



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 09:12 AM UTC

PDB ID : 8BEX / pdb_00008bex
Title : Structure of the Lysinibacillus sphaericus Tpp49Aa1 pesticidal protein at pH 3
Authors : Williamson, L.J.; Rizkallah, P.J.; Berry, C.; Oberthur, D.; Galchenkova, M.; Yefanov, O.; Bean, R.
Deposited on : 2022-10-22
Resolution : 1.78 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

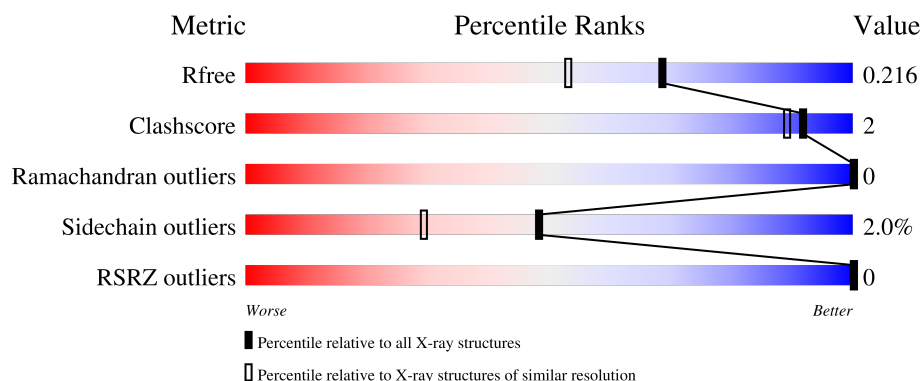
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.78 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	1365 (1.78-1.78)
Clashscore	190562	1395 (1.78-1.78)
Ramachandran outliers	187476	1382 (1.78-1.78)
Sidechain outliers	187428	1382 (1.78-1.78)
RSRZ outliers	180081	1365 (1.78-1.78)

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	416	
1	B	416	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 7234 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 Cry49Aa protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	416	Total	C	N	O	S	0	8	0
			3422	2152	617	642	11			
1	B	416	Total	C	N	O	S	0	10	0
			3445	2162	627	646	10			

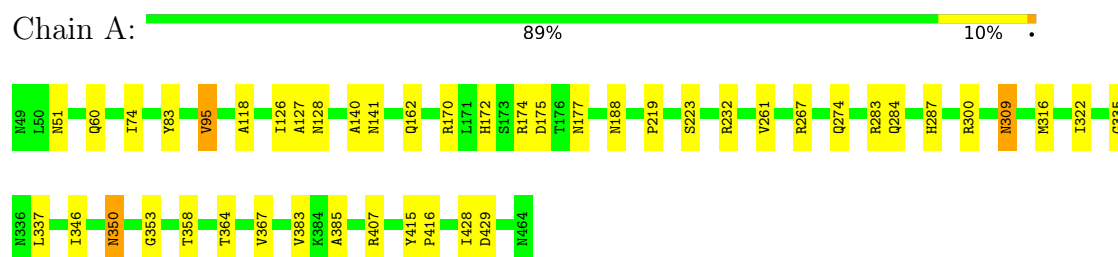
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	185	Total	O	0	0
			185	185		
2	B	182	Total	O	0	0
			182	182		

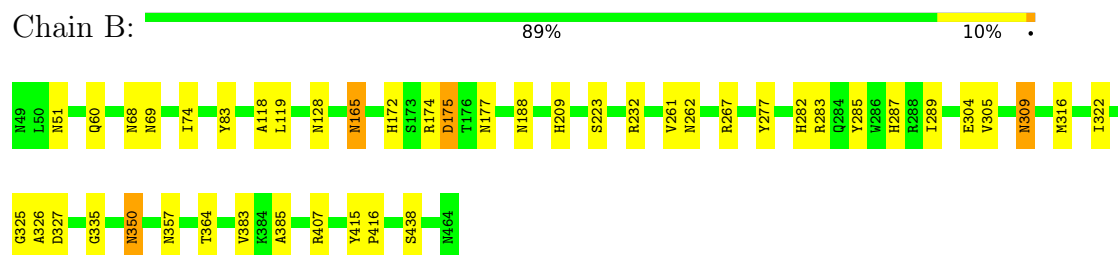
3 Residue-property plots [i](#)

