Full wwPDB X-ray Structure Validation Report ⓘ

Oct 4, 2023 – 10:01 AM EDT

PDB ID	:	6O44
Title	:	Insight into subtilisin E-S7 cleavage pattern based on crystal structure and hydrolysates peptide analysis
Authors	:	Tang, H.; Shi, K.; Aihara, H.
Deposited on	:	2019-02-28
Resolution	:	1.83 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:

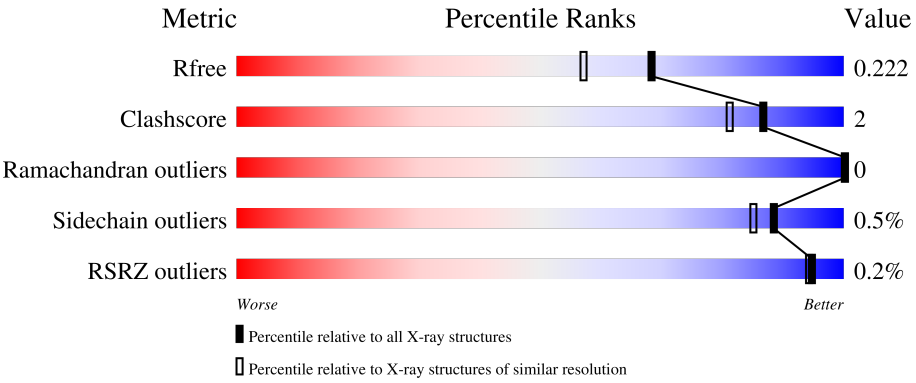
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

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 1.83 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	4003 (1.86-1.82)
Clashscore	141614	4233 (1.86-1.82)
Ramachandran outliers	138981	4185 (1.86-1.82)
Sidechain outliers	138945	4186 (1.86-1.82)
RSRZ outliers	127900	3957 (1.86-1.82)

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	284	92% 6%
1	B	284	94%

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
4	EDO	A	307	-	-	-	X

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 8264 atoms, of which 3859 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 Nattokinase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	276	Total	C	H	N	O	S	0	2	0
			3883	1218	1917	339	404	5			
1	B	276	Total	C	H	N	O	S	0	0	0
			3861	1212	1907	337	400	5			

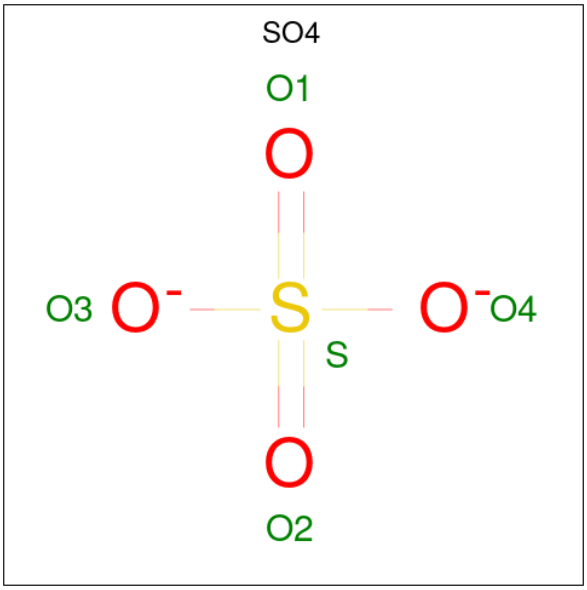
There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	221	CYS	SER	engineered mutation	UNP A0A024B5N4
A	276	SER	-	expression tag	UNP A0A024B5N4
A	277	LEU	-	expression tag	UNP A0A024B5N4
A	278	GLU	-	expression tag	UNP A0A024B5N4
A	279	HIS	-	expression tag	UNP A0A024B5N4
A	280	HIS	-	expression tag	UNP A0A024B5N4
A	281	HIS	-	expression tag	UNP A0A024B5N4
A	282	HIS	-	expression tag	UNP A0A024B5N4
A	283	HIS	-	expression tag	UNP A0A024B5N4
A	284	HIS	-	expression tag	UNP A0A024B5N4
B	221	CYS	SER	engineered mutation	UNP A0A024B5N4
B	276	SER	-	expression tag	UNP A0A024B5N4
B	277	LEU	-	expression tag	UNP A0A024B5N4
B	278	GLU	-	expression tag	UNP A0A024B5N4
B	279	HIS	-	expression tag	UNP A0A024B5N4
B	280	HIS	-	expression tag	UNP A0A024B5N4
B	281	HIS	-	expression tag	UNP A0A024B5N4
B	282	HIS	-	expression tag	UNP A0A024B5N4
B	283	HIS	-	expression tag	UNP A0A024B5N4
B	284	HIS	-	expression tag	UNP A0A024B5N4

