



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 07:15 AM UTC

PDB ID : 1XJ5 / pdb_00001xj5
Title : X-RAY STRUCTURE OF SPERMIDINE SYNTHASE FROM ARABIDOPSIS THALIANA GENE AT1G23820
Authors : Wesenberg, G.E.; Smith, D.W.; Phillips Jr., G.N.; Bitto, E.; Bingman, C.A.; Allard, S.T.M.; Center for Eukaryotic Structural Genomics (CESG)
Deposited on : 2004-09-22
Resolution : 2.70 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	:	4-5-2 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

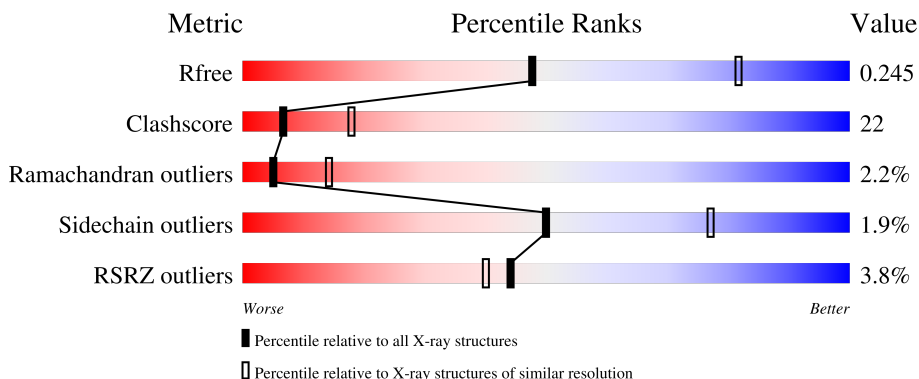
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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	334	 4% 46% 37% 13%
1	B	334	 2% 58% 25% 15%
1	C	334	 3% 52% 32% 13%
1	D	334	 4% 54% 28% 15%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 9440 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 Spermidine synthase 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	290	Total	C	N	O	S	Se	0	0	0
			2234	1433	361	426	7	7			
1	B	285	Total	C	N	O	S	Se	0	0	0
			2198	1417	354	412	8	7			
1	C	290	Total	C	N	O	S	Se	0	0	0
			2234	1433	361	426	7	7			
1	D	285	Total	C	N	O	S	Se	0	0	0
			2198	1417	354	412	8	7			

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	SER	-	cloning artifact	UNP Q9ZUB3
A	26	MSE	MET	modified residue	UNP Q9ZUB3
A	51	MSE	MET	modified residue	UNP Q9ZUB3
A	54	MSE	MET	modified residue	UNP Q9ZUB3
A	109	MSE	MET	modified residue	UNP Q9ZUB3
A	149	MSE	MET	modified residue	UNP Q9ZUB3
A	155	MSE	MET	modified residue	UNP Q9ZUB3
A	242	MSE	MET	modified residue	UNP Q9ZUB3
A	278	MSE	MET	modified residue	UNP Q9ZUB3
B	1	SER	-	cloning artifact	UNP Q9ZUB3
B	26	MSE	MET	modified residue	UNP Q9ZUB3
B	51	MSE	MET	modified residue	UNP Q9ZUB3
B	54	MSE	MET	modified residue	UNP Q9ZUB3
B	109	MSE	MET	modified residue	UNP Q9ZUB3
B	149	MSE	MET	modified residue	UNP Q9ZUB3
B	155	MSE	MET	modified residue	UNP Q9ZUB3
B	242	MSE	MET	modified residue	UNP Q9ZUB3
B	278	MSE	MET	modified residue	UNP Q9ZUB3
C	1	SER	-	cloning artifact	UNP Q9ZUB3
C	26	MSE	MET	modified residue	UNP Q9ZUB3
C	51	MSE	MET	modified residue	UNP Q9ZUB3

