



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 01:08 PM UTC

PDB ID : 9PAP / pdb_00009pap
Title : STRUCTURE OF PAPAIN REFINED AT 1.65 ANGSTROMS RESOLUTION
Authors : Kamphuis, I.G.; Drenth, J.
Deposited on : 1986-03-31
Resolution : 1.65 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

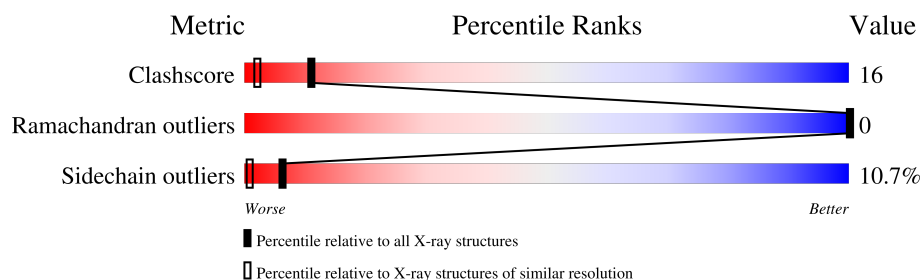
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.65 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))
Clashscore	190562	2662 (1.66-1.66)
Ramachandran outliers	187476	2621 (1.66-1.66)
Sidechain outliers	187428	2621 (1.66-1.66)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	212	50% 36% 11% .

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
2	MOH	A	216	-	-	X	-
2	MOH	A	230	-	-	X	-
2	MOH	A	239	-	-	X	-

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 1908 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.

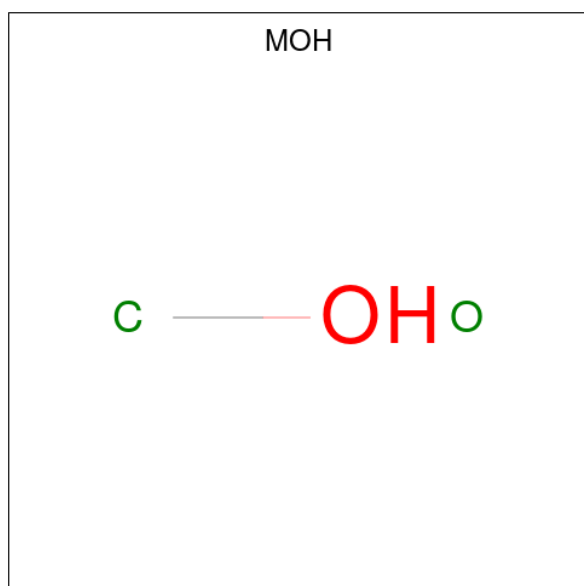
- Molecule 1 is a protein called PAPAIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	212	Total	C	N	O	S	0	0	0
			1655	1048	292	308	7			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	47	GLN	GLU	conflict	UNP P00784
A	118	GLN	GLU	conflict	UNP P00784
A	135	GLN	GLU	conflict	UNP P00784

- Molecule 2 is METHANOL (CCD ID: MOH) (formula: CH₄O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		
2	A	1	Total	C	O	0	0
			2	1	1		

- Molecule 3 is water.

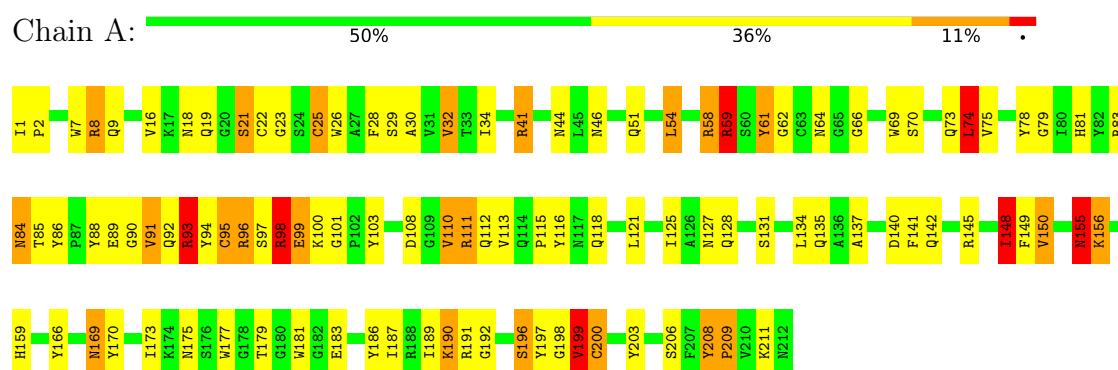
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	195	Total	O	0	0
			195	195		

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. 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. 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.

Note EDS was not executed.