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

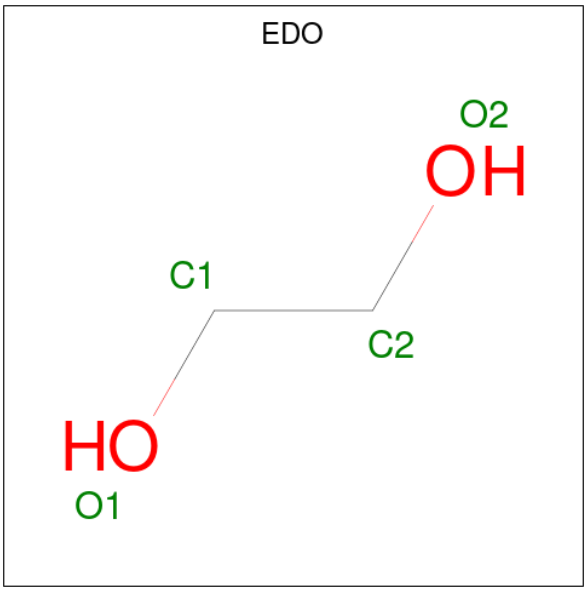
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	2	Total Ca 2 2	0	0
2	B	2	Total Ca 2 2	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	H	O	0	0
			9	2	5	2		
4	A	1	Total	C	H	O	0	0
			10	2	6	2		
4	A	1	Total	C	H	O	0	0
			10	2	6	2		
4	A	1	Total	C	H	O	0	0
			10	2	6	2		
4	B	1	Total	C	H	O	0	0
			10	2	6	2		
4	B	1	Total	C	H	O	0	0
			10	2	6	2		

- Molecule 5 is water.

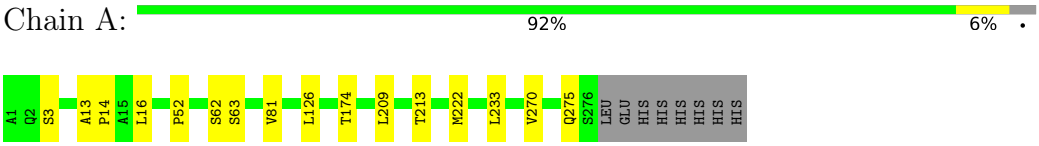
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	233	Total	O	0	0
			233	233		
5	B	219	Total	O	0	0
			219	219		

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.

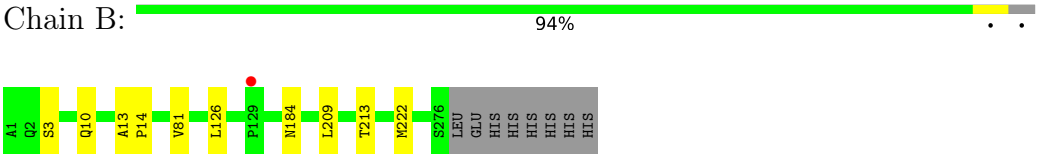
- Molecule 1: Nattokinase

Chain A:



- Molecule 1: Nattokinase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	74.18Å 80.12Å 87.73Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	59.16 – 1.83 59.16 – 1.83	Depositor EDS
% Data completeness (in resolution range)	98.9 (59.16-1.83) 99.0 (59.16-1.83)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.61 (at 1.83Å)	Xtriage
Refinement program	PHENIX (1.14_3247: ???)	Depositor
R, R_{free}	0.187 , 0.222 0.191 , 0.222	Depositor DCC
R_{free} test set	2246 reflections (4.85%)	wwPDB-VP
Wilson B-factor (Å^2)	17.6	Xtriage
Anisotropy	0.306	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 49.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	8264	wwPDB-VP
Average B, all atoms (Å^2)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 50.05 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 6.8411e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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

Bond lengths and bond angles in the following residue types are not validated in this section: CA, SO4, EDO

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	0.27	0/2005	0.49	0/2738
1	B	0.28	0/1993	0.49	0/2722
All	All	0.28	0/3998	0.49	0/5460

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	1966	1917	1910	9	1
1	B	1954	1907	1902	5	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	5	0	0	0	0
4	A	16	23	24	2	0
4	B	8	12	12	0	0
5	A	233	0	0	3	2
5	B	219	0	0	0	3
All	All	4405	3859	3848	16	4

