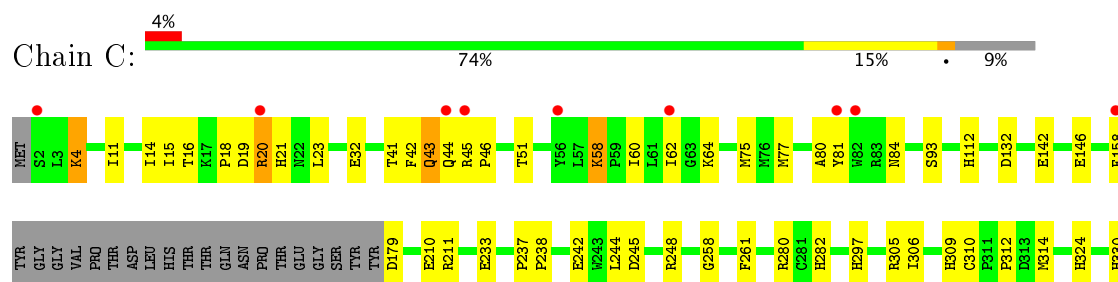
- Molecule 1: mandelate racemase

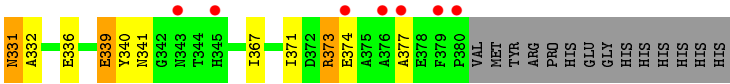


- Molecule 1: mandelate racemase



- Molecule 1: mandelate racemase





## 4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	121.84Å 121.84Å 319.35Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.59 – 2.20 41.59 – 2.20	Depositor EDS
% Data completeness (in resolution range)	100.0 (41.59-2.20) 99.7 (41.59-2.20)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	96.18 (at 2.20Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.173 , 0.234 0.173 , 0.235	Depositor DCC
$R_{free}$ test set	3113 reflections (5.36%)	DCC
Wilson B-factor (Å <sup>2</sup> )	33.3	Xtriage
Anisotropy	0.076	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 45.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	8955	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.00% 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 ⓘ

### 5.1 Standard geometry ⓘ

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

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	0.81	0/2937	0.87	8/3988 (0.2%)
1	B	0.84	0/2928	0.89	9/3976 (0.2%)
1	C	0.86	1/2928 (0.0%)	0.85	8/3976 (0.2%)
All	All	0.84	1/8793 (0.0%)	0.87	25/11940 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	242	GLU	CB-CG	5.52	1.62	1.52

The worst 5 of 25 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	314	MET	CG-SD-CE	-13.34	78.85	100.20
1	C	305	ARG	NE-CZ-NH2	-10.85	114.88	120.30
1	B	305	ARG	NE-CZ-NH2	-10.29	115.15	120.30
1	C	280	ARG	NE-CZ-NH2	9.36	124.98	120.30
1	A	305	ARG	NE-CZ-NH2	-8.61	116.00	120.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts ⓘ

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	2863	0	2798	53	0
1	B	2857	0	2792	75	0
1	C	2857	0	2792	60	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
3	A	135	0	0	6	0
3	B	113	0	0	6	0
3	C	127	0	0	3	0
All	All	8955	0	8382	186	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 11.

The worst 5 of 186 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:57:LEU:HD13	1:B:76:MET:CE	1.54	1.37
1:A:11:ILE:O	1:A:58:LYS:HE2	1.29	1.30
1:A:19:ASP:HB2	1:A:341:ASN:ND2	1.53	1.23
1:B:19:ASP:CG	1:B:341:ASN:HD21	1.41	1.22
1:A:57:LEU:HD13	1:A:76:MET:CE	1.80	1.11

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	356/394 (90%)	346 (97%)	9 (2%)	1 (0%)	44	49
1	B	355/394 (90%)	346 (98%)	7 (2%)	2 (1%)	28	29
1	C	355/394 (90%)	342 (96%)	12 (3%)	1 (0%)	44	49

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	1066/1182 (90%)	1034 (97%)	28 (3%)	4 (0%)	38 41

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	341	ASN
1	A	81	TYR
1	B	84	ASN
1	C	84	ASN

### 5.3.2 Protein sidechains ⓘ

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	309/339 (91%)	300 (97%)	9 (3%)	48 60
1	B	308/339 (91%)	291 (94%)	17 (6%)	25 29
1	C	308/339 (91%)	297 (96%)	11 (4%)	40 50
All	All	925/1017 (91%)	888 (96%)	37 (4%)	36 45

5 of 37 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	74	GLN
1	B	158	PHE
1	C	331	ASN
1	B	93	SER
1	B	131	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 39 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	309	HIS
1	B	331	ASN

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Mol	Chain	Res	Type
1	C	326	ASN
1	B	324	HIS
1	B	326	ASN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 3 ligands modelled in this entry, 3 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

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	359/394 (91%)	-0.08	5 (1%) 75 73	13, 22, 42, 56	0
1	B	359/394 (91%)	-0.14	6 (1%) 70 68	13, 22, 41, 61	0
1	C	359/394 (91%)	-0.08	16 (4%) 34 32	13, 22, 46, 61	0
All	All	1077/1182 (91%)	-0.10	27 (2%) 58 55	13, 22, 43, 61	0

The worst 5 of 27 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	81	TYR	5.8
1	B	379	PHE	4.8
1	C	2	SER	4.7
1	A	158	PHE	3.7
1	C	377	ALA	3.6

### 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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	NA	B	503	1/1	0.88	0.36	-	37,37,37,37	1
2	NA	A	502	1/1	0.99	0.15	-	19,19,19,19	1
2	NA	C	501	1/1	0.87	0.17	-	16,16,16,16	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.