



wwPDB X-ray Structure Validation Summary Report ⓘ

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PDB ID : 4AIR
Title : Leishmania major cysteine synthase
Authors : Fyfe, P.K.; Westrop, G.D.; Coombs, G.H.; Hunter, W.N.
Deposited on : 2012-02-13
Resolution : 1.80 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

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 : 4.02b-467
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.32.1
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) : 2.32.1

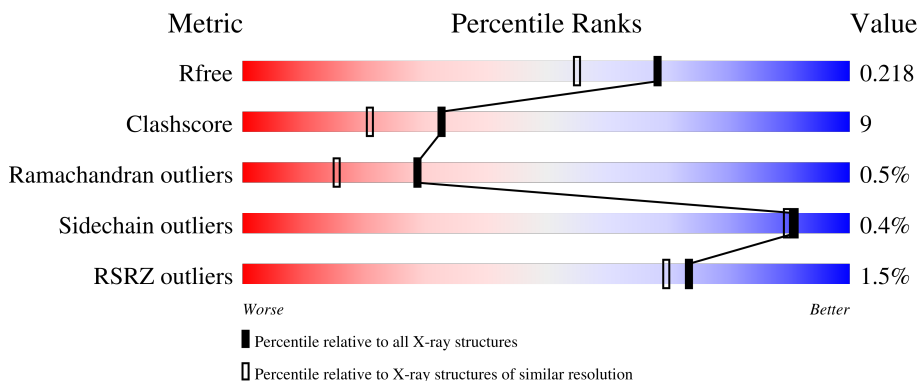
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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}	130704	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (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	354	 2% 75% 10% 14%
1	B	354	 1% 77% 7% 14%
2	C	5	 60% 40%
3	D	4	 100%

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 5915 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 Cysteine synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	304	2578	1615	443	503	17	0	38	0
1	B	304	2562	1603	447	494	18	0	36	0

There are 42 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	initiating methionine	UNP Q4Q159
A	-19	GLY	-	expression tag	UNP Q4Q159
A	-18	SER	-	expression tag	UNP Q4Q159
A	-17	SER	-	expression tag	UNP Q4Q159
A	-16	HIS	-	expression tag	UNP Q4Q159
A	-15	HIS	-	expression tag	UNP Q4Q159
A	-14	HIS	-	expression tag	UNP Q4Q159
A	-13	HIS	-	expression tag	UNP Q4Q159
A	-12	HIS	-	expression tag	UNP Q4Q159
A	-11	HIS	-	expression tag	UNP Q4Q159
A	-10	SER	-	expression tag	UNP Q4Q159
A	-9	SER	-	expression tag	UNP Q4Q159
A	-8	GLY	-	expression tag	UNP Q4Q159
A	-7	GLU	-	expression tag	UNP Q4Q159
A	-6	ASN	-	expression tag	UNP Q4Q159
A	-5	LEU	-	expression tag	UNP Q4Q159
A	-4	TYR	-	expression tag	UNP Q4Q159
A	-3	PHE	-	expression tag	UNP Q4Q159
A	-2	GLN	-	expression tag	UNP Q4Q159
A	-1	GLY	-	expression tag	UNP Q4Q159
A	0	HIS	-	expression tag	UNP Q4Q159
B	-20	MET	-	initiating methionine	UNP Q4Q159
B	-19	GLY	-	expression tag	UNP Q4Q159
B	-18	SER	-	expression tag	UNP Q4Q159
B	-17	SER	-	expression tag	UNP Q4Q159

