Full wwPDB NMR Structure Validation Report (i)

Jun 16, 2024 – 08:27 AM EDT

PDB ID	:	2J15
BMRB ID	:	7341
Title	:	Cyclic MrIA: An exceptionally stable and potent cyclic conotoxin with a novel topological fold that targets the norepinephrine transporter.
Authors	:	Lovelace, E.S.; Armishaw, C.J.; Colgrave, M.L.; Walstrom, M.E.; Alewood, P.F.; Daly, N.L.; Craik, D.J.
Deposited on	:	2006-08-09

This is a Full wwPDB NMR 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/NMRValidationReportHelp
with specific help available everywhere you see the (i) 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 (1)) were used in the production of this report:

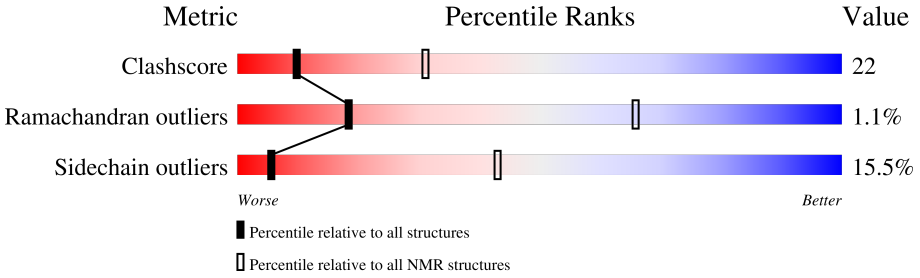
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
SOLUTION NMR

The overall completeness of chemical shifts assignment was not calculated.

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)	NMR archive (#Entries)
Clashscore	158937	12864
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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%

Mol	Chain	Length	Quality of chain
1	A	15	40% 20% 40%

2 Ensemble composition and analysis (i)

This entry contains 21 models. The atoms present in the NMR models are not consistent. Some calculations may have failed as a result. All residues are included in the validation scores. Model 21 is the overall representative, medoid model (most similar to other models).

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	**Residue range (total)**	**Backbone RMSD (Å)**	**Medoid model**
1	A:3-A:11 (9)	0.19	21

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 2 clusters and 1 single-model cluster was found.

Cluster number	Models
1	1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, 20, 21
2	3, 6, 15
Single-model clusters	17

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 195 atoms, of which 92 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called MAI126P.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	15	195	62	92	19	18	4	0

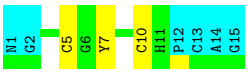
4 Residue-property plots (i)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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 outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

• Molecule 1: MAI126P

Chain A: 40% 20% 40%



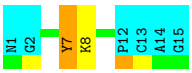
4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

