wwPDB NMR Structure Validation Summary Report (i)

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PDB ID	:	2KLW
Title	:	Solution structure of an abc collagen heterotrimer reveals a single-register helix stabilized by electrostatic interactions
Authors	:	Fallas, J.A.; Gauba, V.; Hartgerink, J.D.
Deposited on	:	2009-07-09

This is a wwPDB NMR 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/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

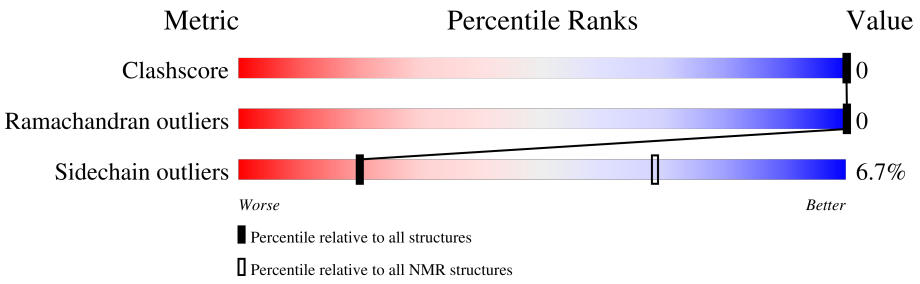
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	2.27
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.27

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	32	75% 25%
2	B	32	47% 53%
3	C	32	44% 56%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA and RNA chains that are outliers for geometric criteria:

Mol	Chain	Compound	Res	Total models with violations	
				Chirality	Geometry
3	C	HYP	67	2	-

2 Ensemble composition and analysis (i)

This entry contains 15 models. Model 11 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *lowest energy*.

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:6-A:29, B:39-B:40, B:42-B:43, B:45-B:46, B:48-B:49, B:51-B:52, B:54-B:55, B:57-B:58, B:60-B:60, C:72-C:72, C:74-C:75, C:77-C:78, C:80-C:81, C:83-C:84, C:86-C:87, C:89-C:90, C:92-C:92 (53)	0.39	11

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 3 clusters and 1 single-model cluster was found.

Cluster number	Models
1	1, 5, 6, 9, 11, 13, 14, 15
2	2, 3, 7, 8
3	4, 10
Single-model clusters	12

3 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 1157 atoms, of which 555 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called (PKG)10.

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
1	A	32	439	132	235	41	31	1

- Molecule 2 is a protein called (DOG)10.

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
2	B	32	349	112	145	31	61	1

- Molecule 3 is a protein called (POG)10.

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
3	C	32	369	122	175	31	41	1

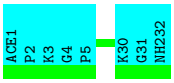
4 Residue-property plots (i)

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: (PKG)10

Chain A: 75% 25%

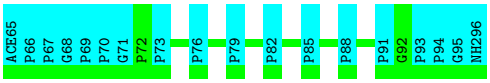


- Molecule 2: (DOG)10

Chain B: 47% 53%

- Molecule 3: (POG)10

Chain C: 44% 56%

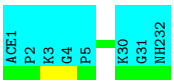


4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 11. Colouring as in section 4.1 above.

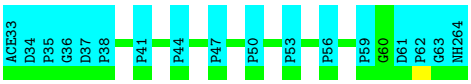
- Molecule 1: (PKG)10

Chain A: 75% 25%



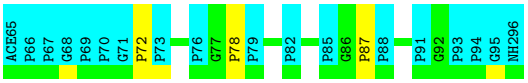
- Molecule 2: (DOG)10

Chain B: 47% 53%



- Molecule 3: (POG)10

Chain C: 34% 9% 56%



5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *simulated annealing, constraint minimization.*

Of the 300 calculated structures, 15 were deposited, based on the following criterion: *structures with the lowest energy.*

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

Software name	Classification	Version
CNS	structure solution	v 1.21
Amber	refinement	9

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, NH2, ACE

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

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
All	All	4875	4590	4590	-

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 -.

There are no clashes.

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	24/32 (75%)	24±0 (100±0%)	0±0 (0±0%)	0±0 (0±0%)	100	100
2	B	15/32 (47%)	15±0 (100±0%)	0±0 (0±0%)	0±0 (0±0%)	100	100
3	C	14/32 (44%)	14±0 (100±2%)	0±0 (0±2%)	0±0 (0±0%)	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	795/1440 (55%)	794 (100%)	1 (0%)	0 (0%)	100 100

There are no Ramachandran outliers.

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	16/20 (80%)	16±0 (100±0%)	0±0 (0±0%)	100 100
2	B	7/10 (70%)	7±1 (96±8%)	0±1 (4±8%)	36 84
3	C	7/10 (70%)	5±1 (75±20%)	2±1 (25±20%)	2 25
All	All	450/600 (75%)	420 (93%)	30 (7%)	20 68

5 of 9 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)
3	C	81	PRO	6
3	C	87	PRO	5
3	C	75	PRO	4
3	C	78	PRO	4
3	C	72	PRO	3

6.3.3 RNA (i)

There are no RNA molecules in this entry.