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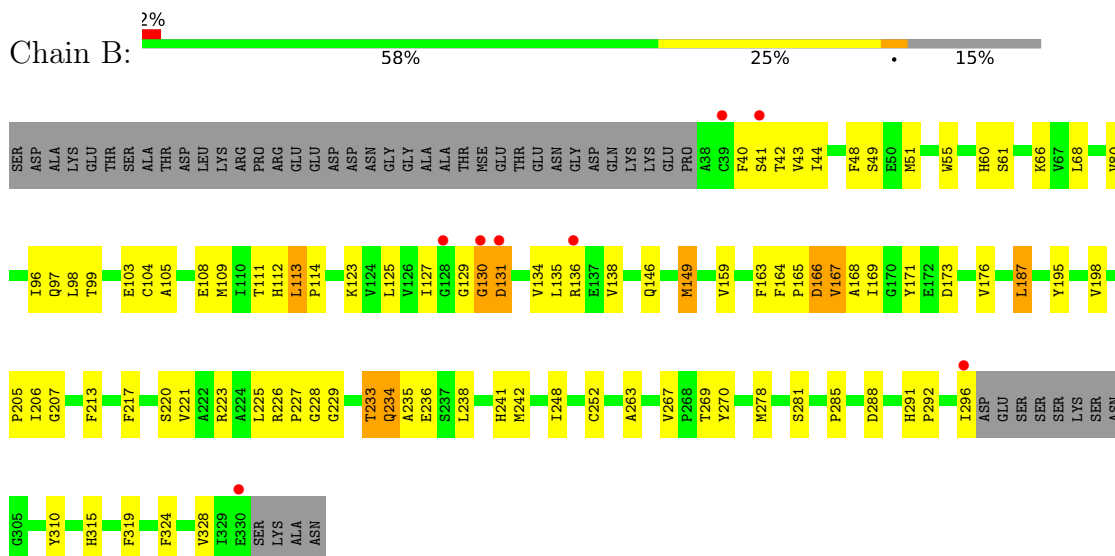
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Chain	Residue	Modelled	Actual	Comment	Reference
C	54	MSE	MET	modified residue	UNP Q9ZUB3
C	109	MSE	MET	modified residue	UNP Q9ZUB3
C	149	MSE	MET	modified residue	UNP Q9ZUB3
C	155	MSE	MET	modified residue	UNP Q9ZUB3
C	242	MSE	MET	modified residue	UNP Q9ZUB3
C	278	MSE	MET	modified residue	UNP Q9ZUB3
D	1	SER	-	cloning artifact	UNP Q9ZUB3
D	26	MSE	MET	modified residue	UNP Q9ZUB3
D	51	MSE	MET	modified residue	UNP Q9ZUB3
D	54	MSE	MET	modified residue	UNP Q9ZUB3
D	109	MSE	MET	modified residue	UNP Q9ZUB3
D	149	MSE	MET	modified residue	UNP Q9ZUB3
D	155	MSE	MET	modified residue	UNP Q9ZUB3
D	242	MSE	MET	modified residue	UNP Q9ZUB3
D	278	MSE	MET	modified residue	UNP Q9ZUB3

