



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 02:03 AM UTC

PDB ID : 9GWU / pdb_00009gwu
Title : Crystal structure of sulfoquinovose-1-dehydrogenase from Pseudomonas Putida (sulfo-ED pathway)
Authors : Sharma, M.; Davies, G.J.
Deposited on : 2024-09-27
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

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>.

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

MolProbity : 4-5-2 with Phenix2.0
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

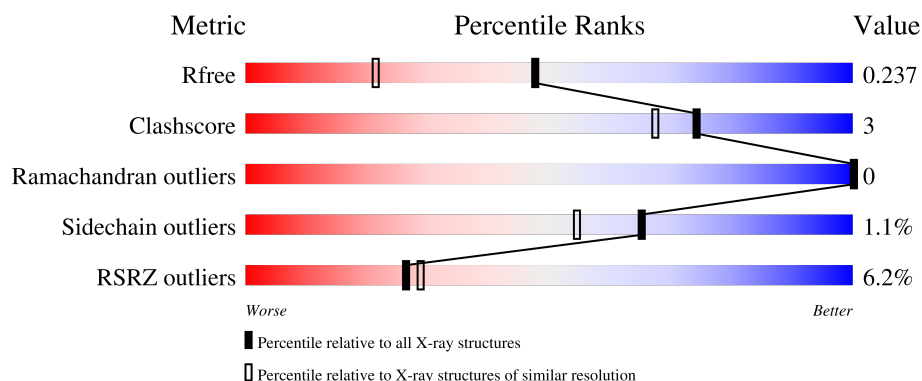
1 Overall quality at a glance

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}	180053	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (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 ≥ 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	273	
1	B	273	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3978 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 Sulfoquinovose 1-dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	260	Total	C	N	O	S	0	1	0
			1892	1177	347	356	12			
1	A	259	Total	C	N	O	S	0	1	0
			1907	1185	347	362	13			

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-12	MET	-	initiating methionine	UNP P0DOV5
B	-11	GLY	-	expression tag	UNP P0DOV5
B	-10	SER	-	expression tag	UNP P0DOV5
B	-9	SER	-	expression tag	UNP P0DOV5
B	-8	HIS	-	expression tag	UNP P0DOV5
B	-7	HIS	-	expression tag	UNP P0DOV5
B	-6	HIS	-	expression tag	UNP P0DOV5
B	-5	HIS	-	expression tag	UNP P0DOV5
B	-4	HIS	-	expression tag	UNP P0DOV5
B	-3	HIS	-	expression tag	UNP P0DOV5
B	-2	SER	-	expression tag	UNP P0DOV5
B	-1	SER	-	expression tag	UNP P0DOV5
B	0	GLY	-	expression tag	UNP P0DOV5
A	-12	MET	-	initiating methionine	UNP P0DOV5
A	-11	GLY	-	expression tag	UNP P0DOV5
A	-10	SER	-	expression tag	UNP P0DOV5
A	-9	SER	-	expression tag	UNP P0DOV5
A	-8	HIS	-	expression tag	UNP P0DOV5
A	-7	HIS	-	expression tag	UNP P0DOV5
A	-6	HIS	-	expression tag	UNP P0DOV5
A	-5	HIS	-	expression tag	UNP P0DOV5
A	-4	HIS	-	expression tag	UNP P0DOV5
A	-3	HIS	-	expression tag	UNP P0DOV5
A	-2	SER	-	expression tag	UNP P0DOV5
A	-1	SER	-	expression tag	UNP P0DOV5

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Chain	Residue	Modelled	Actual	Comment	Reference
A	0	GLY	-	expression tag	UNP P0DOV5

- Molecule 2 is water.

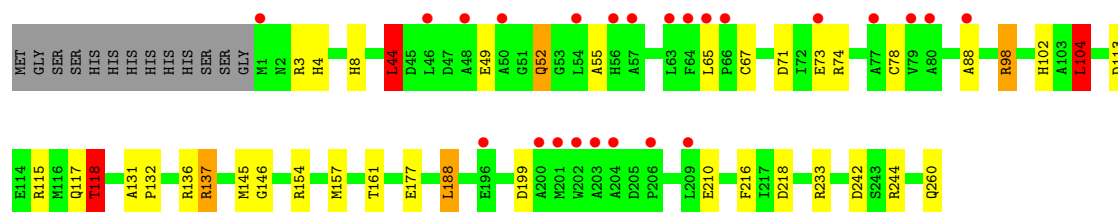
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	76	Total O 76 76	0	0
2	A	103	Total O 103 103	0	0

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.

