



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 09:42 AM UTC

PDB ID : 1XBZ / pdb_00001xbz
Title : Crystal structure of 3-keto-L-gulonate 6-phosphate decarboxylase E112D/R139V/T169A mutant with bound L-xylulose 5-phosphate
Authors : Wise, E.L.; Yew, W.S.; Akana, J.; Gerlt, J.A.; Rayment, I.
Deposited on : 2004-08-31
Resolution : 1.80 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
Mogul : 2022.3.0, CSD as543be (2022)
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

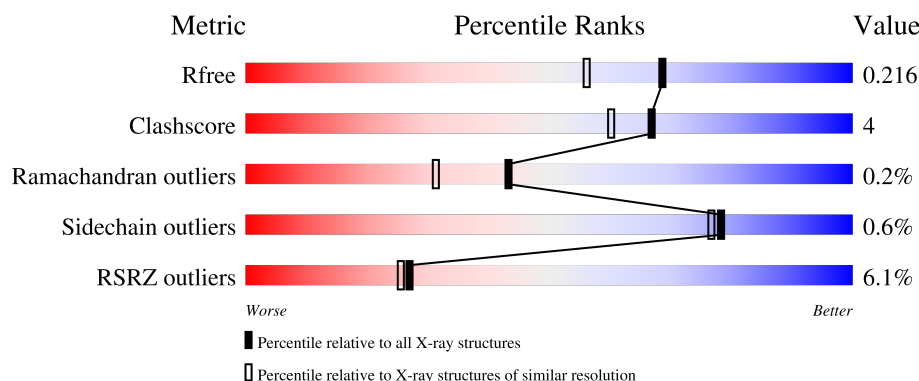
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	216	5% 87% 10%
1	B	216	7% 92% 7%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3645 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.

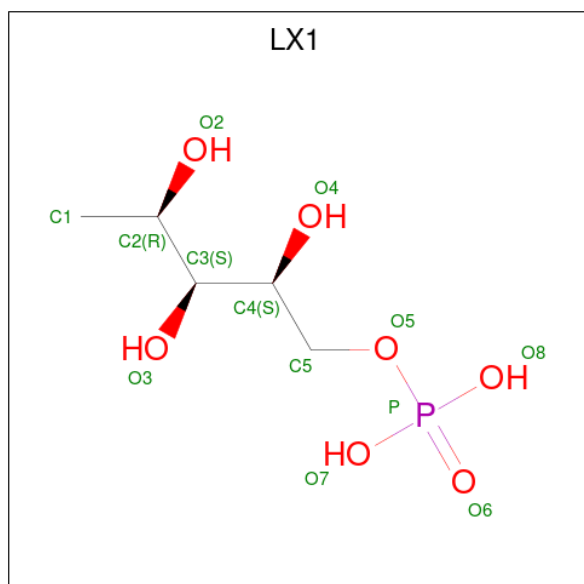
- Molecule 1 is a protein called 3-Keto-L-Gulonate 6-Phosphate Decarboxylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	210	Total	C	N	O	S	0	0	0
			1609	1024	278	299	8			
1	B	216	Total	C	N	O	S	0	0	0
			1630	1035	284	303	8			

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Mg	0	0
			2	2		

- Molecule 3 is L-XYLULOSE 5-PHOSPHATE (CCD ID: LX1) (formula: C₅H₁₃O₇P).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			13	5	7	1		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total	C	O	P	0	0
			13	5	7	1		

- Molecule 4 is water.

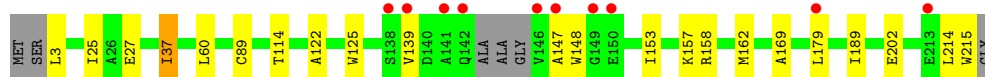
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	169	Total	O	0	0
			169	169		
4	B	209	Total	O	0	0
			209	209		

3 Residue-property plots [i](#)

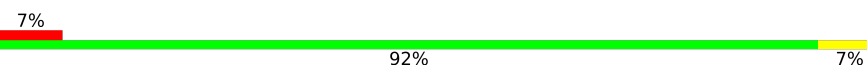
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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.

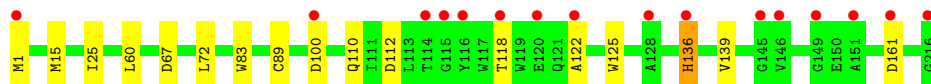
- Molecule 1: 3-Keto-L-Gulonate 6-Phosphate Decarboxylase

Chain A: 



- Molecule 1: 3-Keto-L-Gulonate 6-Phosphate Decarboxylase

Chain B: 



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	123.78Å 41.44Å 91.01Å 90.00° 96.72° 90.00°	Depositor
Resolution (Å)	91.29 – 1.80 90.39 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.5 (91.29-1.80) 99.5 (90.39-1.80)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	8.16 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.168 , 0.210 (Not available) , 0.216	Depositor DCC
R_{free} test set	2157 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	17.2	Xtriage
Anisotropy	0.684	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 45.7	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	3645	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.03% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: MG, LX1

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	0.86	1/1637 (0.1%)	0.88	0/2222
1	B	1.13	3/1658 (0.2%)	0.95	1/2253 (0.0%)
All	All	1.00	4/3295 (0.1%)	0.92	1/4475 (0.0%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	1	MET	C-N	22.59	1.63	1.33
1	A	37	ILE	CA-CB	6.84	1.62	1.54
1	B	118	THR	C-N	5.86	1.42	1.34
1	B	15	MET	SD-CE	-5.04	1.67	1.79

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	25	ILE	N-CA-C	5.09	117.11	112.43

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	1609	0	1601	15	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	1630	0	1629	12	0
2	A	2	0	0	0	0
3	A	13	0	9	0	0
3	B	13	0	11	1	0
4	A	169	0	0	5	0
4	B	209	0	0	4	0
All	All	3645	0	3250	24	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 4.

All (24) 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:100:ASP:HB3	4:B:597:HOH:O	1.71	0.90
1:A:139:VAL:HA	4:A:760:HOH:O	1.71	0.88
1:B:139:VAL:HB	4:B:707:HOH:O	1.79	0.82
1:A:37:ILE:HG12	4:A:657:HOH:O	1.81	0.79
1:A:3:LEU:N	4:A:748:HOH:O	2.24	0.69
1:B:161:ASP:OD2	4:B:708:HOH:O	2.11	0.66
1:A:27:GLU:OE2	4:A:767:HOH:O	2.13	0.65
1:A:122:ALA:HA	1:A:125:TRP:CE3	2.33	0.64
1:B:122:ALA:HA	1:B:125:TRP:CE3	2.38	0.58
1:B:60:LEU:HD12	1:B:83:TRP:HE3	1.71	0.55
1:A:153:ILE:HG22	1:A:157:LYS:HE2	1.93	0.50
1:B:60:LEU:HD11	1:B:110:GLN:NE2	2.27	0.50
1:A:89:CYS:HB3	1:B:89:CYS:HB3	1.96	0.48
1:A:202:GLU:HG3	4:A:701:HOH:O	2.13	0.48
1:B:136:HIS:NE2	3:B:502:LX1:H2	2.31	0.46
1:A:169:ALA:HB2	1:A:189:ILE:HD12	1.98	0.45
1:A:148:TRP:HB2	1:A:179:LEU:HD12	1.98	0.45
1:A:214:LEU:HB2	1:A:215:TRP:CE3	2.53	0.44
1:B:112:ASP:OD1	1:B:136:HIS:CE1	2.71	0.44
1:B:136:HIS:HD2	4:B:580:HOH:O	2.01	0.43
1:A:25:ILE:C	1:A:25:ILE:HD12	2.44	0.43
1:A:37:ILE:CD1	1:B:72:LEU:HG	2.50	0.41
1:A:158:ARG:O	1:A:162:MET:HG3	2.21	0.40
1:A:114:THR:HG21	1:B:67:ASP:HB3	2.04	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	206/216 (95%)	199 (97%)	6 (3%)	1 (0%)	24	14
1	B	214/216 (99%)	209 (98%)	5 (2%)	0	100	100
All	All	420/432 (97%)	408 (97%)	11 (3%)	1 (0%)	43	31

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	147	ALA

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	162/168 (96%)	161 (99%)	1 (1%)	78	77
1	B	163/168 (97%)	162 (99%)	1 (1%)	78	77
All	All	325/336 (97%)	323 (99%)	2 (1%)	78	77

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	60	LEU
1	B	136	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	13	GLN
1	A	124	GLN
1	A	206	GLN
1	B	7	GLN
1	B	93	ASN
1	B	110	GLN
1	B	123	GLN
1	B	186	HIS
1	B	206	GLN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

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	$\# Z > 2$
3	LX1	A	501	2	12,12,12	0.86	0	16,17,17	2.52	3 (18%)
3	LX1	B	502	-	12,12,12	0.89	0	16,17,17	2.32	5 (31%)

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
3	LX1	A	501	2	-	5/14/14/14	-
3	LX1	B	502	-	-	5/14/14/14	-

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	501	LX1	C4-C3-C2	-8.50	99.39	112.48
3	B	502	LX1	C4-C3-C2	-7.12	101.52	112.48
3	A	501	LX1	O2-C2-C3	2.87	114.53	109.77
3	B	502	LX1	C1-C2-C3	2.80	115.55	112.11
3	B	502	LX1	O2-C2-C3	2.75	114.33	109.77
3	B	502	LX1	O4-C4-C5	-2.16	105.23	109.99
3	B	502	LX1	O5-P-O6	-2.12	100.72	106.44
3	A	501	LX1	C1-C2-C3	2.09	114.67	112.11

There are no chirality outliers.

All (10) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	501	LX1	O2-C2-C3-O3
3	B	502	LX1	O2-C2-C3-O3
3	A	501	LX1	C1-C2-C3-O3
3	B	502	LX1	C1-C2-C3-O3
3	A	501	LX1	O2-C2-C3-C4
3	B	502	LX1	O2-C2-C3-C4
3	B	502	LX1	C4-C5-O5-P
3	A	501	LX1	C4-C5-O5-P
3	A	501	LX1	C1-C2-C3-C4
3	B	502	LX1	C1-C2-C3-C4

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	502	LX1	1	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	B	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	1:MET	C	2:SER	N	1.63

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	210/216 (97%)	0.29	10 (4%) 35 34	11, 22, 45, 62	0
1	B	216/216 (100%)	0.17	16 (7%) 20 19	10, 18, 37, 42	0
All	All	426/432 (98%)	0.23	26 (6%) 27 25	10, 20, 39, 62	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	149	GLY	6.0
1	A	138	SER	5.0
1	B	116	TYR	4.9
1	A	139	VAL	4.9
1	B	145	GLY	4.5
1	A	146	VAL	4.0
1	A	141	ALA	3.5
1	A	147	ALA	3.1
1	B	128	ALA	3.0
1	B	118	THR	3.0
1	B	146	VAL	2.8
1	A	150	GLU	2.7
1	B	1	MET	2.6
1	B	122	ALA	2.6
1	A	142	GLN	2.6
1	B	151	ALA	2.5
1	B	114	THR	2.5
1	A	179	LEU	2.4
1	B	136	HIS	2.4
1	B	100	ASP	2.2
1	A	213	GLU	2.2
1	B	149	GLY	2.2
1	B	161	ASP	2.2
1	B	115	GLY	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	216	GLY	2.1
1	B	120	GLU	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](#)

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, 95th 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($\text{\AA}^2$)	Q<0.9
3	LX1	A	501	13/13	0.97	0.06	15,17,19,20	0
3	LX1	B	502	13/13	0.97	0.07	12,15,19,21	0
2	MG	A	601	1/1	0.98	0.33	15,15,15,15	0
2	MG	A	602	1/1	0.98	0.33	15,15,15,15	0

6.5 Other polymers [i](#)

There are no such residues in this entry.