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 (16) 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)
4:A:306:EDO:O2	5:A:401:HOH:O	2.07	0.72
4:A:307:EDO:O2	5:A:402:HOH:O	2.08	0.71
1:A:174:THR:O	5:A:403:HOH:O	2.18	0.55
1:A:16:LEU:CD1	1:A:270:VAL:HG22	2.40	0.51
1:B:209:LEU:HB2	1:B:213:THR:HG23	1.99	0.45
1:B:3:SER:O	1:B:81:VAL:HA	2.16	0.45
1:A:62:SER:O	1:A:63:SER:CB	2.66	0.44
1:B:10:GLN:NE2	1:B:184:ASN:OD1	2.50	0.44
1:B:13:ALA:N	1:B:14:PRO:CD	2.82	0.43
1:A:13:ALA:N	1:A:14:PRO:CD	2.82	0.42
1:A:3:SER:O	1:A:81:VAL:HA	2.19	0.41
1:A:16:LEU:HD11	1:A:270:VAL:HG22	2.03	0.41
1:A:16:LEU:HD13	1:A:233:LEU:HB3	2.02	0.41
1:B:126:LEU:HD12	1:B:126:LEU:C	2.40	0.41
1:A:209:LEU:HB2	1:A:213:THR:HG23	2.03	0.41
1:A:126:LEU:HD12	1:A:126:LEU:C	2.40	0.40

All (4) 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:B:511:HOH:O	5:B:560:HOH:O[3_454]	1.93	0.27
5:A:568:HOH:O	5:B:543:HOH:O[1_655]	2.10	0.10
5:A:616:HOH:O	5:B:414:HOH:O[1_655]	2.15	0.05
1:A:52:PRO:O	1:A:275:GLN:HE21[3_554]	1.59	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	276/284 (97%)	265 (96%)	11 (4%)	0	100	100
1	B	274/284 (96%)	263 (96%)	11 (4%)	0	100	100
All	All	550/568 (97%)	528 (96%)	22 (4%)	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	210/216 (97%)	209 (100%)	1 (0%)	88	85
1	B	208/216 (96%)	207 (100%)	1 (0%)	88	85
All	All	418/432 (97%)	416 (100%)	2 (0%)	88	85

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	222	MET
1	B	222	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 11 ligands modelled in this entry, 4 are monoatomic - leaving 7 for Mogul analysis.

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	$\#\|Z\| > 2$
4	EDO	A	304	2	3,3,3	0.47	0	2,2,2	0.31	0
4	EDO	B	303	-	3,3,3	0.47	0	2,2,2	0.29	0
4	EDO	B	304	-	3,3,3	0.48	0	2,2,2	0.23	0
3	SO4	A	303	-	4,4,4	0.12	0	6,6,6	0.08	0
4	EDO	A	307	2	3,3,3	0.45	0	2,2,2	0.27	0
4	EDO	A	306	-	3,3,3	0.46	0	2,2,2	0.29	0
4	EDO	A	305	-	3,3,3	0.47	0	2,2,2	0.26	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
4	EDO	A	304	2	-	0/1/1/1	-
4	EDO	B	303	-	-	0/1/1/1	-
4	EDO	B	304	-	-	1/1/1/1	-
4	EDO	A	305	-	-	0/1/1/1	-
4	EDO	A	306	-	-	1/1/1/1	-
4	EDO	A	307	2	-	1/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	304	EDO	O1-C1-C2-O2
4	A	306	EDO	O1-C1-C2-O2
4	A	307	EDO	O1-C1-C2-O2

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	307	EDO	1	0
4	A	306	EDO	1	0

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, 95^{th} 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	276/284 (97%)	-0.06	0 100 100	16, 23, 36, 54	0
1	B	276/284 (97%)	-0.07	1 (0%) 92 92	16, 23, 40, 60	0
All	All	552/568 (97%)	-0.07	1 (0%) 95 94	16, 23, 38, 60	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	129	PRO	2.3

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

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, 95^{th} 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
4	EDO	A	307	4/4	0.07	0.44	89,115,138,138	0
4	EDO	B	304	4/4	0.53	0.20	60,72,82,82	0
4	EDO	A	304	4/4	0.58	0.18	39,48,61,61	0
4	EDO	A	306	4/4	0.71	0.22	41,58,70,70	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	EDO	A	305	4/4	0.79	0.15	38,46,52,60	0
4	EDO	B	303	4/4	0.80	0.17	32,45,54,60	0
2	CA	A	302	1/1	0.86	0.10	37,37,37,37	0
2	CA	B	302	1/1	0.87	0.14	44,44,44,44	0
3	SO4	A	303	5/5	0.98	0.09	32,40,49,64	0
2	CA	A	301	1/1	0.99	0.06	15,15,15,15	0
2	CA	B	301	1/1	0.99	0.06	16,16,16,16	0

6.5 Other polymers (i)

There are no such residues in this entry.