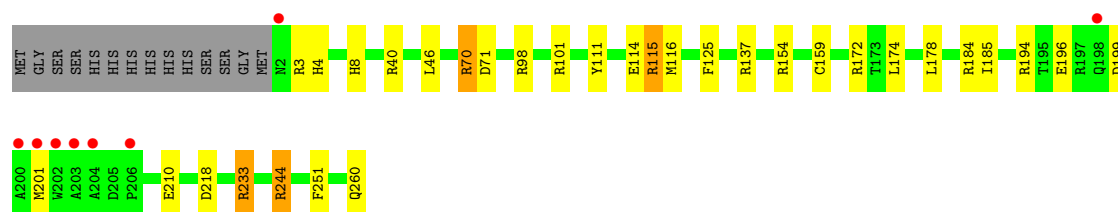
• Molecule 1: Sulfoquinovose 1-dehydrogenase

Chain B: 



• Molecule 1: Sulfoquinovose 1-dehydrogenase

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	I 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	82.73Å 57.29Å 91.27Å 90.00° 93.40° 90.00°	Depositor
Resolution (Å)	63.07 – 1.70 63.07 – 1.70	Depositor EDS
% Data completeness (in resolution range)	99.2 (63.07-1.70) 99.1 (63.07-1.70)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.34 (at 1.70Å)	Xtriage
Refinement program	REFMAC 5.8.0430	Depositor
R, R_{free}	0.195 , 0.237 0.195 , 0.237	Depositor DCC
R_{free} test set	2396 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å ²)	21.8	Xtriage
Anisotropy	0.626	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 34.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3978	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.33% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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

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	1.02	0/1941	1.55	22/2630 (0.8%)
1	B	1.04	3/1926 (0.2%)	1.60	28/2612 (1.1%)
All	All	1.03	3/3867 (0.1%)	1.57	50/5242 (1.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	4
1	B	0	3
All	All	0	7

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	74	ARG	CA-CB	5.96	1.62	1.53
1	B	102	HIS	CE1-NE2	5.74	1.38	1.32
1	B	244	ARG	NE-CZ	5.12	1.38	1.33

All (50) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	73	GLU	CB-CA-C	11.91	129.87	110.81
1	A	199	ASP	CA-CB-CG	8.53	121.13	112.60
1	B	177	GLU	CG-CD-OE2	-8.38	99.12	118.40
1	A	101	ARG	CB-CA-C	8.24	123.74	109.65
1	B	199	ASP	CA-CB-CG	7.89	120.49	112.60
1	B	74	ARG	N-CA-CB	7.81	121.71	110.16
1	B	177	GLU	CG-CD-OE1	7.48	135.60	118.40
1	A	218	ASP	CA-CB-CG	7.31	119.91	112.60
1	B	49	GLU	CB-CG-CD	-7.28	100.22	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	260	GLN	CB-CA-C	-7.14	96.54	110.10
1	B	98	ARG	CG-CD-NE	-7.07	96.45	112.00
1	B	71	ASP	CA-CB-CG	7.00	119.60	112.60
1	B	44	LEU	N-CA-CB	-6.97	99.47	110.69
1	B	3	ARG	CA-CB-CG	6.77	127.64	114.10
1	B	74	ARG	N-CA-C	-6.69	104.07	111.36
1	A	201	MET	CG-SD-CE	6.62	115.47	100.90
1	B	137	ARG	CD-NE-CZ	6.58	133.61	124.40
1	B	4	HIS	CA-CB-CG	-6.41	107.39	113.80
1	A	251	PHE	CA-CB-CG	-6.30	107.50	113.80
1	A	184	ARG	CD-NE-CZ	-6.22	115.69	124.40
1	B	52	GLN	CB-CA-C	6.19	121.06	110.79
1	A	260	GLN	CB-CA-C	-6.04	98.63	110.10
1	A	196	GLU	CB-CA-C	5.94	120.78	110.68
1	A	4	HIS	CA-CB-CG	-5.93	107.87	113.80
1	B	216	PHE	N-CA-CB	5.88	118.77	110.12
1	B	104	LEU	N-CA-CB	-5.85	101.29	110.06
1	B	177	GLU	CB-CA-C	-5.82	99.86	110.63
1	B	210	GLU	CB-CA-C	5.73	120.30	110.79
1	A	98	ARG	CB-CA-C	5.62	119.13	110.14
1	B	146	GLY	N-CA-C	-5.61	106.06	112.79
1	A	71	ASP	CA-CB-CG	5.59	118.19	112.60
1	B	118	THR	N-CA-CB	-5.58	101.70	110.30
1	A	46	LEU	N-CA-CB	-5.50	101.75	110.28
1	B	102	HIS	CB-CG-CD2	-5.45	124.11	131.20
1	B	177	GLU	CB-CG-CD	5.44	121.86	112.60
1	A	8	HIS	CA-CB-CG	-5.35	108.45	113.80
1	A	3	ARG	CB-CA-C	5.31	120.35	109.67
1	A	172	ARG	CA-CB-CG	-5.31	103.48	114.10
1	B	8	HIS	CA-CB-CG	-5.30	108.50	113.80
1	A	210	GLU	CB-CA-C	5.29	119.85	110.85
1	A	70	ARG	NE-CZ-NH1	-5.23	116.27	121.50
1	A	125	PHE	N-CA-CB	5.19	118.33	110.28
1	B	188	LEU	CA-C-N	-5.18	117.55	123.25
1	B	188	LEU	C-N-CA	-5.18	117.55	123.25
1	A	125	PHE	CA-CB-CG	-5.14	108.66	113.80
1	A	244	ARG	CA-CB-CG	-5.13	103.84	114.10
1	A	3	ARG	N-CA-CB	-5.10	102.68	110.33
1	A	194	ARG	CD-NE-CZ	5.03	131.45	124.40
1	B	98	ARG	N-CA-CB	-5.03	102.88	110.77
1	B	137	ARG	CG-CD-NE	-5.01	100.97	112.00

There are no chirality outliers.

