wwPDB NMR Structure Validation Summary Report (i)

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PDB ID	:	2BGO
Title	:	MANNAN BINDING MODULE FROM MAN5C
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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
http://wwpdb.org/validation/2016/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

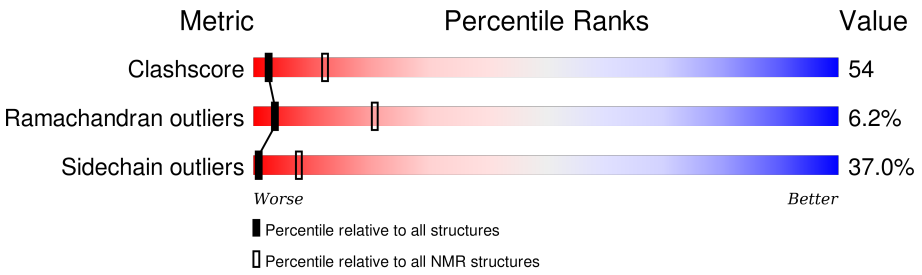
Cyrange	:	Kirchner and Güntert (2011)
NmrClust	:	Kelley et al. (1996)
MolProbity	:	4.02b-467
Mogul	:	unknown
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
ShiftChecker	:	rb-20027457
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20027457

1 Overall quality at a glance (i)

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

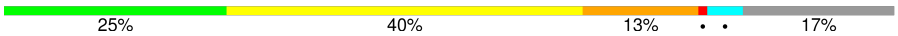
The overall completeness of chemical shifts assignment is 93%.

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	114402	11133
Ramachandran outliers	111179	9975
Sidechain outliers	111093	9958

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	140	

2 Ensemble composition and analysis (i)

This entry contains 5 models. Model 1 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:12-A:121 (110)	0.30	1

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. No single-model clusters were found.

Cluster number	Models
1	1, 3, 4
2	2, 5

3 Entry composition (i)

There is only 1 type of molecule in this entry. The entry contains 1709 atoms, of which 844 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called ENDO-B1,4-MANNANASE 5C.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	116	1709	551	844	142	170	2	0

4 Residue-property plots (i)

4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA 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: ENDO-B1,4-MANNANASE 5C

Chain A: 25% 40% 13% • • 17%

MET ALA VAL PRO GLU GLY ASN S8 W9 T10 Y11 T12 A13 A14 S15 I18 T19 A20 P21 A22 Q23 L24 N27 V28 G29 E30 L31 Q32 G33 A34 G35 S36 A37 V38 I39 W40 V44 P45 V46 T47 Y50 R51 I52 N53 L54 T55 W56 Y60 S61 S62 K63 V64 N65 T66 L67

V68 M69 L74 S75 Y76 A77 F78 A79 E80 A81 T82 V83 P84 V85 T86 Y87 V88 Q89 T90 K91 T92 L93 S94 N97 H98 S99 F100 G101 V102 R103 V104 G105 D108 W109 G110 Y111 M112 N113 V114 H115 S116 L117 K118 L119 E120 L121 L122 G123 GLY LEU THR ILE ARG SER PRO ALA ASN

LEU GLU HIS HIS HIS HIS HIS

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

The representative model is number 1. Colouring as in section 4.1 above.

- Molecule 1: ENDO-B1,4-MANNANASE 5C

Chain A: 24% 41% 11% • • 17%

MET ALA VAL PRO GLU GLY ASN S8 W9 T10 Y11 T12 A13 A14 S15 A16 S17 I18 T19 A20 P21 A22 Q23 L24 N27 V28 G29 E30 L31 Q32 G33 A34 G35 S36 A37 V38 I39 W40 V41 V42 D43 V44 P45 V46 T47 Y50 R51 I52 N53 L54 T55 S58 F59 Y60 S61 S62 K63

V64 L67 V68 M69 L74 S75 Y76 A77 F78 A79 E80 A81 T82 V83 P84 V85 T86 Y87 V88 Q89 T90 K91 T92 L93 S94 A95 F100 G101 V102 R103 V104 G105 S106 S107 D108 W109 G110 Y111 M112 N113 V114 H115 S116 L117 K118 L119 E120 L121 L122 G123 GLY LEU THR ILE ARG SER PRO

ALA ASN LEU GLU HIS HIS HIS HIS HIS HIS

5 Refinement protocol and experimental data overview (i)

Of the 80 calculated structures, 5 were deposited, based on the following criterion: *RANDOM 5 STRUCTURES FROM 20 LOWEST ENERGY*.

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

Software name	Classification	Version
CNS	refinement	
FELIX	structure solution	
CNS	structure solution	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	BMRB entry 6475
Number of chemical shift lists	1
Total number of shifts	1492
Number of shifts mapped to atoms	1492
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	93%

No validations of the models with respect to experimental NMR restraints is performed at this time.

6 Model quality (i)

6.1 Standard geometry (i)

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
1	A	814	799	797	86±9
All	All	4070	3995	3985	432

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 54.