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-16	HIS	-	expression tag	UNP Q4Q159
B	-15	HIS	-	expression tag	UNP Q4Q159
B	-14	HIS	-	expression tag	UNP Q4Q159
B	-13	HIS	-	expression tag	UNP Q4Q159
B	-12	HIS	-	expression tag	UNP Q4Q159
B	-11	HIS	-	expression tag	UNP Q4Q159
B	-10	SER	-	expression tag	UNP Q4Q159
B	-9	SER	-	expression tag	UNP Q4Q159
B	-8	GLY	-	expression tag	UNP Q4Q159
B	-7	GLU	-	expression tag	UNP Q4Q159
B	-6	ASN	-	expression tag	UNP Q4Q159
B	-5	LEU	-	expression tag	UNP Q4Q159
B	-4	TYR	-	expression tag	UNP Q4Q159
B	-3	PHE	-	expression tag	UNP Q4Q159
B	-2	GLN	-	expression tag	UNP Q4Q159
B	-1	GLY	-	expression tag	UNP Q4Q159
B	0	HIS	-	expression tag	UNP Q4Q159

- Molecule 2 is a protein called FGA-FGA-FGA-FGA-FGA.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	5	46	25	5	16	0	0	0

- Molecule 3 is a protein called FGA-FGA-FGA-FGA.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	D	4	27	15	3	9	0	0	1

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cl		
4	A	1	1	1	0	0
4	B	1	1	1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	360	Total 360	O 360	0	0
5	B	340	Total 340	O 340	0	0

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	48.96Å 86.33Å 134.02Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	45.00 – 1.80 45.99 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.7 (45.00-1.80) 99.7 (45.99-1.80)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.45 (at 1.79Å)	Xtrriage
Refinement program	REFMAC 5.6.0119	Depositor
R, R_{free}	0.157 , 0.208 0.166 , 0.218	Depositor DCC
R_{free} test set	2713 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	18.2	Xtrriage
Anisotropy	0.198	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 45.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5915	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.47% 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

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

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	0.75	0/2611	0.74	2/3522 (0.1%)
1	B	0.71	0/2595	0.76	5/3494 (0.1%)
All	All	0.73	0/5206	0.75	7/7016 (0.1%)

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	B	0	1

There are no bond length outliers.

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	317	ARG	NE-CZ-NH2	-6.94	116.83	120.30
1	A	317	ARG	NE-CZ-NH1	5.31	122.96	120.30
1	B	317[A]	ARG	NE-CZ-NH2	-5.10	117.75	120.30
1	B	317[B]	ARG	NE-CZ-NH2	-5.10	117.75	120.30
1	B	317[A]	ARG	NE-CZ-NH1	5.07	122.83	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	187[A]	THR	Peptide

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	2578	0	2612	58	0
1	B	2562	0	2606	40	0
2	C	46	0	27	0	0
3	D	27	0	13	0	0
4	A	1	0	0	1	0
4	B	1	0	0	0	0
5	A	360	0	0	16	1
5	B	340	0	0	6	1
All	All	5915	0	5258	92	2

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 9.

The worst 5 of 92 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:A:64[B]:LYS:CE	5:A:2119:HOH:O	1.83	1.27
1:A:158:ASN:HD21	1:A:188[A]:GLY:HA2	0.99	1.14
1:B:186[B]:GLY:O	1:B:188[B]:GLY:N	1.79	1.13
5:A:2035:HOH:O	1:B:8[B]:SER:HA	1.51	1.08
1:B:158:ASN:ND2	1:B:189[B]:GLY:HA3	1.70	1.06

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:A:2067:HOH:O	5:A:2126:HOH:O[1_455]	2.16	0.04
5:B:2088:HOH:O	5:B:2253:HOH:O[3_545]	2.16	0.04

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	339/354 (96%)	326 (96%)	11 (3%)	2 (1%)	25	12
1	B	336/354 (95%)	321 (96%)	11 (3%)	4 (1%)	13	3
All	All	675/708 (95%)	647 (96%)	22 (3%)	6 (1%)	29	6

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	186[A]	GLY
1	A	186[B]	GLY
1	B	186[A]	GLY
1	B	186[B]	GLY
1	B	187[A]	THR

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	281/285 (99%)	279 (99%)	2 (1%)	84	81
1	B	279/285 (98%)	277 (99%)	2 (1%)	84	81
All	All	560/570 (98%)	556 (99%)	4 (1%)	91	81