All (7) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	137	ARG	Sidechain
1	A	233	ARG	Sidechain
1	A	244	ARG	Sidechain
1	A	40	ARG	Sidechain
1	B	115	ARG	Sidechain
1	B	136	ARG	Sidechain
1	B	233	ARG	Sidechain

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	1907	0	1849	7	0
1	B	1892	0	1824	17	0
2	A	103	0	0	0	0
2	B	76	0	0	4	0
All	All	3978	0	3673	23	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 3.

All (23) 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:218:ASP:HB2	2:B:371:HOH:O	2.05	0.56
1:A:116:MET:HE1	1:A:159:CYS:O	2.08	0.54
1:B:218:ASP:CB	2:B:371:HOH:O	2.58	0.51
1:B:242:ASP:HA	1:A:233:ARG:HD3	1.94	0.49
1:B:52:GLN:O	2:B:301:HOH:O	2.20	0.48
1:B:55:ALA:HB1	2:B:306:HOH:O	2.13	0.48
1:B:67:CYS:HB2	1:B:78:CYS:SG	2.54	0.48
1:B:113:ASP:O	1:B:117:GLN:HG3	2.16	0.46
1:B:98:ARG:HB2	1:B:118:THR:HG21	1.98	0.45
1:B:88:ALA:HB3	1:B:137:ARG:NH2	2.33	0.44
1:A:174:LEU:HD23	1:A:174:LEU:HA	1.84	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:157:MET:HG3	1:B:161:THR:HG23	1.98	0.44
1:B:188:LEU:HD23	1:B:188:LEU:C	2.43	0.44
1:B:145:MET:HE3	1:B:145:MET:HB3	1.88	0.44
1:B:154:ARG:HD2	1:B:154:ARG:HA	1.81	0.43
1:A:178:LEU:HD12	1:A:185:ILE:HD11	2.01	0.42
1:B:131:ALA:HB3	1:B:132:PRO:HD3	2.02	0.42
1:A:111:TYR:CE2	1:A:115:ARG:HG3	2.56	0.41
1:B:44:LEU:HD12	1:B:65:LEU:HB2	2.02	0.41
1:B:104:LEU:C	1:B:104:LEU:HD23	2.45	0.41
1:A:70:ARG:CZ	1:A:114:GLU:HG2	2.50	0.41
1:A:154:ARG:HA	1:A:154:ARG:HD2	1.83	0.41
1:B:98:ARG:HB2	1:B:118:THR:CG2	2.51	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	258/273 (94%)	249 (96%)	9 (4%)	0	100	100
1	B	259/273 (95%)	250 (96%)	9 (4%)	0	100	100
All	All	517/546 (95%)	499 (96%)	18 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	186/205 (91%)	185 (100%)	1 (0%)	81	76
1	B	180/205 (88%)	177 (98%)	3 (2%)	53	38
All	All	366/410 (89%)	362 (99%)	4 (1%)	65	54

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	44	LEU
1	B	104	LEU
1	B	118	THR
1	A	115	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

There are no ligands in this entry.

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

6.1 Protein, DNA and RNA chains

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, 95th 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 ²)	Q<0.9
1	A	259/273 (94%)	-0.03	8 (3%) 51 55	11, 26, 48, 86	1 (0%)
1	B	260/273 (95%)	0.45	24 (9%) 14 15	11, 32, 62, 102	1 (0%)
All	All	519/546 (95%)	0.21	32 (6%) 26 29	11, 29, 58, 102	2 (0%)

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	202	TRP	4.6
1	B	203	ALA	3.7
1	B	200	ALA	3.4
1	B	73	GLU	3.2
1	B	65	LEU	3.0
1	A	202	TRP	3.0
1	B	64	PHE	2.7
1	B	1	MET	2.7
1	A	2	ASN	2.6
1	B	77	ALA	2.6
1	B	54	LEU	2.6
1	A	201	MET	2.6
1	A	206	PRO	2.6
1	B	46	LEU	2.5
1	B	56	HIS	2.4
1	B	209	LEU	2.4
1	A	200	ALA	2.4
1	B	206	PRO	2.3
1	A	198	GLN	2.3
1	B	66	PRO	2.3
1	B	50	ALA	2.3
1	B	79	VAL	2.3
1	B	48	ALA	2.2
1	B	57	ALA	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	203	ALA	2.2
1	A	204	ALA	2.2
1	B	80	ALA	2.2
1	B	201	MET	2.1
1	B	204	ALA	2.1
1	B	88	ALA	2.1
1	B	196	GLU	2.1
1	B	63	LEU	2.1

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.