• Molecule 1: PAPAIN



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	45.20Å 104.64Å 50.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 1.65	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.65)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.161 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1908	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

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	1.75	14/1689 (0.8%)	2.49	117/2292 (5.1%)

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	A	0	4

The worst 5 of 14 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	69	TRP	NE1-CE2	-8.55	1.28	1.37
1	A	26	TRP	NE1-CE2	-8.34	1.28	1.37
1	A	95	CYS	CA-CB	-7.37	1.43	1.53
1	A	94	TYR	CA-CB	7.21	1.65	1.53
1	A	177	TRP	NE1-CE2	-6.76	1.30	1.37

The worst 5 of 117 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	155	ASN	CA-CB-CG	16.54	129.14	112.60
1	A	84	ASN	CA-CB-CG	-15.90	96.70	112.60
1	A	108	ASP	CA-CB-CG	-13.52	99.08	112.60
1	A	9	GLN	CB-CG-CD	9.86	129.37	112.60
1	A	145	ARG	CD-NE-CZ	9.24	137.34	124.40

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	111	ARG	Sidechain
1	A	200	CYS	Mainchain
1	A	58	ARG	Mainchain
1	A	59	ARG	Mainchain

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	1655	0	1586	51	0
2	A	58	0	0	10	0
3	A	195	0	0	8	0
All	All	1908	0	1586	54	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 16.

The worst 5 of 54 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:98:ARG:NH1	1:A:99:GLU:HG3	1.24	1.44
1:A:98:ARG:HH12	1:A:99:GLU:CG	1.51	1.23
1:A:135:GLN:HE22	1:A:156:LYS:HE2	1.14	1.09
1:A:98:ARG:NH1	1:A:99:GLU:CG	2.10	1.08
1:A:41:ARG:HH11	2:A:216:MOH:C	1.68	1.06

There are no symmetry-related clashes.

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	209/212 (99%)	203 (97%)	6 (3%)	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	168/169 (99%)	150 (89%)	18 (11%)	6	1

5 of 18 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	156	LYS
1	A	199	VAL
1	A	196	SER
1	A	98	ARG
1	A	155	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	112	GLN
1	A	118	GLN
1	A	127	ASN
1	A	64	ASN
1	A	47	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	OCS	A	25	1	6,8,9	1.81	3 (50%)	7,11,13	2.62	3 (42%)

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
1	OCS	A	25	1	-	2/4/7/9	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	25	OCS	CB-CA	2.54	1.55	1.53
1	A	25	OCS	OD1-SG	2.41	1.51	1.45
1	A	25	OCS	O-C	2.08	1.27	1.20

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	25	OCS	OD2-SG-CB	4.77	115.18	105.97
1	A	25	OCS	OD1-SG-CB	-3.80	101.08	106.76
1	A	25	OCS	OD2-SG-OD1	-2.77	104.48	111.40

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	25	OCS	CA-CB-SG-OD2
1	A	25	OCS	CA-CB-SG-OD3

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	25	OCS	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

29 ligands 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	$\# Z > 2$
2	MOH	A	229	-	1,1,1	0.45	0	-		
2	MOH	A	241	-	1,1,1	0.53	0	-		
2	MOH	A	228	-	1,1,1	0.68	0	-		
2	MOH	A	236	-	1,1,1	0.51	0	-		
2	MOH	A	240	-	1,1,1	0.70	0	-		
2	MOH	A	216	-	1,1,1	0.67	0	-		
2	MOH	A	239	-	1,1,1	0.55	0	-		
2	MOH	A	235	-	1,1,1	0.72	0	-		
2	MOH	A	232	-	1,1,1	0.62	0	-		
2	MOH	A	217	-	1,1,1	0.44	0	-		
2	MOH	A	231	-	1,1,1	0.57	0	-		
2	MOH	A	230	-	1,1,1	0.67	0	-		
2	MOH	A	242	-	1,1,1	0.57	0	-		
2	MOH	A	218	-	1,1,1	0.52	0	-		
2	MOH	A	223	-	1,1,1	0.62	0	-		
2	MOH	A	237	-	1,1,1	0.57	0	-		
2	MOH	A	234	-	1,1,1	0.71	0	-		
2	MOH	A	238	-	1,1,1	0.63	0	-		
2	MOH	A	215	-	1,1,1	0.51	0	-		
2	MOH	A	214	-	1,1,1	0.65	0	-		

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	MOH	A	222	-	1,1,1	0.38	0	-		
2	MOH	A	227	-	1,1,1	0.66	0	-		
2	MOH	A	224	-	1,1,1	0.39	0	-		
2	MOH	A	225	-	1,1,1	0.45	0	-		
2	MOH	A	219	-	1,1,1	0.39	0	-		
2	MOH	A	233	-	1,1,1	0.56	0	-		
2	MOH	A	226	-	1,1,1	0.64	0	-		
2	MOH	A	220	-	1,1,1	0.52	0	-		
2	MOH	A	221	-	1,1,1	0.25	0	-		

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.

7 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	216	MOH	2	0
2	A	239	MOH	2	0
2	A	230	MOH	2	0
2	A	234	MOH	1	0
2	A	224	MOH	1	0
2	A	225	MOH	1	0
2	A	219	MOH	1	0

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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.