



Full wwPDB NMR Structure Validation Report ⓘ

Mar 5, 2026 – 03:30 PM UTC

PDB ID : 2LTD / pdb_00002ltd
BMRB ID : 18469
Title : Solution NMR Structure of apo YdbC from *Lactococcus lactis*, Northeast Structural Genomics Consortium (NESG) Target KR150
Authors : Rossi, P.; Barbieri, C.M.; Aramini, J.M.; Bini, E.; Lee, H.; Janjua, H.; Ciccosanti, C.; Wang, H.; Acton, T.B.; Xiao, R.; Everett, J.K.; Montelione, G.T.; Northeast Structural Genomics Consortium (NESG)
Deposited on : 2012-05-16

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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

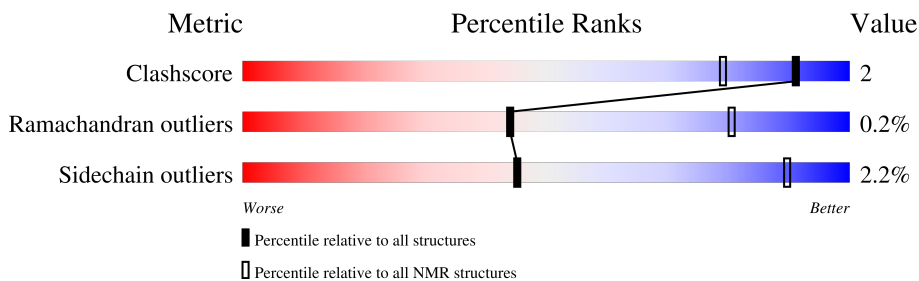
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLUTION NMR

The overall completeness of chemical shifts assignment is 46%.

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	229148	14424
Ramachandran outliers	224038	12848
Sidechain outliers	223484	12823

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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	80	
1	B	80	

2 Ensemble composition and analysis i

This entry contains 20 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:73, B:6-B:73 (136)	0.56	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 4 clusters and 5 single-model clusters were found.

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

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 2658 atoms, of which 1320 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Uncharacterized protein ydbC.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	80	1329	424	660	119	124	2	0
1	B	80	1329	424	660	119	124	2	0

There are 16 discrepancies between the modelled and reference sequences:

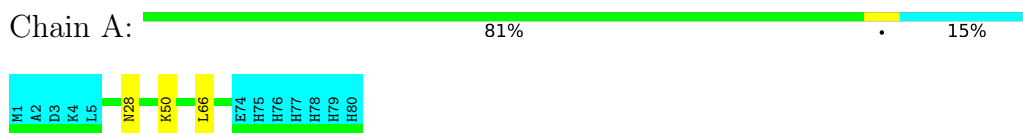
Chain	Residue	Modelled	Actual	Comment	Reference
A	73	LEU	-	expression tag	UNP Q9CIP3
A	74	GLU	-	expression tag	UNP Q9CIP3
A	75	HIS	-	expression tag	UNP Q9CIP3
A	76	HIS	-	expression tag	UNP Q9CIP3
A	77	HIS	-	expression tag	UNP Q9CIP3
A	78	HIS	-	expression tag	UNP Q9CIP3
A	79	HIS	-	expression tag	UNP Q9CIP3
A	80	HIS	-	expression tag	UNP Q9CIP3
B	73	LEU	-	expression tag	UNP Q9CIP3
B	74	GLU	-	expression tag	UNP Q9CIP3
B	75	HIS	-	expression tag	UNP Q9CIP3
B	76	HIS	-	expression tag	UNP Q9CIP3
B	77	HIS	-	expression tag	UNP Q9CIP3
B	78	HIS	-	expression tag	UNP Q9CIP3
B	79	HIS	-	expression tag	UNP Q9CIP3
B	80	HIS	-	expression tag	UNP Q9CIP3

4 Residue-property plots [i](#)

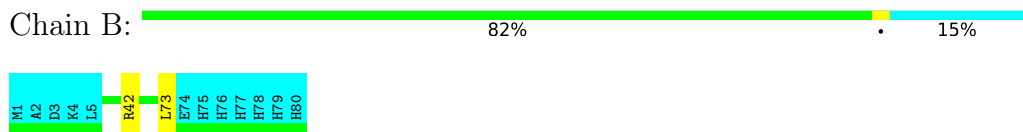
4.1 Average score per residue in the NMR ensemble

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: Uncharacterized protein ydbC