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

20 non-standard protein/DNA/RNA residues are 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
2	HYP	B	44	2	6,8,9	0.51±0.02	0±0 (0±0%)
3	HYP	C	85	3	6,8,9	0.51±0.01	0±0 (0±0%)
2	HYP	B	56	2	6,8,9	0.51±0.01	0±0 (0±0%)
3	HYP	C	70	3	6,8,9	0.51±0.02	0±0 (0±0%)
2	HYP	B	50	2	6,8,9	0.52±0.01	0±0 (0±0%)
2	HYP	B	47	2	6,8,9	0.51±0.01	0±0 (0±0%)
3	HYP	C	94	3	6,8,9	0.50±0.02	0±0 (0±0%)
2	HYP	B	59	2	6,8,9	0.51±0.02	0±0 (0±0%)
3	HYP	C	76	3	6,8,9	0.50±0.01	0±0 (0±0%)
3	HYP	C	82	3	6,8,9	0.50±0.02	0±0 (0±0%)
2	HYP	B	53	2	6,8,9	0.51±0.01	0±0 (0±0%)
2	HYP	B	41	2	6,8,9	0.51±0.01	0±0 (0±0%)
2	HYP	B	62	2	6,8,9	0.51±0.03	0±0 (0±0%)
3	HYP	C	73	3	6,8,9	0.52±0.02	0±0 (0±0%)
3	HYP	C	88	3	6,8,9	0.52±0.01	0±0 (0±0%)
2	HYP	B	38	2	6,8,9	0.50±0.02	0±0 (0±0%)
2	HYP	B	35	2	6,8,9	0.49±0.03	0±0 (0±0%)
3	HYP	C	91	3	6,8,9	0.50±0.03	0±0 (0±0%)
3	HYP	C	67	3	6,8,9	0.50±0.03	0±0 (0±0%)
3	HYP	C	79	3	6,8,9	0.50±0.01	0±0 (0±0%)

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
2	HYP	B	44	2	5,10,12	0.83±0.24	0±0 (2±9%)
3	HYP	C	85	3	5,10,12	0.79±0.02	0±0 (0±0%)
2	HYP	B	56	2	5,10,12	0.78±0.03	0±0 (0±0%)
3	HYP	C	70	3	5,10,12	0.83±0.03	0±0 (0±0%)
2	HYP	B	50	2	5,10,12	0.90±0.28	0±0 (1±4%)
2	HYP	B	47	2	5,10,12	0.75±0.20	0±0 (2±9%)
3	HYP	C	94	3	5,10,12	0.88±0.11	0±0 (2±6%)
2	HYP	B	59	2	5,10,12	0.86±0.11	0±0 (0±0%)

Mol	Type	Chain	Res	Link	Bond angles		
					Counts	RMSZ	#Z>2
3	HYP	C	76	3	5,10,12	0.84±0.03	0±0 (0±0%)
3	HYP	C	82	3	5,10,12	0.83±0.17	0±0 (0±0%)
2	HYP	B	53	2	5,10,12	0.73±0.05	0±0 (0±0%)
2	HYP	B	41	2	5,10,12	0.90±0.25	0±1 (5±13%)
2	HYP	B	62	2	5,10,12	0.84±0.17	0±0 (4±8%)
3	HYP	C	73	3	5,10,12	1.07±0.40	1±1 (13±18%)
3	HYP	C	88	3	5,10,12	0.81±0.03	0±0 (0±0%)
2	HYP	B	38	2	5,10,12	0.88±0.27	0±1 (4±10%)
2	HYP	B	35	2	5,10,12	0.91±0.17	0±0 (5±8%)
3	HYP	C	91	3	5,10,12	0.89±0.26	0±1 (5±13%)
3	HYP	C	67	3	5,10,12	0.94±0.21	0±0 (4±8%)
3	HYP	C	79	3	5,10,12	0.77±0.02	0±0 (0±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
2	HYP	B	59	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	94	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	53	2	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	41	2	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	35	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	67	3	1±0,1,2,4	0±0,0,11,13	0±0,1,1,1
3	HYP	C	88	3	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	82	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	62	2	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	44	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	91	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	50	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	73	3	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	85	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	38	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	70	3	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	76	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	56	2	-	0±0,0,11,13	0±0,1,1,1
3	HYP	C	79	3	-	0±0,0,11,13	0±0,1,1,1
2	HYP	B	47	2	-	0±0,0,11,13	0±0,1,1,1

There are no bond-length outliers.

5 of 17 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
3	C	73	HYP	CG-CB-CA	2.48	107.09	103.96	11	5
3	C	73	HYP	CB-CG-CD	2.40	106.20	103.27	14	5
2	B	44	HYP	CB-CG-CD	2.36	106.16	103.27	5	1
2	B	44	HYP	CG-CB-CA	2.35	106.93	103.96	5	1
2	B	35	HYP	O-C-CA	2.33	118.67	124.78	5	4

All unique chiral outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Atoms	Models (Total)
3	C	67	HYP	CG	1
3	C	67	HYP	CA	1

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)

There are no chain breaks in this entry.

7 Chemical shift validation (i)

No chemical shift data were provided