• Molecule 1: MAI126P

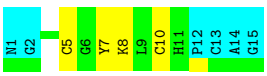
Chain A: 47% 7% 7% 40%



4.2.2 Score per residue for model 2

• Molecule 1: MAI126P

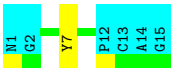
Chain A: 33% 27% 40%



4.2.3 Score per residue for model 3

- Molecule 1: MAI126P

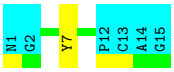
Chain A: 53% 7% 40%



4.2.4 Score per residue for model 4

- Molecule 1: MAI126P

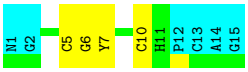
Chain A: 53% 7% 40%



4.2.5 Score per residue for model 5

- Molecule 1: MAI126P

Chain A: 33% 27% 40%



4.2.6 Score per residue for model 6

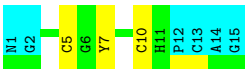
- Molecule 1: MAI126P

Chain A: 53% 7% 40%

4.2.7 Score per residue for model 7

- Molecule 1: MAI126P

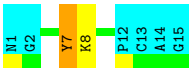
Chain A: 40% 20% 40%



4.2.8 Score per residue for model 8

- Molecule 1: MAI126P

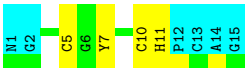
Chain A: 47% 7% 7% 40%



4.2.9 Score per residue for model 9

- Molecule 1: MAI126P

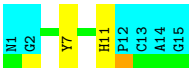
Chain A: 33% 27% 40%



4.2.10 Score per residue for model 10

- Molecule 1: MAI126P

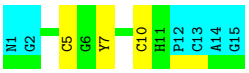
Chain A: 47% 13% 40%



4.2.11 Score per residue for model 11

- Molecule 1: MAI126P

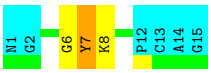
Chain A: 40% 20% 40%



4.2.12 Score per residue for model 12

- Molecule 1: MAI126P

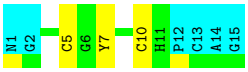
Chain A: 40% 13% 7% 40%



4.2.13 Score per residue for model 13

- Molecule 1: MAI126P

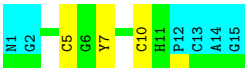
Chain A: 40% 20% 40%



4.2.14 Score per residue for model 14

- Molecule 1: MAI126P

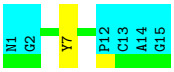
Chain A: 40% 20% 40%



4.2.15 Score per residue for model 15

- Molecule 1: MAI126P

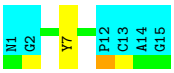
Chain A: 53% 7% 40%



4.2.16 Score per residue for model 16

- Molecule 1: MAI126P

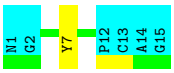
Chain A: 53% 7% 40%



4.2.17 Score per residue for model 17

- Molecule 1: MAI126P

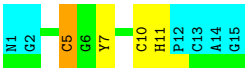
Chain A: 53% 7% 40%



4.2.18 Score per residue for model 18

- Molecule 1: MAI126P

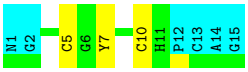
Chain A: 33% 20% 7% 40%



4.2.19 Score per residue for model 19

- Molecule 1: MAI126P

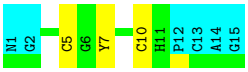
Chain A: 40% 20% 40%



4.2.20 Score per residue for model 20

- Molecule 1: MAI126P

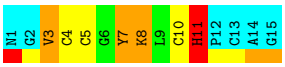
Chain A: 40% 20% 40%



4.2.21 Score per residue for model 21 (medoid)

- Molecule 1: MAI126P

Chain A: 13% 20% 20% 7% 40%



5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *DISTANCE GEOMETRY, SIMULATED ANNEALING, RESTRAINED MOLECULAR DYNAMICS, WATERGATE.*

Of the 50 calculated structures, 21 were deposited, based on the following criterion: *LOWEST ENERGY.*

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
CNS	refinement	
CNS	structure solution	1.1

No chemical shift data was provided.

6 Model quality (i)

6.1 Standard geometry (i)

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

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 (average) 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	1.22±4.01	1±4/69 (1.2± 5.2%)	1.43±4.61	1±5/91 (1.3± 5.9%)
All	All	4.20	17/1449 (1.2%)	4.82	25/1911 (1.3%)

All unique bond outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	7	TYR	CE1-CZ	-55.76	0.66	1.38	21	1
1	A	7	TYR	CG-CD2	-53.95	0.69	1.39	21	1
1	A	7	TYR	CE2-CZ	-52.77	0.69	1.38	21	1
1	A	7	TYR	CG-CD1	-50.96	0.72	1.39	21	1
1	A	8	LYS	CE-NZ	-49.86	0.24	1.49	21	1
1	A	11	HIS	CG-ND1	-44.43	0.41	1.38	21	1
1	A	11	HIS	CE1-NE2	-39.63	0.41	1.32	21	1
1	A	8	LYS	CD-CE	-38.15	0.55	1.51	21	1
1	A	11	HIS	CG-CD2	-35.55	0.75	1.35	21	1
1	A	11	HIS	CB-CG	-31.23	0.93	1.50	21	1
1	A	11	HIS	CD2-NE2	-30.23	0.71	1.38	21	1
1	A	8	LYS	CB-CG	-29.23	0.73	1.52	21	1
1	A	3	VAL	CB-CG2	-28.28	0.93	1.52	21	1
1	A	3	VAL	CB-CG1	-28.23	0.93	1.52	21	1
1	A	11	HIS	ND1-CE1	-19.82	0.85	1.34	21	1
1	A	4	CYS	CB-SG	-16.45	1.54	1.82	21	1
1	A	8	LYS	CG-CD	-11.63	1.12	1.52	21	1

All unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	7	TYR	CD1-CG-CD2	-89.99	18.91	117.90	21	1
1	A	7	TYR	CB-CG-CD1	83.53	171.12	121.00	21	1
1	A	7	TYR	CB-CG-CD2	81.63	169.98	121.00	21	1
1	A	7	TYR	CE1-CZ-CE2	-62.50	19.80	119.80	21	1
1	A	7	TYR	CG-CD1-CE1	61.76	170.71	121.30	21	1
1	A	7	TYR	CG-CD2-CE2	61.39	170.41	121.30	21	1
1	A	7	TYR	CZ-CE2-CD2	56.18	170.36	119.80	21	1
1	A	7	TYR	CD1-CE1-CZ	55.57	169.81	119.80	21	1
1	A	11	HIS	ND1-CG-CD2	-31.34	62.12	106.00	21	1
1	A	11	HIS	CG-CD2-NE2	21.48	150.02	109.20	21	1
1	A	7	TYR	OH-CZ-CE2	18.64	170.43	120.10	21	1
1	A	8	LYS	CA-CB-CG	18.44	153.97	113.40	21	1
1	A	8	LYS	CG-CD-CE	18.42	167.16	111.90	21	1
1	A	7	TYR	CE1-CZ-OH	18.40	169.77	120.10	21	1
1	A	11	HIS	CE1-NE2-CD2	-18.28	60.89	106.60	21	1
1	A	11	HIS	CG-ND1-CE1	17.02	132.03	108.20	21	1
1	A	8	LYS	CB-CG-CD	16.73	155.11	111.60	21	1
1	A	11	HIS	CA-CB-CG	16.07	140.92	113.60	21	1
1	A	3	VAL	CG1-CB-CG2	-12.51	90.89	110.90	21	1
1	A	11	HIS	ND1-CE1-NE2	11.38	134.93	109.90	21	1
1	A	8	LYS	CD-CE-NZ	10.44	135.70	111.70	21	1
1	A	3	VAL	CA-CB-CG1	10.14	126.11	110.90	21	1
1	A	3	VAL	CA-CB-CG2	9.96	125.84	110.90	21	1
1	A	11	HIS	CB-CG-CD2	9.67	160.78	130.80	21	1
1	A	11	HIS	CB-CG-ND1	5.56	137.10	123.20	21	1

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	68	37	64	3±10
All	All	1428	1317	1344	61

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 22.

All unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:8:LYS:CB	1:A:8:LYS:CD	1.54	1.81	21	1
1:A:7:TYR:CZ	1:A:7:TYR:CD1	1.50	1.99	21	1
1:A:7:TYR:CZ	1:A:7:TYR:CD2	1.46	2.03	21	1
1:A:7:TYR:CG	1:A:7:TYR:CE2	1.44	2.02	21	1
1:A:7:TYR:CG	1:A:7:TYR:CE1	1.43	2.06	21	1
1:A:8:LYS:NZ	1:A:8:LYS:CG	1.36	1.86	21	1
1:A:7:TYR:CD2	1:A:7:TYR:CB	1.28	2.15	21	1
1:A:3:VAL:CG2	1:A:3:VAL:CA	1.18	2.21	21	1
1:A:8:LYS:CG	1:A:8:LYS:CA	1.17	2.21	21	1
1:A:3:VAL:CA	1:A:3:VAL:CG1	1.16	2.22	21	1
1:A:7:TYR:CE1	1:A:7:TYR:OH	1.12	1.98	21	1
1:A:7:TYR:CD1	1:A:7:TYR:CB	1.03	2.19	21	1
1:A:3:VAL:CG1	1:A:3:VAL:HB	1.02	1.65	21	1
1:A:3:VAL:CG2	1:A:3:VAL:HB	1.01	1.65	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG22	1.01	1.55	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG21	1.01	1.55	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG11	1.00	1.55	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG13	0.98	1.55	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG23	0.98	1.55	21	1
1:A:3:VAL:CB	1:A:3:VAL:HG12	0.97	1.55	21	1
1:A:7:TYR:CE2	1:A:7:TYR:OH	0.94	2.02	21	1
1:A:3:VAL:CG2	1:A:3:VAL:CB	0.93	0.93	21	1
1:A:3:VAL:CG1	1:A:3:VAL:CB	0.93	0.93	21	1
1:A:8:LYS:NZ	1:A:8:LYS:HD3	0.90	1.31	21	1
1:A:8:LYS:CB	1:A:8:LYS:HD2	0.87	1.97	21	1
1:A:8:LYS:CD	1:A:8:LYS:NZ	0.79	0.74	21	1
1:A:8:LYS:CG	1:A:8:LYS:HB3	0.76	1.29	21	1
1:A:8:LYS:CG	1:A:8:LYS:HB2	0.75	1.29	21	1
1:A:8:LYS:CB	1:A:8:LYS:HG2	0.75	1.29	21	1
1:A:8:LYS:CB	1:A:8:LYS:HG3	0.74	1.29	21	1
1:A:8:LYS:NZ	1:A:8:LYS:HD2	0.74	1.13	21	1
1:A:8:LYS:CB	1:A:8:LYS:CG	0.70	0.73	21	1
1:A:8:LYS:NZ	1:A:8:LYS:HE3	0.67	1.05	21	1
1:A:8:LYS:NZ	1:A:8:LYS:HE2	0.66	1.05	21	1
1:A:7:TYR:CD1	1:A:7:TYR:CG	0.57	0.72	21	1
1:A:7:TYR:O	1:A:8:LYS:HG2	0.56	2.00	1	3
1:A:8:LYS:HD2	1:A:8:LYS:HZ3	0.55	0.97	21	1
1:A:7:TYR:CZ	1:A:7:TYR:CE2	0.55	0.70	21	1
1:A:7:TYR:CZ	1:A:7:TYR:CE1	0.53	0.66	21	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:11:HIS:CG	1:A:11:HIS:HD2	0.52	1.34	21	1
1:A:7:TYR:CD2	1:A:7:TYR:CG	0.52	0.69	21	1
1:A:3:VAL:CG1	1:A:3:VAL:C	0.51	2.79	21	1
1:A:8:LYS:CB	1:A:8:LYS:HD3	0.48	2.16	21	1
1:A:5:CYS:HA	1:A:10:CYS:HA	0.47	1.85	18	11
1:A:7:TYR:CG	1:A:7:TYR:HD1	0.47	1.22	21	1
1:A:7:TYR:CZ	1:A:7:TYR:HE2	0.44	1.21	21	1
1:A:7:TYR:CG	1:A:7:TYR:HD2	0.44	1.20	21	1
1:A:7:TYR:CZ	1:A:7:TYR:HE1	0.43	1.18	21	1
1:A:11:HIS:CD2	1:A:11:HIS:CE1	0.41	0.62	21	1