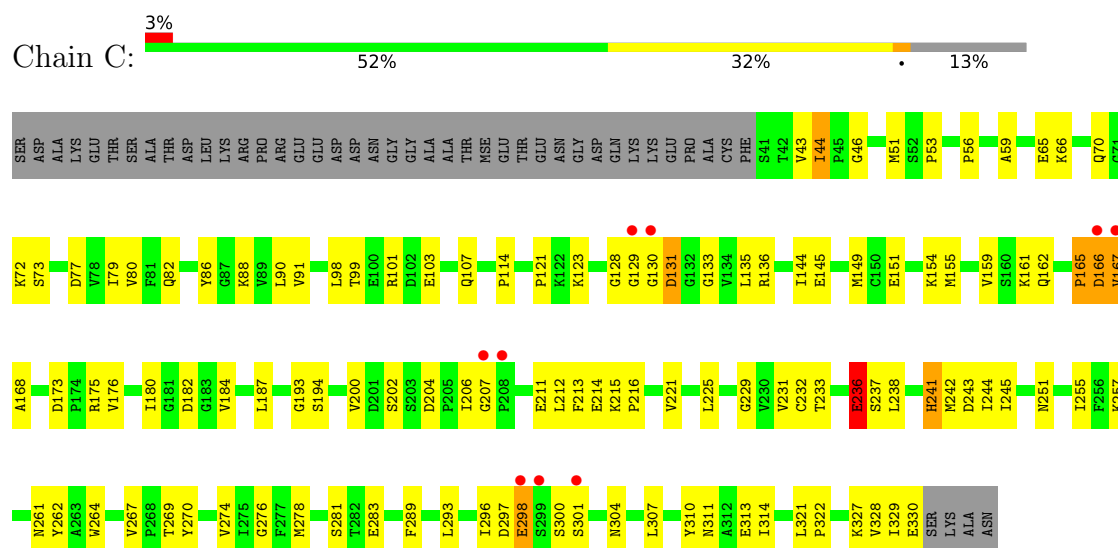
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	132	Total O 132 132	0	0
2	B	173	Total O 173 173	0	0
2	C	135	Total O 135 135	0	0
2	D	136	Total O 136 136	0	0

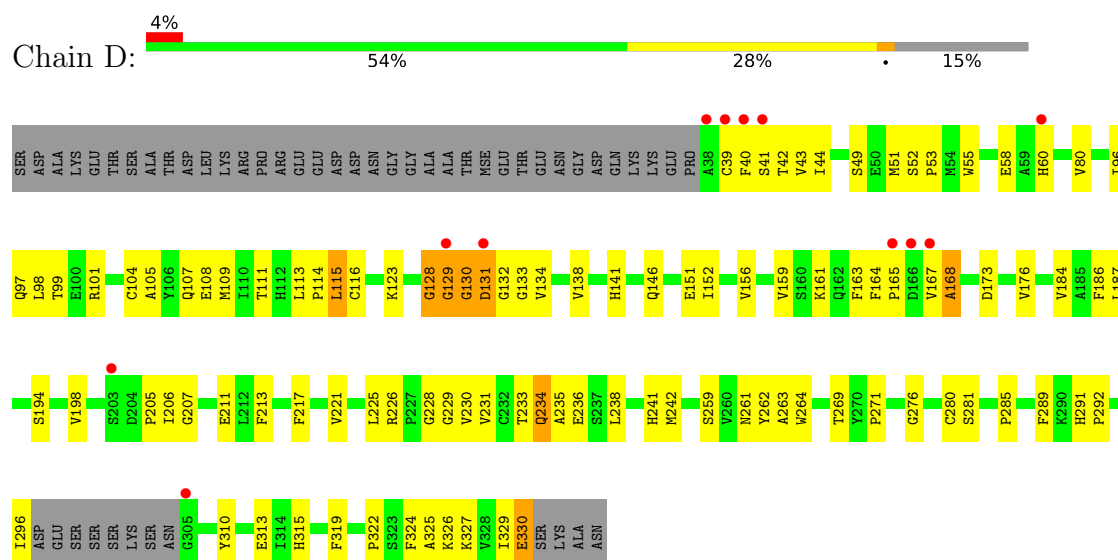
- Molecule 1: Spermidine synthase 1



- Molecule 1: Spermidine synthase 1



- Molecule 1: Spermidine synthase 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	88.81Å 95.21Å 89.16Å 90.00° 104.96° 90.00°	Depositor
Resolution (Å)	26.29 – 2.70 26.29 – 2.70	Depositor EDS
% Data completeness (in resolution range)	95.6 (26.29-2.70) 95.5 (26.29-2.70)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.37 (at 2.64Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.188 , 0.245 0.188 , 0.245	Depositor DCC
R_{free} test set	3788 reflections (9.55%)	wwPDB-VP
Wilson B-factor (Å ²)	36.7	Xtriage
Anisotropy	0.700	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 69.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.018 for l,-k,h	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	9440	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.07% 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](#)

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	0.45	0/2282	0.97	8/3089 (0.3%)
1	B	0.47	0/2246	1.02	9/3040 (0.3%)
1	C	0.44	0/2282	0.97	4/3089 (0.1%)
1	D	0.46	0/2246	1.01	8/3040 (0.3%)
All	All	0.45	0/9056	0.99	29/12258 (0.2%)

There are no bond length outliers.

The worst 5 of 29 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	168	ALA	N-CA-C	-7.53	103.35	112.54
1	A	55	TRP	CA-C-N	6.69	126.67	119.78
1	A	55	TRP	C-N-CA	6.69	126.67	119.78
1	C	44	ILE	N-CA-C	-6.69	101.01	107.76
1	B	328	VAL	N-CA-C	6.59	116.75	110.42

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	2234	0	2199	122	0
1	B	2198	0	2168	73	0
1	C	2234	0	2199	117	0
1	D	2198	0	2168	74	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	132	0	0	5	0
2	B	173	0	0	9	0
2	C	135	0	0	7	0
2	D	136	0	0	8	0
All	All	9440	0	8734	379	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 22.

The worst 5 of 379 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:C:135:LEU:HD22	1:C:149:MSE:HE2	1.45	0.98
1:A:238:LEU:HA	1:A:242:MSE:HE3	1.48	0.96
1:C:238:LEU:HA	1:C:242:MSE:HE3	1.50	0.94
1:A:236:GLU:HB3	1:A:241:HIS:CD2	2.11	0.84
1:A:135:LEU:HD22	1:A:149:MSE:HE2	1.61	0.82

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	288/334 (86%)	268 (93%)	14 (5%)	6 (2%)	5	15
1	B	281/334 (84%)	264 (94%)	11 (4%)	6 (2%)	5	15
1	C	288/334 (86%)	264 (92%)	16 (6%)	8 (3%)	4	9
1	D	281/334 (84%)	261 (93%)	15 (5%)	5 (2%)	6	18
All	All	1138/1336 (85%)	1057 (93%)	56 (5%)	25 (2%)	5	14

5 of 25 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	131	ASP
1	B	236	GLU
1	C	131	ASP
1	D	131	ASP
1	A	130	GLY

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	249/276 (90%)	244 (98%)	5 (2%)	48	76
1	B	243/276 (88%)	237 (98%)	6 (2%)	42	71
1	C	249/276 (90%)	247 (99%)	2 (1%)	73	88
1	D	243/276 (88%)	237 (98%)	6 (2%)	42	71
All	All	984/1104 (89%)	965 (98%)	19 (2%)	50	77

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	115	LEU
1	D	234	GLN
1	D	330	GLU
1	D	226	ARG
1	B	226	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	60	HIS
1	D	162	GLN
1	D	261	ASN
1	D	219	GLN
1	B	162	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](#)

There are no ligands in this entry.

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	283/334 (84%)	0.01	14 (4%) 35 31	20, 40, 97, 124	0
1	B	278/334 (83%)	-0.19	8 (2%) 53 50	15, 36, 79, 123	0
1	C	283/334 (84%)	-0.02	9 (3%) 50 46	18, 40, 93, 133	0
1	D	278/334 (83%)	-0.14	12 (4%) 40 36	14, 36, 81, 114	0
All	All	1122/1336 (83%)	-0.08	43 (3%) 44 40	14, 38, 85, 133	0

The worst 5 of 43 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	130	GLY	5.2
1	A	130	GLY	4.9
1	D	166	ASP	4.0
1	D	131	ASP	3.8
1	D	305	GLY	3.8

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.