W O R L D W I D E
wwPDB
P R O T E I N   D A T A   B A N K

Full wwPDB X-ray Structure Validation Report (i)

Jun 12, 2024 – 10:53 AM EDT

PDB ID	:	1VDH
Title	:	Structure-based functional identification of a novel heme-binding protein from thermus thermophilus HB8
Authors	:	Ebihara, A.; Okamoto, A.; Kousumi, Y.; Yamamoto, H.; Masui, R.; Ueyama, N.; Shibata, T.; Inoue, Y.; Yokoyama, S.; Kuramitsu, S.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)
Deposited on	:	2004-03-22
Resolution	:	2.00 Å(reported)

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

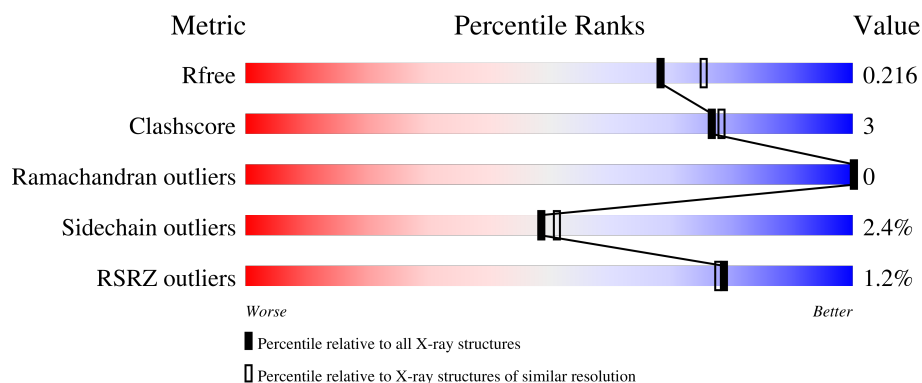|		
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 2.00 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	Percentile Ranks	Value
Rfree		0.216
Clashscore		3
Ramachandran outliers		0
Sidechain outliers		2.4%
RSRZ outliers		1.2%

Worse   *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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 <=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	249	92% 6% •
1	B	249	92% 8% •
1	C	249	2% 88% 10% ••
1	D	249	2% 90% 9% •
1	E	249	93% 5% ••

2 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 11168 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 muconolactone isomerase-like protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	247	Total	C	N	O	S	0	0	0
			2030	1307	350	367	6			
1	B	247	Total	C	N	O	S	0	0	0
			2030	1307	350	367	6			
1	C	247	Total	C	N	O	S	0	0	0
			2030	1307	350	367	6			
1	D	247	Total	C	N	O	S	0	0	0
			2030	1307	350	367	6			
1	E	247	Total	C	N	O	S	0	0	0
			2030	1307	350	367	6			

- Molecule 2 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	195	Total	O	0	0
			195	195		
2	B	233	Total	O	0	0
			233	233		
2	C	189	Total	O	0	0
			189	189		
2	D	184	Total	O	0	0
			184	184		
2	E	217	Total	O	0	0
			217	217		

3 Residue-property plots ⓘ

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: muconolactone isomerase-like protein
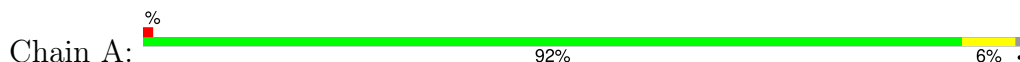
Chain A:

- Molecule 1: muconolactone isomerase-like protein

Chain B:

