



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 10, 2024 – 07:18 PM EST

PDB ID : 2IMB  
Title : Clostridium botulinum Neurotoxin Serotype A Light Chain Inhibited by L-arginine hydroxamate  
Authors : Silvaggi, N.R.; Allen, K.N.  
Deposited on : 2006-10-04  
Resolution : 2.41 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 : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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

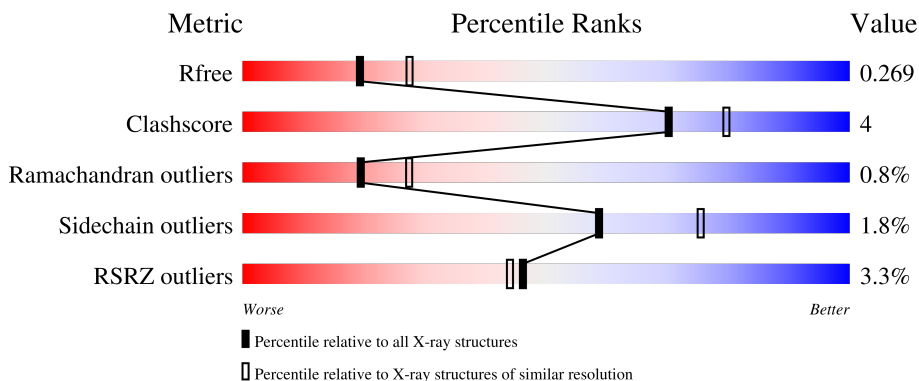
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.41 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	4647 (2.44-2.40)
Clashscore	141614	5161 (2.44-2.40)
Ramachandran outliers	138981	5073 (2.44-2.40)
Sidechain outliers	138945	5074 (2.44-2.40)
RSRZ outliers	127900	4543 (2.44-2.40)

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  $\leq 5\%$ . 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	444	 3% 80% 8% 11%
1	B	444	 3% 81% 9% 9%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6716 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 Botulinum neurotoxin A light-chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	393	3175	2048	524	596	7	0	0	0
1	B	402	3251	2092	536	615	8	0	0	0

There are 42 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	cloning artifact	UNP Q7B8V4
A	-18	GLY	-	cloning artifact	UNP Q7B8V4
A	-17	SER	-	cloning artifact	UNP Q7B8V4
A	-16	SER	-	cloning artifact	UNP Q7B8V4
A	-15	HIS	-	cloning artifact	UNP Q7B8V4
A	-14	HIS	-	cloning artifact	UNP Q7B8V4
A	-13	HIS	-	cloning artifact	UNP Q7B8V4
A	-12	HIS	-	cloning artifact	UNP Q7B8V4
A	-11	HIS	-	cloning artifact	UNP Q7B8V4
A	-10	HIS	-	cloning artifact	UNP Q7B8V4
A	-9	SER	-	cloning artifact	UNP Q7B8V4
A	-8	SER	-	cloning artifact	UNP Q7B8V4
A	-7	GLY	-	cloning artifact	UNP Q7B8V4
A	-6	LEU	-	cloning artifact	UNP Q7B8V4
A	-5	VAL	-	cloning artifact	UNP Q7B8V4
A	-4	PRO	-	cloning artifact	UNP Q7B8V4
A	-3	ARG	-	cloning artifact	UNP Q7B8V4
A	-2	GLY	-	cloning artifact	UNP Q7B8V4
A	-1	SER	-	cloning artifact	UNP Q7B8V4
A	0	HIS	-	cloning artifact	UNP Q7B8V4
A	2	GLN	PRO	conflict	UNP Q7B8V4
B	-19	MET	-	cloning artifact	UNP Q7B8V4
B	-18	GLY	-	cloning artifact	UNP Q7B8V4
B	-17	SER	-	cloning artifact	UNP Q7B8V4
B	-16	SER	-	cloning artifact	UNP Q7B8V4

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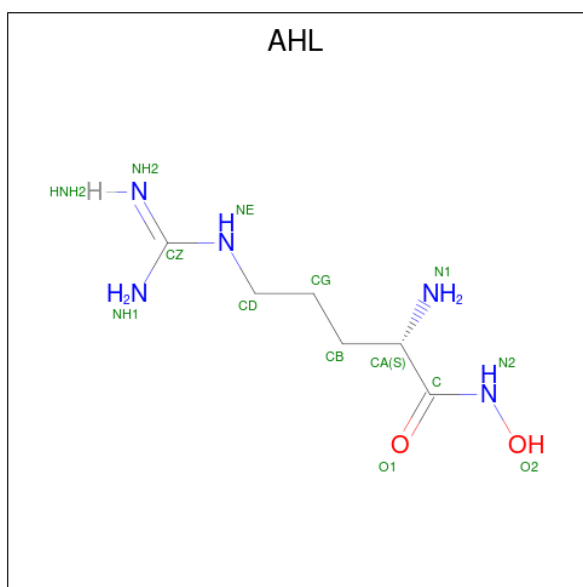
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Chain	Residue	Modelled	Actual	Comment	Reference
B	-15	HIS	-	cloning artifact	UNP Q7B8V4
B	-14	HIS	-	cloning artifact	UNP Q7B8V4
B	-13	HIS	-	cloning artifact	UNP Q7B8V4
B	-12	HIS	-	cloning artifact	UNP Q7B8V4
B	-11	HIS	-	cloning artifact	UNP Q7B8V4
B	-10	HIS	-	cloning artifact	UNP Q7B8V4
B	-9	SER	-	cloning artifact	UNP Q7B8V4
B	-8	SER	-	cloning artifact	UNP Q7B8V4
B	-7	GLY	-	cloning artifact	UNP Q7B8V4
B	-6	LEU	-	cloning artifact	UNP Q7B8V4
B	-5	VAL	-	cloning artifact	UNP Q7B8V4
B	-4	PRO	-	cloning artifact	UNP Q7B8V4
B	-3	ARG	-	cloning artifact	UNP Q7B8V4
B	-2	GLY	-	cloning artifact	UNP Q7B8V4
B	-1	SER	-	cloning artifact	UNP Q7B8V4
B	0	HIS	-	cloning artifact	UNP Q7B8V4
B	2	GLN	PRO	conflict	UNP Q7B8V4

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Zn 1 1	0	0
2	B	1	Total Zn 1 1	0	0

- Molecule 3 is N-HYDROXY-L-ARGININAMIDE (three-letter code: AHL) (formula: C<sub>6</sub>H<sub>15</sub>N<sub>5</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			13	6	5	2		
3	B	1	Total	C	N	O	0	0
			13	6	5	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	125	Total	O	0	0
			125	125		
4	B	137	Total	O	0	0
			137	137		



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	74.24Å 67.93Å 98.31Å 90.00° 105.10° 90.00°	Depositor
Resolution (Å)	50.00 – 2.41 17.95 – 2.41	Depositor EDS
% Data completeness (in resolution range)	96.0 (50.00-2.41) 96.2 (17.95-2.41)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.40 (at 2.40Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.191 , 0.260 0.201 , 0.269	Depositor DCC
$R_{free}$ test set	1778 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	31.5	Xtrriage
Anisotropy	0.081	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 57.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	6716	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.46% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

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

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	0.83	1/3246 (0.0%)	0.78	2/4382 (0.0%)
1	B	0.89	2/3324 (0.1%)	0.83	1/4494 (0.0%)
All	All	0.86	3/6570 (0.0%)	0.81	3/8876 (0.0%)

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	B	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	407	GLU	CG-CD	5.81	1.60	1.51
1	A	273	PHE	CE2-CZ	5.05	1.47	1.37
1	B	165	CYS	CB-SG	-5.03	1.73	1.81

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	18	ASP	CB-CG-OD1	6.35	124.02	118.30
1	A	105	ARG	NE-CZ-NH2	-6.01	117.30	120.30
1	A	49	ASP	CB-CG-OD1	5.13	122.92	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:



Mol	Chain	Res	Type	Group
1	B	301	LYS	Peptide

## 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	3175	0	3111	24	2
1	B	3251	0	3203	22	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	13	0	13	0	0
3	B	13	0	13	0	0
4	A	125	0	0	4	0
4	B	137	0	0	1	2
All	All	6716	0	6340	46	2

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 4.

The worst 5 of 46 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:22:ILE:HD13	1:A:35:ALA:HB3	1.55	0.89
1:B:376:ILE:HD12	1:B:378:ILE:CD1	2.06	0.85
1:A:22:ILE:HD13	1:A:35:ALA:CB	2.18	0.73
1:A:243:PHE:CE2	1:A:263:LEU:HD11	2.30	0.66
1:A:243:PHE:CE2	1:A:263:LEU:CD1	2.81	0.63

All (2) 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:82:ASN:ND2	4:B:727:HOH:O[1_545]	1.90	0.30
1:A:82:ASN:CG	4:B:727:HOH:O[1_545]	2.15	0.05

## 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	381/444 (86%)	358 (94%)	21 (6%)	2 (0%)	29	40
1	B	394/444 (89%)	371 (94%)	19 (5%)	4 (1%)	15	22
All	All	775/888 (87%)	729 (94%)	40 (5%)	6 (1%)	19	27

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	69	PRO
1	B	302	SER
1	A	157	SER
1	B	157	SER
1	B	270	ASP

### 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	348/397 (88%)	345 (99%)	3 (1%)	78	89
1	B	361/397 (91%)	351 (97%)	10 (3%)	43	62
All	All	709/794 (89%)	696 (98%)	13 (2%)	59	75

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	202	VAL

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Mol	Chain	Res	Type
1	B	235	ILE
1	B	396	ASN
1	B	314	LYS
1	B	378	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	139	GLN
1	A	368	ASN

### 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 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	$\# Z  > 2$
3	AHL	B	600	2	12,12,12	0.44	0	12,14,14	0.79	0
3	AHL	A	600	2	12,12,12	0.52	0	12,14,14	1.14	1 (8%)

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
3	AHL	B	600	2	-	3/13/13/13	-
3	AHL	A	600	2	-	2/13/13/13	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	600	AHL	O1-C-N2	2.26	126.20	123.27

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	600	AHL	N1-CA-CB-CG
3	A	600	AHL	C-CA-CB-CG
3	B	600	AHL	N1-CA-CB-CG
3	B	600	AHL	C-CA-CB-CG
3	B	600	AHL	CA-CB-CG-CD

There are no ring outliers.

No monomer is involved in short contacts.

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	393/444 (88%)	-0.13	14 (3%) 42 41	17, 28, 48, 63	0
1	B	402/444 (90%)	-0.16	12 (2%) 50 48	13, 27, 49, 59	0
All	All	795/888 (89%)	-0.14	26 (3%) 46 44	13, 28, 49, 63	0

The worst 5 of 26 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	328	SER	4.7
1	B	306	THR	4.3
1	B	369	PHE	4.1
1	B	277	LEU	3.9
1	A	54	PRO	3.6

### 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 monosaccharides in this entry.

### 6.4 Ligands [i](#)

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<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
3	AHL	A	600	13/13	0.92	0.19	47,49,53,53	0
3	AHL	B	600	13/13	0.98	0.13	38,41,42,42	0
2	ZN	A	500	1/1	0.99	0.05	27,27,27,27	0
2	ZN	B	500	1/1	1.00	0.05	24,24,24,24	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.