5 of 222 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:31:LEU:HD21	1:A:38:VAL:HG22	1.06	1.26	5	5
1:A:67:LEU:HD11	1:A:69:MET:CE	0.86	2.00	1	4
1:A:83:VAL:O	1:A:85:VAL:HG23	0.86	1.70	3	5
1:A:18:ILE:HD11	1:A:24:LEU:HD23	0.85	1.48	1	5
1:A:38:VAL:HG21	1:A:114:VAL:HG21	0.85	1.49	2	5

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	110/140 (79%)	86±2 (78±2%)	17±2 (15±2%)	7±1 (6±1%)	4 21
All	All	550/700 (79%)	431 (78%)	85 (15%)	34 (6%)	4 21

5 of 14 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	84	PRO	5
1	A	111	TYR	5
1	A	61	SER	5
1	A	33	GLY	3
1	A	62	SER	3

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	88/113 (78%)	55±2 (63±3%)	33±2 (37±3%)	1 8
All	All	440/565 (78%)	277 (63%)	163 (37%)	1 8

5 of 54 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	38	VAL	5
1	A	47	THR	5
1	A	82	THR	5
1	A	111	TYR	5
1	A	46	VAL	5

6.3.3 RNA (i)

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.5 Carbohydrates (i)

There are no carbohydrates 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)

The completeness of assignment taking into account all chemical shift lists is 93% for the well-defined parts and 93% for the entire structure.

7.1 Chemical shift list 1

File name: BMRB entry 6475

Chemical shift list name: *assigned_ chem_ shift_ list_ 1*

7.1.1 Bookkeeping (i)

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	1492
Number of shifts mapped to atoms	1492
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	6

7.1.2 Chemical shift referencing (i)

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction ± precision, *ppm*	Suggested action
$^{13}C_{\alpha}$	126	-0.02 ± 0.23	None needed (< 0.5 ppm)
$^{13}C_{\beta}$	112	0.33 ± 0.13	None needed (< 0.5 ppm)
$^{13}C'$	122	0.53 ± 0.15	Should be applied
^{15}N	119	-1.36 ± 0.41	Should be applied

7.1.3 Completeness of resonance assignments (i)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 93%, i.e. 1132 atoms were assigned a chemical shift out of a possible 1222. 23 out of 23 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	541/542 (100%)	216/216 (100%)	219/220 (100%)	106/106 (100%)
Sidechain	513/570 (90%)	308/328 (94%)	196/224 (88%)	9/18 (50%)

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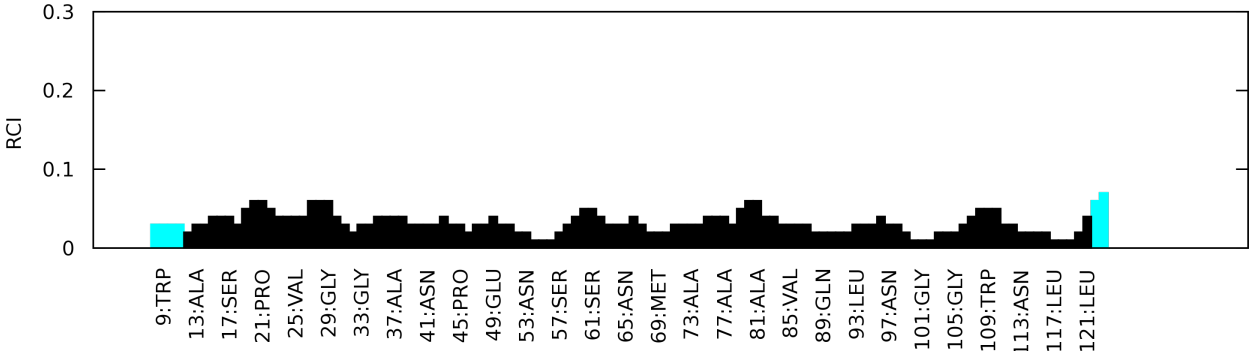
	Total	^{1}H	^{13}C	^{15}N
Aromatic	78/110 (71%)	39/56 (70%)	36/47 (77%)	3/7 (43%)
Overall	1132/1222 (93%)	563/600 (94%)	451/491 (92%)	118/131 (90%)

7.1.4 Statistically unusual chemical shifts (i)

The following table lists the statistically unusual chemical shifts. These are statistical measures, and large deviations from the mean do not necessarily imply incorrect assignments. Molecules containing paramagnetic centres or hemes are expected to give rise to anomalous chemical shifts.

Mol	Chain	Res	Type	Atom	Shift, *ppm*	Expected range, *ppm*	Z-score
1	A	117	LEU	HB2	-0.58	3.32 – -0.08	-6.5
1	A	16	ALA	HB2	-0.09	2.61 – 0.11	-5.8
1	A	16	ALA	HB3	-0.09	2.61 – 0.11	-5.8
1	A	16	ALA	HB1	-0.09	2.61 – 0.11	-5.8
1	A	76	TYR	HD1	5.29	8.44 – 5.44	-5.5
1	A	85	VAL	HB	0.32	3.59 – 0.39	-5.2

7.1.5 Random Coil Index (RCI) plots (i)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition.

Random coil index (RCI) for chain A: