



# wwPDB X-ray Structure Validation Summary Report

Mar 9, 2026 – 12:47 AM UTC

PDB ID : 1LS5 / pdb\_00001ls5  
Title : Crystal structure of plasmepsin IV from *P. falciparum* in complex with pepstatin A  
Authors : Asojo, O.A.; Gulnik, S.V.; Afonina, E.; Yu, B.; Ellman, J.A.; Haque, T.S.; Silva, A.M.  
Deposited on : 2002-05-16  
Resolution : 2.80 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](mailto: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>.

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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)  
Xtrriage (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

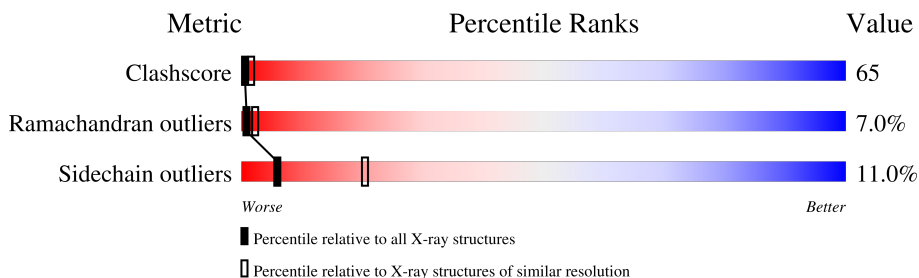
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.80 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	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)

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  $\geq 3$ , 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	328	23% 61% 14% .
1	B	328	29% 53% 16% .
2	C	6	17% 33% 33% 17%
2	D	6	33% 33% 17% 17%

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5342 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 plasmepsin IV.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	328	2609	1686	397	515	11	0	0	0
1	B	328	2609	1686	397	515	11	0	0	0

- Molecule 2 is a protein called Pepstatin.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	6	48	34	5	9	0	0	0
2	D	6	48	34	5	9	0	0	0

- Molecule 3 is water.

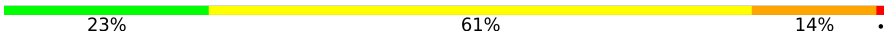
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	18	Total	O	0	0
			18	18		
3	B	10	Total	O	0	0
			10	10		

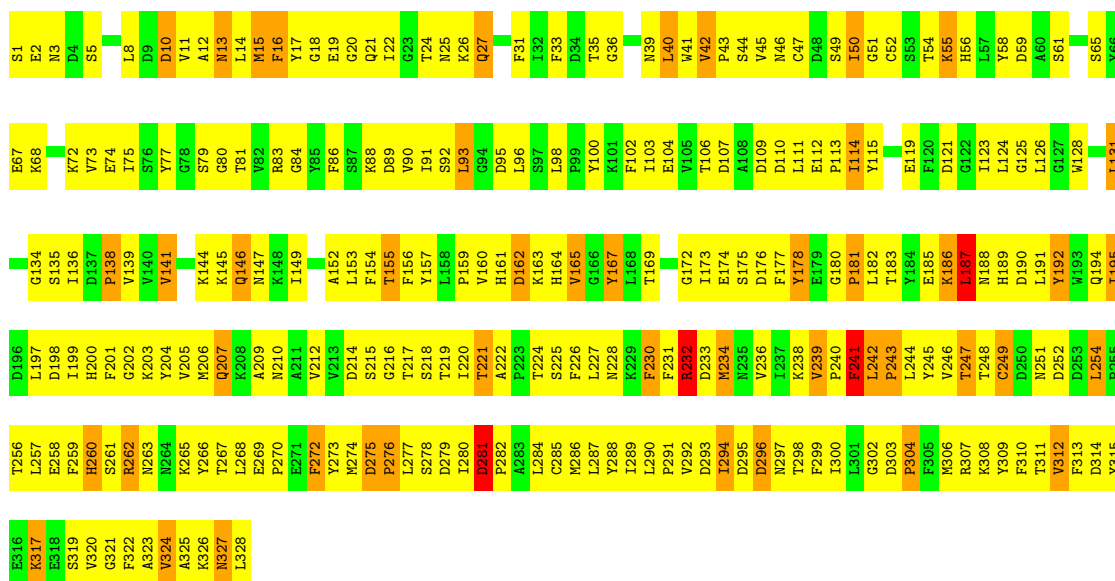
### 3 Residue-property plots [i](#)

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.

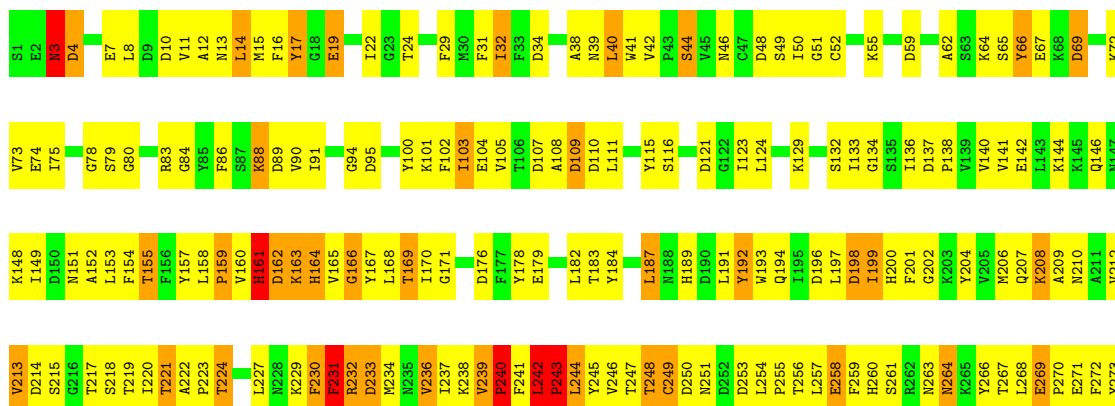
- Molecule 1: plasmepsin IV

Chain A: 



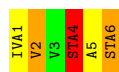
- Molecule 1: plasmepsin IV

Chain B: 

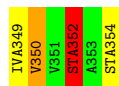
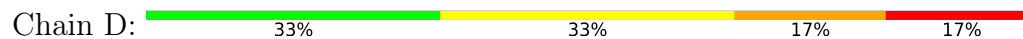




- Molecule 2: Pepstatin



- Molecule 2: Pepstatin



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	101.93Å 101.93Å 123.39Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	10.00 – 2.80	Depositor
% Data completeness (in resolution range)	(Not available) (10.00-2.80)	Depositor
$R_{merge}$	0.10	Depositor
$R_{sym}$	0.08	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, $R_{free}$	0.220 , 0.290	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	5342	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	34.0	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: IVA, STA

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	0.51	0/2677	1.11	25/3637 (0.7%)
1	B	0.54	0/2677	1.12	22/3637 (0.6%)
2	C	0.81	0/17	2.05	1/21 (4.8%)
2	D	0.80	0/17	2.23	1/21 (4.8%)
All	All	0.53	0/5388	1.12	49/7316 (0.7%)

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
2	C	0	2
2	D	0	2
All	All	0	4

There are no bond length outliers.

The worst 5 of 49 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	231	PHE	N-CA-C	-10.92	99.96	113.18
1	A	180	GLY	CA-C-N	10.67	133.17	119.84
1	A	180	GLY	C-N-CA	10.67	133.17	119.84
1	B	242	LEU	N-CA-C	8.20	127.93	109.81
1	B	34	ASP	N-CA-C	7.80	121.79	107.99

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	4	STA	Peptide,Mainchain
2	D	352	STA	Peptide,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	2609	0	2501	408	8
1	B	2609	0	2501	281	7
2	C	48	0	60	11	0
2	D	48	0	60	6	0
3	A	18	0	0	5	0
3	B	10	0	0	1	0
All	All	5342	0	5122	678	8

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 65.

The worst 5 of 678 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:277:LEU:HD22	1:B:280:ILE:HD13	1.33	1.09
1:B:310:PHE:HB2	1:B:325:ALA:HB2	1.39	1.04
1:A:74:GLU:HG2	1:A:83:ARG:HG2	1.38	1.04
1:B:221:THR:HB	1:B:300:ILE:HB	1.39	1.02
1:A:307:ARG:HH11	1:A:307:ARG:HB2	1.26	1.00

The worst 5 of 8 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)
1:A:198:ASP:OD2	1:B:232:ARG:NH2[3_454]	1.23	0.97
1:A:207:GLN:NE2	1:B:233:ASP:O[3_454]	1.59	0.61
1:A:198:ASP:CG	1:B:232:ARG:NH2[3_454]	1.64	0.56
1:A:145:LYS:CE	1:B:163:LYS:NZ[5_665]	1.97	0.23
1:A:134:GLY:CA	1:B:282:PRO:CB[5_665]	2.01	0.19

## 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	326/328 (99%)	251 (77%)	53 (16%)	22 (7%)	1	3
1	B	326/328 (99%)	259 (79%)	43 (13%)	24 (7%)	1	2
2	C	3/6 (50%)	2 (67%)	1 (33%)	0	100	100
2	D	3/6 (50%)	3 (100%)	0	0	100	100
All	All	658/668 (98%)	515 (78%)	97 (15%)	46 (7%)	1	2

5 of 46 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	15	MET
1	A	181	PRO
1	A	186	LYS
1	A	276	PRO
1	A	327	ASN

### 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	293/293 (100%)	263 (90%)	30 (10%)	7	23
1	B	293/293 (100%)	258 (88%)	35 (12%)	5	17
2	C	2/2 (100%)	2 (100%)	0	100	100
2	D	2/2 (100%)	2 (100%)	0	100	100
All	All	590/590 (100%)	525 (89%)	65 (11%)	6	20

5 of 65 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	277	LEU
1	B	287	LEU
1	A	262	ARG
1	A	260	HIS
1	B	292	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	161	HIS
1	B	210	ASN
1	B	194	GLN
1	B	228	ASN
1	A	56	HIS

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

4 non-standard protein/DNA/RNA residues 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	STA	C	6	2	11,11,11	2.26	3 (27%)	11,14,14	1.43	2 (18%)
2	STA	C	4	2	10,10,11	1.03	1 (10%)	9,12,14	1.66	2 (22%)
2	STA	D	354	2	11,11,11	2.31	2 (18%)	11,14,14	1.22	2 (18%)
2	STA	D	352	2	10,10,11	0.97	1 (10%)	9,12,14	1.28	1 (11%)

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
2	STA	C	6	2	-	2/12/12/12	-
2	STA	C	4	2	-	2/11/11/12	-
2	STA	D	354	2	-	0/12/12/12	-
2	STA	D	352	2	-	2/11/11/12	-

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	354	STA	CH-CA	5.49	1.58	1.53
2	C	6	STA	CH-CA	5.47	1.58	1.53
2	D	354	STA	OH-CH	4.60	1.53	1.43
2	C	6	STA	OH-CH	3.83	1.51	1.43
2	C	4	STA	CH-CA	3.14	1.56	1.53

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	4	STA	OH-CH-CM	-3.43	101.34	109.24
2	C	6	STA	CM-CH-CA	-3.40	107.67	112.93
2	D	352	STA	OH-CH-CM	-2.66	103.12	109.24
2	C	6	STA	OH-CH-CM	2.34	115.08	109.45
2	C	4	STA	CG-CB-CA	2.22	120.55	115.76

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	4	STA	CH-CA-CB-CG
2	D	352	STA	CH-CA-CB-CG
2	D	352	STA	O-C-CM-CH
2	C	4	STA	O-C-CM-CH
2	C	6	STA	OXT-C-CM-CH

There are no ring outliers.

3 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	6	STA	3	0
2	C	4	STA	5	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	352	STA	3	0

## 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](#)

EDS was not executed - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.