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

Mol	Chain	Res	Type
1	A	187[A]	THR

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Mol	Chain	Res	Type
1	A	187[B]	THR
1	B	29[A]	LYS
1	B	29[B]	LYS

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

Mol	Chain	Res	Type
1	A	146	ASN
1	A	152	GLN
1	A	158	ASN
1	B	158	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

9 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
3	FGA	D	1330	3	5,6,9	0.75	0	4,7,11	1.07	0
2	FGA	C	1328	2	7,8,9	0.71	0	7,9,11	1.25	1 (14%)
2	FGA	C	1330	2	7,8,9	0.59	0	7,9,11	1.43	2 (28%)
3	FGA	D	1329	3	7,8,9	0.79	0	7,9,11	1.06	0
2	FGA	C	1331	2	8,9,9	1.02	0	10,11,11	1.02	0
3	FGA	D	1327	3	0,1,9	-	-	-	-	-
2	FGA	C	1329	2	7,8,9	0.80	0	7,9,11	1.26	0
2	FGA	C	1327	2	7,8,9	0.78	0	7,9,11	1.06	0
3	FGA	D	1328	3	7,8,9	0.89	0	7,9,11	0.87	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
3	FGA	D	1330	3	-	0/6/6/9	-
2	FGA	C	1328	2	-	0/7/8/9	-
2	FGA	C	1330	2	-	1/7/8/9	-
3	FGA	D	1329	3	-	0/7/8/9	-
2	FGA	C	1331	2	-	3/9/9/9	-
2	FGA	C	1329	2	-	0/7/8/9	-
2	FGA	C	1327	2	-	2/7/8/9	-
3	FGA	D	1328	3	-	2/7/8/9	-

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	1330	FGA	O-C-CA	-2.39	113.69	122.14
2	C	1330	FGA	OXT-C-CA	2.30	121.21	113.38
2	C	1328	FGA	OXT-C-CA	2.01	120.22	113.38

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	D	1328	FGA	O-C-CA-N
3	D	1328	FGA	OXT-C-CA-N
2	C	1331	FGA	CA-CB-CG-CD
2	C	1327	FGA	O-C-CA-CB
2	C	1327	FGA	OXT-C-CA-CB

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 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 [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, 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	304/354 (85%)	-0.41	7 (2%) 60 56	9, 17, 34, 69	0
1	B	304/354 (85%)	-0.53	2 (0%) 87 86	10, 17, 29, 58	0
2	C	0/5	-	-	-	-
3	D	0/4	-	-	-	-
All	All	608/717 (84%)	-0.47	9 (1%) 73 70	9, 17, 32, 69	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	3	ALA	4.3
1	A	333	ASP	4.0
1	A	145	PRO	2.7
1	A	188[A]	GLY	2.7
1	A	187[A]	THR	2.7

6.2 Non-standard residues in protein, DNA, RNA chains [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(Å ²)	Q<0.9
2	FGA	C	1327	9/10	0.81	0.21	40,52,61,62	0
3	FGA	D	1328	9/10	0.88	0.16	26,30,32,34	0
3	FGA	D	1329	9/10	0.88	0.16	28,35,40,40	0
3	FGA	D	1330	7/10	0.90	0.26	30,37,42,43	0
2	FGA	C	1331	10/10	0.93	0.16	18,21,43,45	0
2	FGA	C	1328	9/10	0.93	0.08	21,28,35,35	0
3	FGA	D	1327	2/10	0.94	0.13	20,20,20,27	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
2	FGA	C	1329	9/10	0.95	0.08	14,18,23,23	0
2	FGA	C	1330	9/10	0.96	0.07	15,16,17,17	0

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, 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(\AA^2)	Q<0.9
4	CL	B	1428	1/1	0.99	0.03	18,18,18,18	0
4	CL	A	1428	1/1	1.00	0.04	13,13,13,13	0

6.5 Other polymers [i](#)

There are no such residues in this entry.