- Molecule 1: Uncharacterized protein ydbC

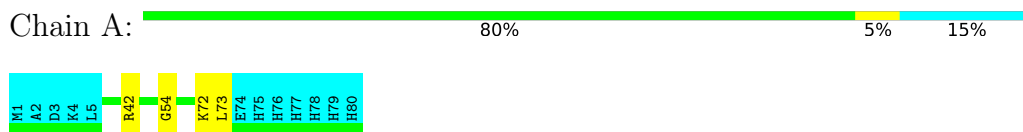


4.2 Scores per residue for each member of the ensemble

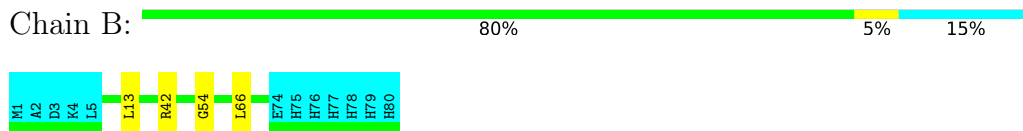
Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

- Molecule 1: Uncharacterized protein ydbC

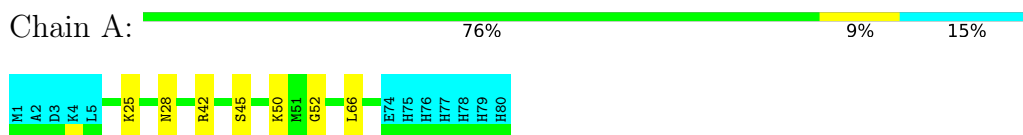


- Molecule 1: Uncharacterized protein ydbC

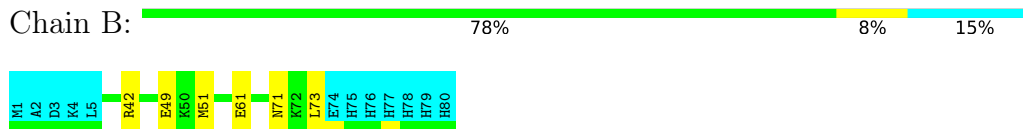


4.2.2 Score per residue for model 2

- Molecule 1: Uncharacterized protein ydbC

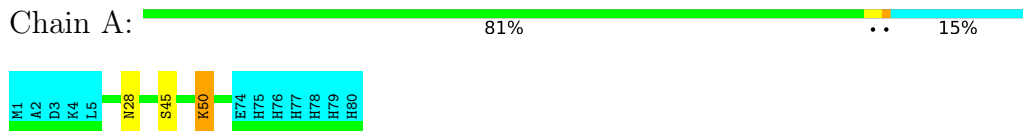


- Molecule 1: Uncharacterized protein ydbC

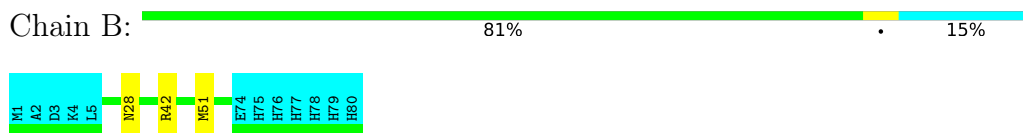


4.2.3 Score per residue for model 3

- Molecule 1: Uncharacterized protein ydbC

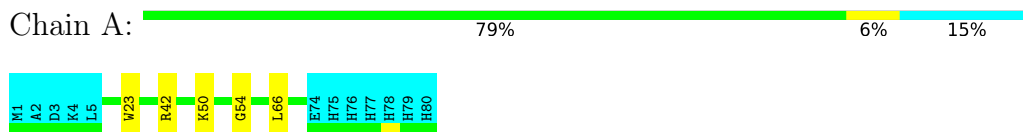


- Molecule 1: Uncharacterized protein ydbC

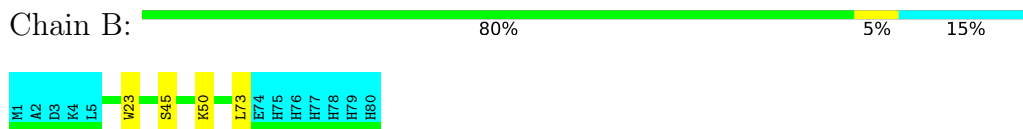


4.2.4 Score per residue for model 4

- Molecule 1: Uncharacterized protein ydbC

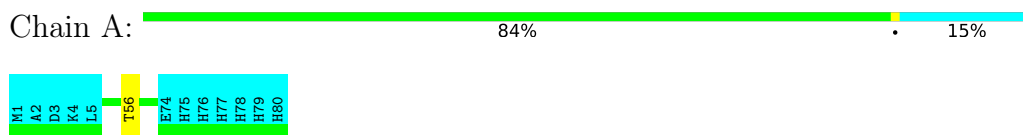


- Molecule 1: Uncharacterized protein ydbC

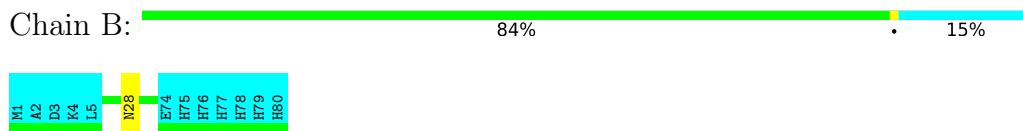


4.2.5 Score per residue for model 5

- Molecule 1: Uncharacterized protein ydbC

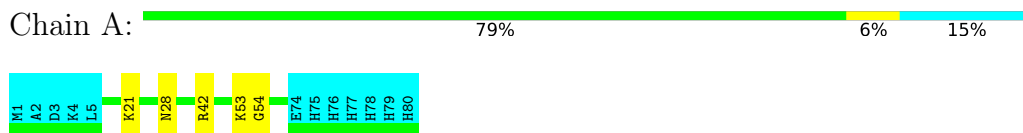