6.3 Torsion angles (i)

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	9/15 (60%)	8±0 (84±5%)	1±0 (15±5%)	0±0 (1±3%)	18	66
All	All	189/315 (60%)	159 (84%)	28 (15%)	2 (1%)	18	66

All 1 unique Ramachandran outliers are listed below.

Mol	Chain	Res	Type	Models (Total)
1	A	6	GLY	2

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	8/10 (80%)	7±1 (85±7%)	1±1 (15±7%)	5	43
All	All	168/210 (80%)	142 (85%)	26 (15%)	5	43

All 4 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	7	TYR	20
1	A	11	HIS	4
1	A	8	LYS	1
1	A	5	CYS	1

6.3.3 RNA (i)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains (i)

1 non-standard protein/DNA/RNA residue is modelled in this entry.

In the following table, the Counts columns list the number of bonds for which Mogul statistics could be retrieved, the number of bonds that are observed in the model and the number of bonds 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 is the number of standard deviations the observed value is removed from the expected value. A bond length with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond lengths.

Mol	Type	Chain	Res	Link	Bond lengths		
					Counts	RMSZ	#Z>2
1	HYP	A	12	1	7,8,9	1.18±0.15	1±0 (12±6%)

In the following table, the Counts columns list the number of angles for which Mogul statistics could be retrieved, the number of angles that are observed in the model and the number of 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 angle is the number of standard deviations the observed value is removed from the expected value. A bond angle with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond angles.

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
1	HYP	A	12	1	5,10,12	1.90±0.11	1±0 (20±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
1	HYP	A	12	1	-	0±0,0,11,13	0±0,1,1,1

All unique bond outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)	Models	
								Worst	Total
1	A	12	HYP	CB-CG	3.07	1.47	1.52	21	18
1	A	12	HYP	CD-CG	2.52	1.48	1.53	21	1

All unique angle outliers are listed below.

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	12	HYP	CB-CG-CD	4.15	107.78	103.16	9	21

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

6.5 Carbohydrates (i)

There are no monosaccharides in this entry.

6.6 Ligand geometry (i)

There are no ligands in this entry.

6.7 Other polymers (i)

There are no such molecules in this entry.

6.8 Polymer linkage issues (i)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	21-A	3

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
21	A	14:ALA	C	15:GLY	N	1.03
21	A	1:ASN	C	2:GLY	N	1.01
21	A	13:CYS	C	14:ALA	N	0.98

7 Chemical shift validation (i)

No chemical shift data were provided