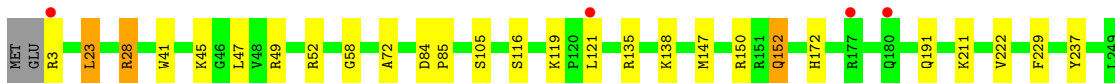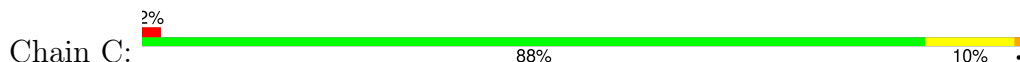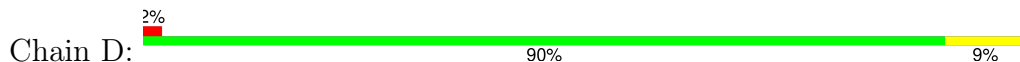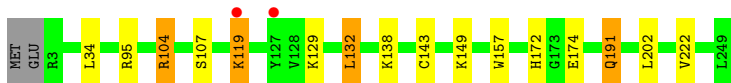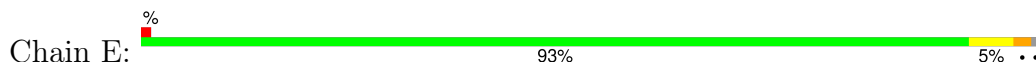- Molecule 1: muconolactone isomerase-like protein

Chain C:

- Molecule 1: muconolactone isomerase-like protein

Chain D:

- Molecule 1: muconolactone isomerase-like protein

Chain E:
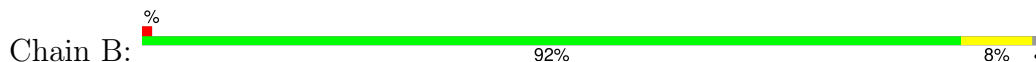
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	99.74Å 123.14Å 131.44Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.99 – 2.00 48.67 – 2.00	Depositor EDS
% Data completeness (in resolution range)	98.3 (19.99-2.00) 98.4 (48.67-2.00)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	7.13 (at 2.00Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.188 , 0.218 0.189 , 0.216	Depositor DCC
R_{free} test set	10795 reflections (10.02%)	wwPDB-VP
Wilson B-factor (Å^2)	13.9	Xtriage
Anisotropy	0.101	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 46.0	EDS
L-test for twinning[2]	$<|L|> = 0.50, <L^2> = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	11168	wwPDB-VP
Average B, all atoms (Å^2)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.91% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1] Intensities estimated from amplitudes.

[2] Theoretical values of $<|L|>$, $<L^2>$ 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	0.34	0/2091	0.57	0/2827
1	B	0.35	0/2091	0.59	0/2827
1	C	0.33	0/2091	0.58	0/2827
1	D	0.33	0/2091	0.57	0/2827
1	E	0.33	0/2091	0.57	0/2827
All	All	0.34	0/10455	0.58	0/14135

There are no bond length outliers.

There are no bond angle outliers.

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	2030	0	1957	10	0
1	B	2030	0	1957	9	0
1	C	2030	0	1957	15	0
1	D	2030	0	1957	20	0
1	E	2030	0	1957	12	0
2	A	195	0	0	0	0
2	B	233	0	0	0	0
2	C	189	0	0	0	0
2	D	184	0	0	0	0
2	E	217	0	0	0	0
All	All	11168	0	9785	59	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 3.