- Molecule 1: Uncharacterized protein ydbC

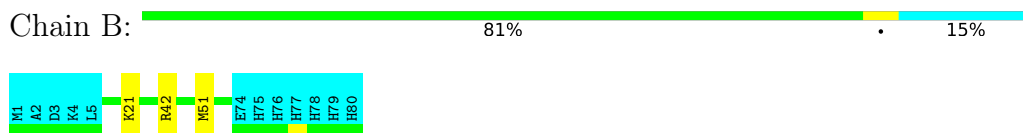


4.2.6 Score per residue for model 6

- Molecule 1: Uncharacterized protein ydbC

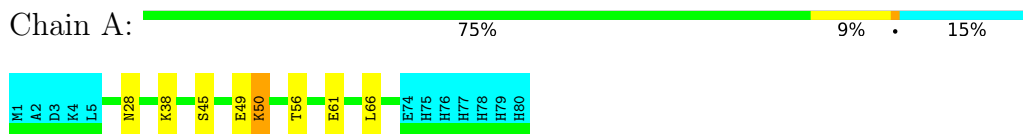


- Molecule 1: Uncharacterized protein ydbC

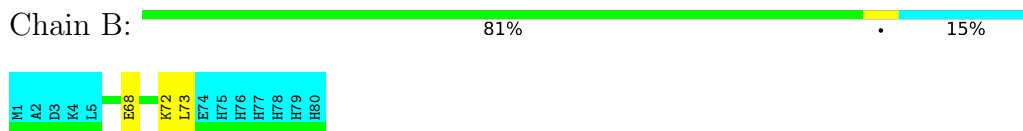


4.2.7 Score per residue for model 7

- Molecule 1: Uncharacterized protein ydbC

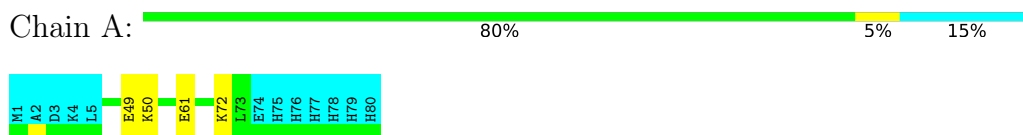


- Molecule 1: Uncharacterized protein ydbC

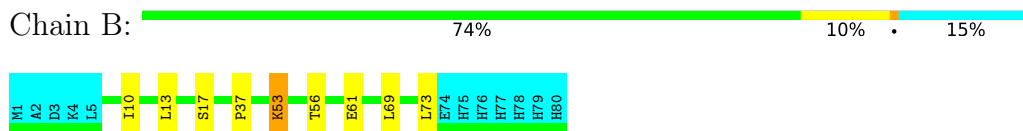


4.2.8 Score per residue for model 8

- Molecule 1: Uncharacterized protein ydbC

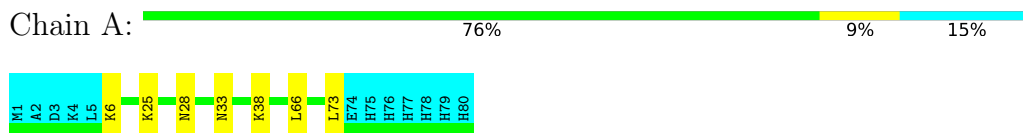


- Molecule 1: Uncharacterized protein ydbC

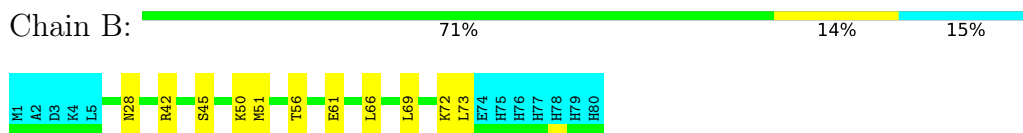


4.2.9 Score per residue for model 9

- Molecule 1: Uncharacterized protein ydbC

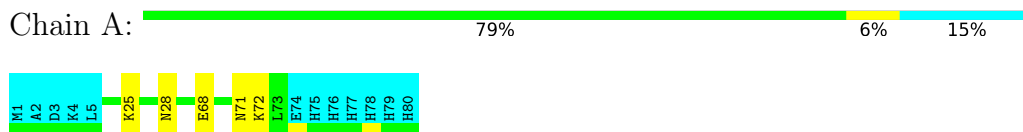


- Molecule 1: Uncharacterized protein ydbC

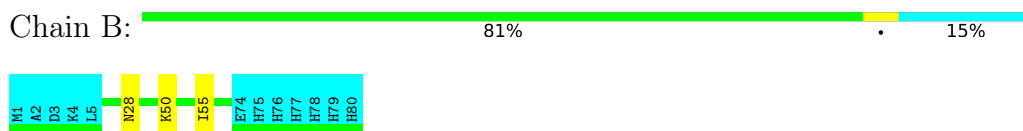


4.2.10 Score per residue for model 10

- Molecule 1: Uncharacterized protein ydbC

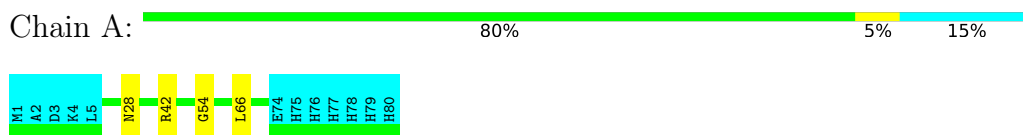


- Molecule 1: Uncharacterized protein ydbC

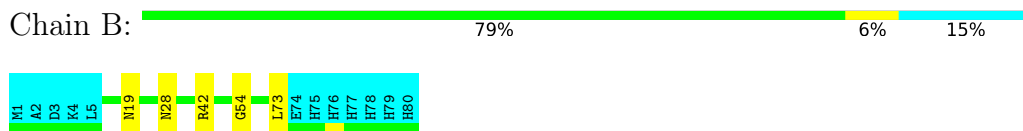


4.2.11 Score per residue for model 11 (medoid)

