Full wwPDB X-ray Structure Validation Report (i)

Jun 15, 2020 – 10:25 pm BST

PDB ID	:	1RCQ
Title	:	The 1.45 A crystal structure of alanine racemase from a pathogenic bacterium, Pseudomonas aeruginosa, contains both internal and external aldimine forms
Authors	:	Le Magueres, P.; Im, H.; Dvorak, A.; Strych, U.; Benedik, M.; Krause, K.L.
Deposited on	:	2003-11-04
Resolution	:	1.45 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 (i) symbol.

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

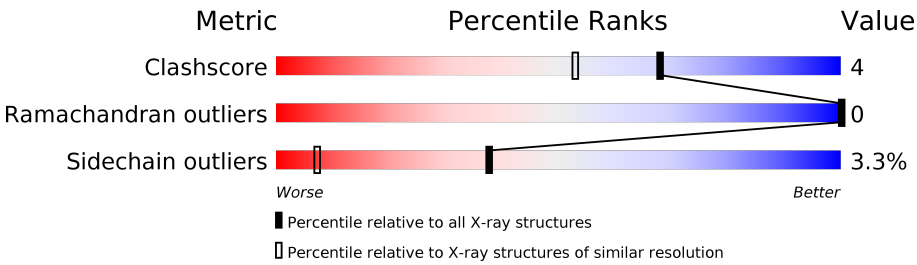
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.45 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))
Clashscore	141614	1202 (1.46-1.46)
Ramachandran outliers	138981	1178 (1.46-1.46)
Sidechain outliers	138945	1178 (1.46-1.46)

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 >=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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	357	89% 8% •

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	DLY	A	359	-	-	X	-

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 3099 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.

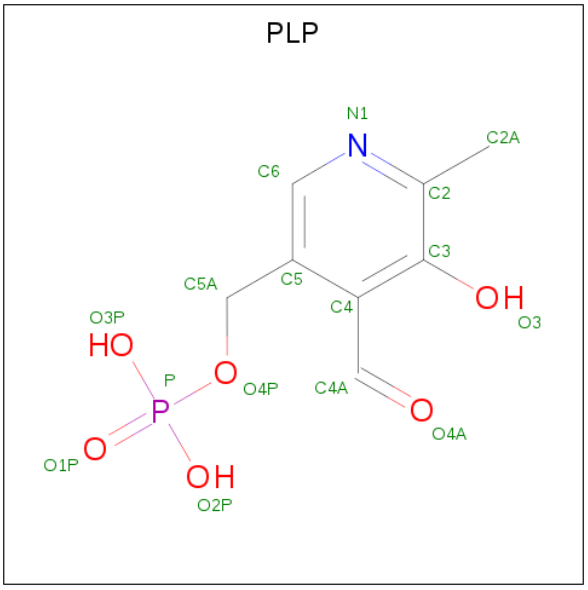
- Molecule 1 is a protein called catabolic alanine racemase DadX.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	357	2753	1741	504	493	15	0	0	0

There is a discrepancy between the modelled and reference sequences:

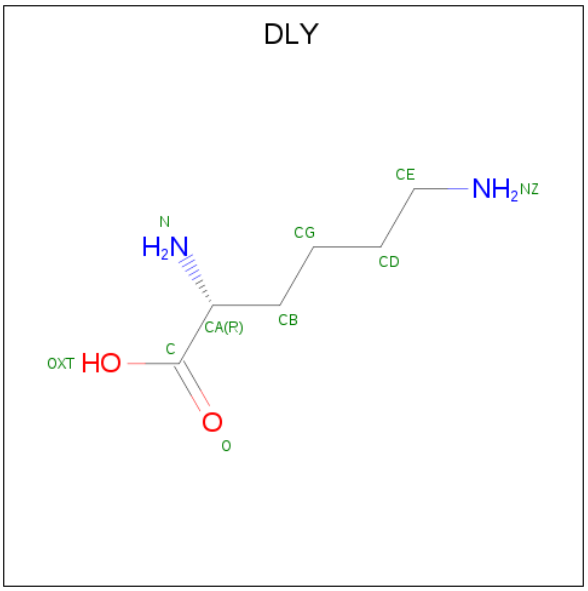
Chain	Residue	Modelled	Actual	Comment	Reference
A	122	KCX	LYS	MODIFIED RESIDUE	UNP Q9HTQ2

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula: $C_8H_{10}NO_6P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	30	16	2	10	2	0	1

- Molecule 3 is D-LYSINE (three-letter code: DLY) (formula: $C_6H_{14}N_2O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	10	6	2	2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	306	306	306	0	0

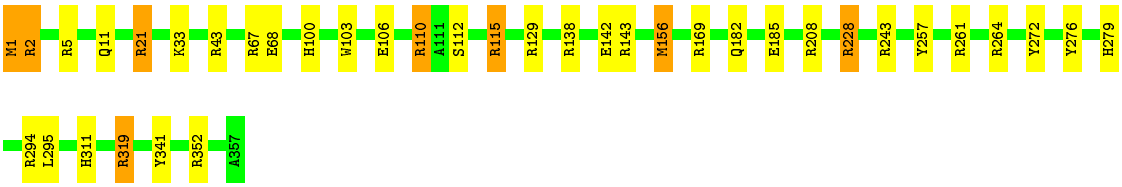
3 Residue-property plots (i)

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. 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. 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.

Note EDS was not executed.

- Molecule 1: catabolic alanine racemase DadX

Chain A:



4 Data and refinement statistics (i)

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	72.68Å 76.13Å 136.27Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 1.45	Depositor
% Data completeness (in resolution range)	(Not available) (30.00-1.45)	Depositor
R_{merge}	0.03	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	SHELXL-97	Depositor
R, R_{free}	0.149 , 0.206	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3099	wwPDB-VP
Average B, all atoms (Å^2)	22.0	wwPDB-VP

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: DLY, KCX, 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	0.49	0/2803	1.30	26/3800 (0.7%)

There are no bond length outliers.

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	208	ARG	NE-CZ-NH1	14.60	127.60	120.30
1	A	341	TYR	CB-CG-CD1	10.61	127.37	121.00
1	A	243	ARG	NE-CZ-NH2	-9.19	115.71	120.30
1	A	115	ARG	CD-NE-CZ	8.60	135.64	123.60
1	A	352	ARG	NE-CZ-NH2	8.27	124.43	120.30
1	A	67	ARG	NE-CZ-NH1	8.04	124.32	120.30
1	A	21	ARG	NE-CZ-NH1	-8.00	116.30	120.30
1	A	208	ARG	NE-CZ-NH2	-7.72	116.44	120.30
1	A	261	ARG	NE-CZ-NH2	-7.57	116.51	120.30
1	A	5	ARG	NE-CZ-NH1	7.42	124.01	120.30
1	A	294	ARG	NE-CZ-NH1	7.21	123.91	120.30
1	A	21	ARG	CD-NE-CZ	-7.08	113.69	123.60
1	A	115	ARG	NE-CZ-NH2	-7.08	116.76	120.30
1	A	264	ARG	NE-CZ-NH2	-7.03	116.78	120.30
1	A	319	ARG	NE-CZ-NH2	-6.52	117.04	120.30
1	A	2	ARG	NE-CZ-NH1	6.40	123.50	120.30
1	A	143	ARG	NE-CZ-NH2	6.33	123.46	120.30
1	A	169	ARG	NE-CZ-NH1	-6.20	117.20	120.30
1	A	21	ARG	NE-CZ-NH2	6.13	123.37	120.30
1	A	257	TYR	CB-CG-CD1	-5.99	117.41	121.00
1	A	68	GLU	OE1-CD-OE2	-5.88	116.25	123.30
1	A	228	ARG	CD-NE-CZ	5.76	131.67	123.60
1	A	43	ARG	NE-CZ-NH2	-5.66	117.47	120.30
1	A	156	MET	CA-CB-CG	5.45	122.57	113.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	264	ARG	NE-CZ-NH1	5.36	122.98	120.30
1	A	67	ARG	NE-CZ-NH2	-5.02	117.79	120.30

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	2753	0	2746	17	0
2	A	30	0	12	3	0
3	A	10	0	11	7	0
4	A	306	0	0	6	0
All	All	3099	0	2769	20	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 (20) 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)
2:A:358[A]:PLP:C4A	3:A:359:DLY:NZ	2.14	1.09
1:A:129:ARG:HH22	3:A:359:DLY:H	1.41	0.69
1:A:319:ARG:HG3	4:A:826:HOH:O	1.99	0.62
1:A:228:ARG:HG2	1:A:228:ARG:HH11	1.70	0.56
1:A:272:TYR:HA	1:A:276:TYR:O	2.07	0.55
1:A:106:GLU:O	1:A:110:ARG:HG3	2.08	0.53
1:A:33:LYS:NZ	3:A:359:DLY:HA	2.24	0.53
1:A:311:HIS:HD2	4:A:591:HOH:O	1.92	0.52
1:A:33:LYS:NZ	2:A:358[B]:PLP:C4	2.50	0.50
1:A:100:HIS:HE1	4:A:589:HOH:O	1.94	0.50
1:A:129:ARG:HH12	3:A:359:DLY:CA	2.24	0.49
2:A:358[B]:PLP:O3	3:A:359:DLY:N	2.48	0.47
1:A:138:ARG:O	1:A:142:GLU:HG3	2.15	0.46
1:A:279:HIS:HD2	4:A:505:HOH:O	1.99	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:103:TRP:HZ2	4:A:725:HOH:O	2.01	0.44
1:A:110:ARG:HB2	1:A:110:ARG:CZ	2.50	0.42
1:A:21:ARG:NH2	4:A:714:HOH:O	2.49	0.41
3:A:359:DLY:NZ	3:A:359:DLY:N	2.69	0.41
1:A:1:MET:HG3	1:A:2:ARG:N	2.35	0.40
1:A:129:ARG:NH2	3:A:359:DLY:H	2.13	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	354/357 (99%)	347 (98%)	7 (2%)	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	276/276 (100%)	267 (97%)	9 (3%)	38 7

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	11	GLN
1	A	110	ARG
1	A	112	SER
1	A	115	ARG
1	A	156	MET
1	A	182	GLN
1	A	185	GLU
1	A	295	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	100	HIS
1	A	158	HIS
1	A	279	HIS
1	A	311	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)

1 non-standard protein/DNA/RNA residue is 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	$\#\|Z\| > 2$
1	KCX	A	122	1	7,11,12	0.53	0	4,12,14	1.18	0

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
1	KCX	A	122	1	-	1/7/10/12	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	122	KCX	CG-CD-CE-NZ

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no carbohydrates in this entry.

5.6 Ligand geometry (i)

3 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	A	358[B]	1,3	15,15,16	1.15	1 (6%)	20,22,23	1.14	2 (10%)
2	PLP	A	358[A]	1	15,15,16	1.18	1 (6%)	20,22,23	1.30	1 (5%)

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	A	358[B]	1,3	-	0/6/6/8	0/1/1/1
2	PLP	A	358[A]	1	-	0/6/6/8	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	358[A]	PLP	C3-C2	-2.79	1.38	1.40
2	A	358[B]	PLP	C3-C2	-2.59	1.38	1.40

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	358[A]	PLP	C4A-C4-C5	-3.32	117.52	120.94
2	A	358[B]	PLP	C4A-C4-C5	-2.35	118.51	120.94
2	A	358[B]	PLP	C2A-C2-N1	2.06	121.70	117.67

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	358[B]	PLP	2	0
2	A	358[A]	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)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates (i)

EDS was not executed - this section is therefore empty.

6.4 Ligands (i)

EDS was not executed - this section is therefore empty.

6.5 Other polymers (i)

EDS was not executed - this section is therefore empty.