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: Cry49Aa protein



- Molecule 1: Cry49Aa protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	79.89Å 82.84Å 157.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.01 – 1.78 36.01 – 1.78	Depositor EDS
% Data completeness (in resolution range)	99.4 (36.01-1.78) 99.4 (36.01-1.78)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.05 (at 1.57Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.189 , 0.213 0.194 , 0.216	Depositor DCC
R_{free} test set	5262 reflections (3.55%)	wwPDB-VP
Wilson B-factor (Å ²)	19.9	Xtriage
Anisotropy	0.421	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 25.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.166 for k,h,-l	Xtriage
F_o, F_c correlation	0.98	EDS
Total number of atoms	7234	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.63% 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	1.36	23/3520 (0.7%)	1.16	5/4783 (0.1%)
1	B	1.37	24/3539 (0.7%)	1.16	5/4810 (0.1%)
All	All	1.37	47/7059 (0.7%)	1.16	10/9593 (0.1%)

All (47) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	335	GLY	C-O	7.03	1.30	1.23
1	B	118	ALA	C-O	6.81	1.32	1.24
1	A	353	GLY	C-O	6.64	1.30	1.23
1	B	316	MET	C-O	6.41	1.31	1.24
1	B	383	VAL	C-O	6.39	1.31	1.23
1	B	261	VAL	C-O	6.37	1.31	1.23
1	A	309	ASN	C-O	6.16	1.31	1.23
1	A	316[A]	MET	C-O	6.16	1.31	1.24
1	A	316[B]	MET	C-O	6.16	1.31	1.24
1	A	287	HIS	CE1-NE2	6.12	1.38	1.32
1	B	287	HIS	CE1-NE2	5.99	1.38	1.32
1	A	322	ILE	C-O	5.98	1.29	1.24
1	B	335	GLY	C-O	5.91	1.29	1.23
1	B	287	HIS	C-O	5.77	1.30	1.24
1	A	283	ARG	C-O	5.68	1.31	1.23
1	B	304	GLU	C-O	5.67	1.30	1.24
1	B	188	ASN	C-O	5.66	1.31	1.24
1	B	385	ALA	C-O	5.65	1.30	1.24
1	A	350	ASN	C-O	5.54	1.30	1.23
1	A	287	HIS	C-O	5.49	1.30	1.24
1	B	305	VAL	C-O	5.42	1.30	1.24
1	B	68	ASN	C-O	5.39	1.30	1.24
1	A	407	ARG	C-O	5.38	1.30	1.24
1	A	383	VAL	C-O	5.35	1.30	1.23
1	A	337	LEU	C-O	5.35	1.30	1.24
1	A	385	ALA	C-O	5.34	1.30	1.24

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	127	ALA	C-O	5.32	1.30	1.24
1	A	118	ALA	C-O	5.31	1.30	1.24
1	B	285	TYR	C-O	5.30	1.30	1.23
1	A	364	THR	C-O	5.29	1.30	1.24
1	A	346	ILE	C-O	5.28	1.30	1.24
1	A	284	GLN	C-O	5.23	1.30	1.23
1	B	309	ASN	C-O	5.22	1.30	1.23
1	A	261	VAL	C-O	5.22	1.29	1.23
1	B	277	TYR	C-O	5.21	1.30	1.23
1	A	428	ILE	C-O	5.20	1.29	1.24
1	B	119	LEU	C-O	5.20	1.30	1.23
1	B	438	SER	C-O	5.16	1.30	1.23
1	B	326	ALA	C-O	5.14	1.30	1.24
1	B	350	ASN	C-O	5.10	1.30	1.23
1	B	282	HIS	C-O	5.06	1.30	1.24
1	A	126	ILE	C-O	5.05	1.29	1.24
1	B	364	THR	C-O	5.04	1.30	1.24
1	B	283	ARG	C-O	5.03	1.30	1.23
1	B	322	ILE	C-O	5.03	1.29	1.24
1	B	325	GLY	C-O	5.01	1.30	1.23
1	A	188	ASN	C-O	5.01	1.30	1.24

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	309	ASN	CB-CA-C	7.72	123.67	109.46
1	A	309	ASN	CB-CA-C	7.58	123.41	109.46
1	A	407	ARG	CG-CD-NE	-5.69	99.48	112.00
1	B	407	ARG	CG-CD-NE	-5.21	100.53	112.00
1	B	327	ASP	CA-CB-CG	5.20	117.80	112.60
1	A	83	TYR	CA-C-N	5.15	125.81	119.99
1	A	83	TYR	C-N-CA	5.15	125.81	119.99
1	A	274	GLN	CB-CG-CD	-5.04	104.04	112.60
1	B	83	TYR	CA-C-N	5.03	125.56	119.98
1	B	83	TYR	C-N-CA	5.03	125.56	119.98

There are no chirality outliers.

There are no planarity outliers.

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	3422	0	3327	12	1
1	B	3445	0	3349	11	1
2	A	185	0	0	1	0
2	B	182	0	0	4	0
All	All	7234	0	6676	21	1

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 2.

All (21) 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:357[A]:ASN:OD1	2:B:501:HOH:O	1.85	0.93
1:B:69[A]:ASN:OD1	2:B:502:HOH:O	1.89	0.89
1:B:262[B]:ASN:ND2	2:B:503:HOH:O	2.24	0.69
1:A:162[A]:GLN:OE1	1:A:170:ARG:HD3	2.01	0.60
1:B:174:ARG:O	1:B:175:ASP:OD1	2.22	0.58
1:A:51:ASN:HD21	1:B:350:ASN:HA	1.71	0.56
1:A:95:VAL:HG13	1:A:140:ALA:HB3	1.92	0.52
1:B:415:TYR:HA	1:B:416:PRO:C	2.36	0.49
1:A:415:TYR:HA	1:A:416:PRO:C	2.37	0.48
1:A:175:ASP:OD1	1:A:175:ASP:N	2.48	0.47
1:A:350:ASN:HA	1:B:51:ASN:HD21	1.82	0.44
1:A:95:VAL:HG21	1:A:141:ASN:HB2	1.99	0.44
1:B:172:HIS:NE2	1:B:177:ASN:HA	2.32	0.44
1:A:172:HIS:NE2	1:A:177:ASN:HA	2.33	0.44
1:A:219:PRO:HD3	2:A:546:HOH:O	2.19	0.43
1:B:209:HIS:CE1	2:B:663:HOH:O	2.72	0.42
1:A:74:ILE:HG13	1:A:128:ASN:CG	2.45	0.42
1:A:172:HIS:CE1	1:A:174:ARG:HA	2.55	0.41
1:B:74:ILE:HG13	1:B:128:ASN:CG	2.45	0.41
1:B:165:ASN:HD22	1:B:165:ASN:C	2.28	0.41
1:A:267:ARG:HA	1:A:267:ARG:HD3	1.95	0.41

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the sym-

metry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:429:ASP:O	1:B:267:ARG:NH2[4_445]	2.19	0.01

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	422/416 (101%)	415 (98%)	7 (2%)	0	100	100
1	B	424/416 (102%)	414 (98%)	10 (2%)	0	100	100
All	All	846/832 (102%)	829 (98%)	17 (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	379/371 (102%)	371 (98%)	8 (2%)	47	27
1	B	381/371 (103%)	374 (98%)	7 (2%)	51	33
All	All	760/742 (102%)	745 (98%)	15 (2%)	48	29

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	60	GLN

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Mol	Chain	Res	Type
1	A	95	VAL
1	A	223	SER
1	A	232	ARG
1	A	300	ARG
1	A	309	ASN
1	A	358	THR
1	A	367	VAL
1	B	60	GLN
1	B	165	ASN
1	B	175	ASP
1	B	223	SER
1	B	232	ARG
1	B	289	ILE
1	B	309	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (19) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	51	ASN
1	A	66	HIS
1	A	68	ASN
1	A	199	ASN
1	A	270	ASN
1	A	284	GLN
1	A	310	ASN
1	A	375	HIS
1	A	418	ASN
1	B	51	ASN
1	B	66	HIS
1	B	68	ASN
1	B	97	HIS
1	B	123	ASN
1	B	165	ASN
1	B	199	ASN
1	B	209	HIS
1	B	270	ASN
1	B	314	ASN

5.3.3 RNA ⓘ

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	416/416 (100%)	-1.37	0 100 100	11, 31, 60, 82	8 (1%)
1	B	416/416 (100%)	-1.32	0 100 100	10, 32, 66, 87	10 (2%)
All	All	832/832 (100%)	-1.35	0 100 100	10, 32, 63, 87	18 (2%)

There are no RSRZ outliers to report.

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.