All (59) 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:D:215:TYR:HB2	1:E:191:GLN:HG3	1.42	0.97
1:D:150:ARG:HG3	1:D:152:GLN:HG2	1.66	0.76
1:A:148:ASN:ND2	1:A:197:GLU:H	1.93	0.67
1:B:78:ASN:HD22	1:B:80:ARG:HH12	1.43	0.67
1:C:23:LEU:HD13	1:C:72:ALA:HA	1.77	0.67
1:D:49:ARG:HD2	1:D:52:ARG:HH11	1.61	0.64
1:A:148:ASN:HD22	1:A:197:GLU:H	1.47	0.62
1:B:29:TRP:O	1:B:37:ARG:HD3	2.00	0.61
1:B:138:LYS:HD2	1:B:237:TYR:OH	2.01	0.61
1:E:104:ARG:HG2	1:E:104:ARG:HH11	1.66	0.61
1:A:174:GLU:HG2	1:A:177:ARG:HH22	1.66	0.59
1:D:45:LYS:O	1:D:49:ARG:HG2	2.03	0.58
1:C:49:ARG:HG2	1:C:52:ARG:HH11	1.68	0.58
1:E:119:LYS:O	1:E:119:LYS:HD2	2.05	0.57
1:C:116:SER:HB3	1:C:121:LEU:HD13	1.86	0.57
1:D:174:GLU:O	1:D:177:ARG:HG2	2.05	0.56
1:B:172:HIS:HB2	1:B:222:VAL:HG11	1.88	0.56
1:C:28:ARG:HH12	1:D:28:ARG:HH12	1.54	0.55
1:D:215:TYR:CB	1:E:191:GLN:HG3	2.28	0.54
1:D:119:LYS:H	1:D:119:LYS:CD	2.21	0.54
1:D:150:ARG:CG	1:D:152:GLN:HG2	2.37	0.53
1:C:147:MET:HE3	1:C:229:PHE:CE1	2.43	0.53
1:C:41:TRP:NE1	1:C:45:LYS:HD2	2.24	0.52
1:C:23:LEU:HD22	1:C:105:SER:HB3	1.92	0.52
1:E:149:LYS:HG2	1:E:157:TRP:CD1	2.44	0.52
1:C:172:HIS:HB2	1:C:222:VAL:HG11	1.91	0.51
1:E:104:ARG:HG2	1:E:104:ARG:NH1	2.25	0.51
1:C:84:ASP:HB2	1:C:85:PRO:HD3	1.93	0.51
1:D:119:LYS:H	1:D:119:LYS:CE	2.25	0.50
1:A:148:ASN:HD21	1:A:196:TRP:HA	1.77	0.50
1:C:211:LYS:HA	1:D:191:GLN:O	2.11	0.50
1:D:211:LYS:HA	1:E:191:GLN:O	2.11	0.50
1:E:104:ARG:HH12	1:E:107:SER:HB3	1.77	0.48
1:E:129:LYS:O	1:E:132:LEU:HB2	2.14	0.48
1:C:138:LYS:HD3	1:C:237:TYR:OH	2.13	0.48
1:A:172:HIS:HB2	1:A:222:VAL:HG11	1.96	0.47
1:B:84:ASP:HB2	1:B:85:PRO:HD3	1.96	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:119:LYS:H	1:D:119:LYS:HE2	1.79	0.47
1:D:119:LYS:HE2	1:D:119:LYS:N	2.31	0.46
1:E:172:HIS:HB2	1:E:222:VAL:HG11	1.97	0.46
1:A:211:LYS:HA	1:B:191:GLN:O	2.16	0.46
1:D:150:ARG:HD2	1:D:225:ARG:O	2.15	0.46
1:C:41:TRP:CE2	1:C:45:LYS:HD2	2.51	0.45
1:D:177:ARG:HA	1:D:180:GLN:HG3	1.98	0.45
1:B:211:LYS:HA	1:C:191:GLN:O	2.17	0.44
1:E:143:CYS:HB3	1:E:202:LEU:HB2	2.00	0.44
1:B:146:PRO:HB2	1:B:196:TRP:CG	2.53	0.43
1:C:58:GLY:HA2	1:C:135:ARG:HH22	1.84	0.43
1:D:119:LYS:H	1:D:119:LYS:HD3	1.84	0.43
1:A:84:ASP:HB2	1:A:85:PRO:HD3	2.00	0.42
1:B:7:GLU:HB3	1:B:162:ALA:HB2	2.00	0.42
1:A:156:ASN:HD22	1:A:156:ASN:C	2.22	0.42
1:D:172:HIS:HB2	1:D:222:VAL:HG11	2.00	0.42
1:D:41:TRP:CZ2	1:D:244:ARG:HB2	2.55	0.41
1:A:143:CYS:HB3	1:A:202:LEU:HB2	2.03	0.41
1:A:119:LYS:HA	1:A:120:PRO:HD3	1.94	0.40
1:D:119:LYS:HA	1:D:120:PRO:HD3	1.92	0.40
1:E:104:ARG:NH1	1:E:107:SER:HB3	2.35	0.40
1:C:150:ARG:HG3	1:C:152:GLN:HE21	1.85	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	245/249 (98%)	238 (97%)	7 (3%)	0	100	100
1	B	245/249 (98%)	240 (98%)	5 (2%)	0	100	100
1	C	245/249 (98%)	239 (98%)	6 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	D	245/249 (98%)	239 (98%)	6 (2%)	0	100	100
1	E	245/249 (98%)	241 (98%)	4 (2%)	0	100	100
All	All	1225/1245 (98%)	1197 (98%)	28 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	209/211 (99%)	206 (99%)	3 (1%)	67	72
1	B	209/211 (99%)	206 (99%)	3 (1%)	67	72
1	C	209/211 (99%)	203 (97%)	6 (3%)	42	43
1	D	209/211 (99%)	204 (98%)	5 (2%)	49	51
1	E	209/211 (99%)	201 (96%)	8 (4%)	33	31
All	All	1045/1055 (99%)	1020 (98%)	25 (2%)	49	51

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	124	GLU
1	A	156	ASN
1	A	212	LYS
1	B	119	LYS
1	B	132	LEU
1	B	249	LEU
1	C	3	ARG
1	C	23	LEU
1	C	28	ARG
1	C	47	LEU
1	C	119	LYS
1	C	152	GLN
1	D	3	ARG

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Mol	Chain	Res	Type
1	D	119	LYS
1	D	132	LEU
1	D	138	LYS
1	D	163	LYS
1	E	34	LEU
1	E	95	ARG
1	E	104	ARG
1	E	119	LYS
1	E	132	LEU
1	E	138	LYS
1	E	174	GLU
1	E	191	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	66	GLN
1	A	148	ASN
1	A	156	ASN
1	A	172	HIS
1	B	66	GLN
1	B	78	ASN
1	B	152	GLN
1	B	154	GLN
1	C	10	HIS
1	C	66	GLN
1	C	152	GLN
1	C	185	GLN
1	D	152	GLN
1	D	180	GLN
1	D	185	GLN
1	D	209	GLN
1	E	66	GLN
1	E	152	GLN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4   Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5   Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6   Ligand geometry ⓘ

There are no ligands in this entry.

5.7   Other polymers ⓘ

There are no such residues in this entry.

5.8   Polymer linkage issues ⓘ

There are no chain breaks in this entry.

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	247/249 (99%)	-0.39	3 (1%)	79	78	5, 12, 27, 47	0
1	B	247/249 (99%)	-0.47	2 (0%)	86	85	4, 10, 25, 44	0
1	C	247/249 (99%)	-0.25	4 (1%)	72	70	6, 13, 30, 42	0
1	D	247/249 (99%)	-0.21	4 (1%)	72	70	6, 15, 30, 45	0
1	E	247/249 (99%)	-0.33	2 (0%)	86	85	6, 13, 30, 41	0
All	All	1235/1245 (99%)	-0.33	15 (1%)	79	78	4, 12, 29, 47	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	3	ARG	3.7
1	B	127	TYR	3.4
1	A	3	ARG	3.2
1	A	5	VAL	2.9
1	C	177	ARG	2.8
1	D	177	ARG	2.7
1	A	119	LYS	2.7
1	D	127	TYR	2.6
1	D	3	ARG	2.4
1	E	127	TYR	2.3
1	C	180	GLN	2.2
1	E	119	LYS	2.2
1	C	121	LEU	2.1
1	D	119	LYS	2.1
1	C	3	ARG	2.1

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

There are no ligands in this entry.

6.5 Other polymers ⓘ

There are no such residues in this entry.