- Molecule 1: Uncharacterized protein ydbC

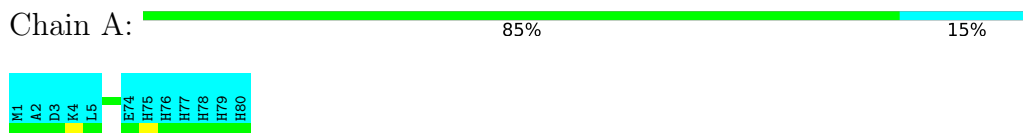


- Molecule 1: Uncharacterized protein ydbC

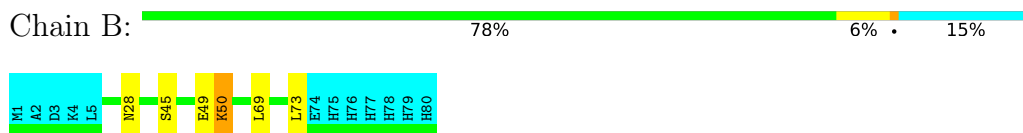


4.2.12 Score per residue for model 12

- Molecule 1: Uncharacterized protein ydbC

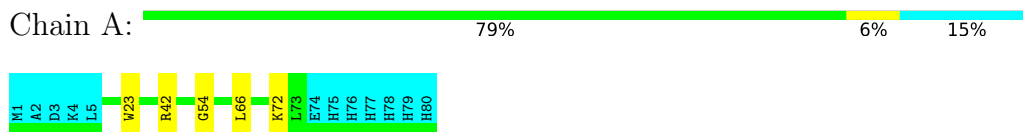


- Molecule 1: Uncharacterized protein ydbC

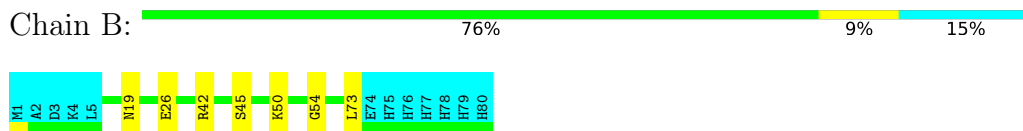


4.2.13 Score per residue for model 13

- Molecule 1: Uncharacterized protein ydbC

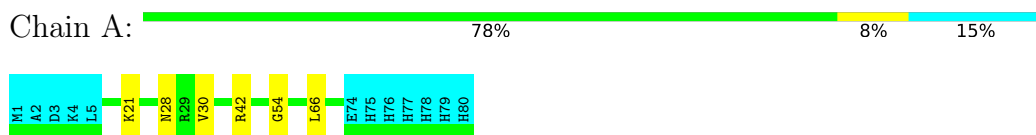


- Molecule 1: Uncharacterized protein ydbC

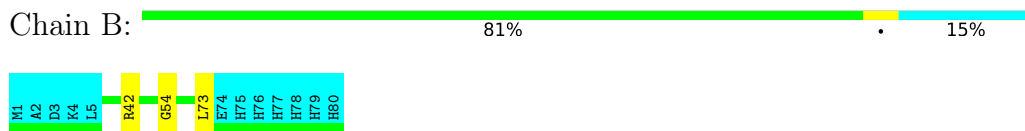


4.2.14 Score per residue for model 14

- Molecule 1: Uncharacterized protein ydbC

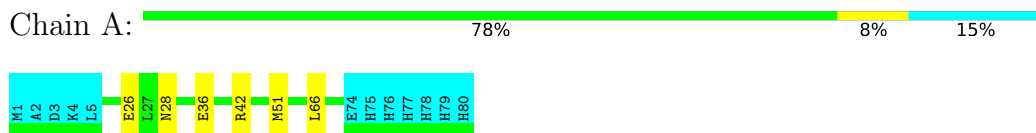


- Molecule 1: Uncharacterized protein ydbC

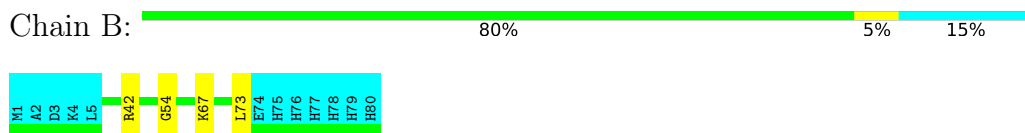


4.2.15 Score per residue for model 15

- Molecule 1: Uncharacterized protein ydbC

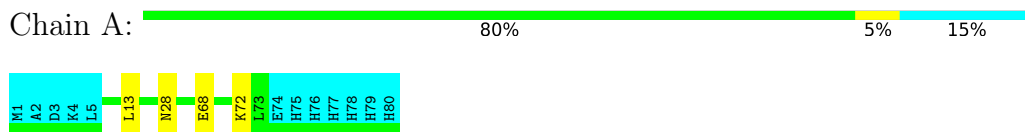


- Molecule 1: Uncharacterized protein ydbC

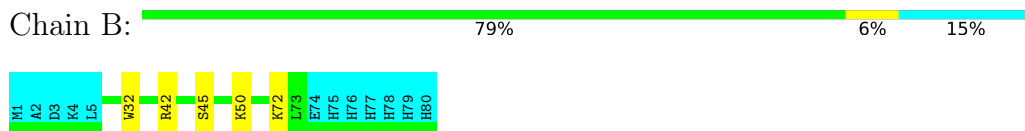


4.2.16 Score per residue for model 16

- Molecule 1: Uncharacterized protein ydbC

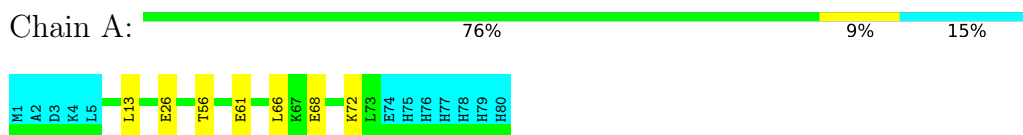


- Molecule 1: Uncharacterized protein ydbC

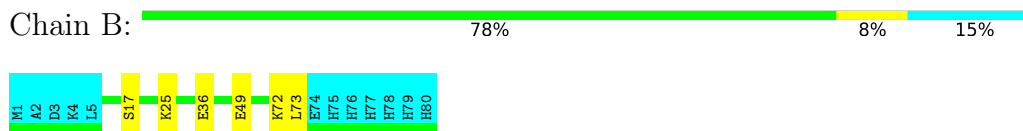


4.2.17 Score per residue for model 17

- Molecule 1: Uncharacterized protein ydbC

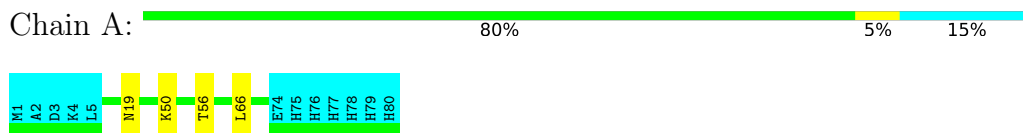


- Molecule 1: Uncharacterized protein ydbC

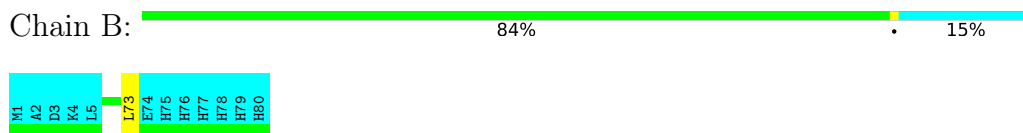


4.2.18 Score per residue for model 18

- Molecule 1: Uncharacterized protein ydbC

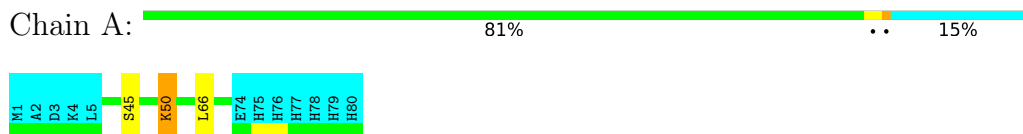


- Molecule 1: Uncharacterized protein ydbC

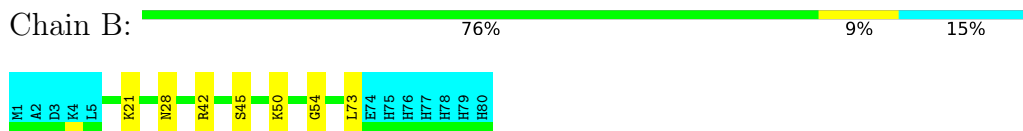


4.2.19 Score per residue for model 19

- Molecule 1: Uncharacterized protein ydbC




- Molecule 1: Uncharacterized protein ydbC




4.2.20 Score per residue for model 20

- Molecule 1: Uncharacterized protein ydbC

Chain A:  75% 9% 15%



- Molecule 1: Uncharacterized protein ydbC

Chain B:  76% 6% 15%



5 Refinement protocol and experimental data overview

The models were refined using the following method: *molecular dynamics*.

Of the 100 calculated structures, 20 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	refinement	
CNS	structure solution	
CNS	geometry optimization	
CYANA	refinement	3.0
CYANA	geometry optimization	3.0
CYANA	structure solution	3.0
TALOS+	geometry optimization	
PALES	geometry optimization	

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)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	953
Number of shifts mapped to atoms	953
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	46%

6 Model quality i

6.1 Standard geometry i

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	1.12±0.04	0±0/573 (0.0± 0.0%)	0.93±0.03	0±0/771 (0.0± 0.0%)
1	B	1.12±0.03	0±0/573 (0.0± 0.0%)	0.92±0.02	0±0/771 (0.0± 0.0%)
All	All	1.12	2/22920 (0.0%)	0.93	3/30840 (0.0%)

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	36	GLU	C-N	5.06	1.39	1.33	15	1
1	B	36	GLU	C-N	5.03	1.38	1.33	17	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(°)	Ideal(°)	Models	
								Worst	Total
1	B	19	ASN	CA-CB-CG	5.52	118.12	112.60	11	2
1	A	19	ASN	CA-CB-CG	5.26	117.86	112.60	18	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	561	562	561	2±1

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Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	B	561	562	561	2±1
All	All	22440	22480	22440	70

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 2.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:B:42:ARG:HB3	1:B:54:GLY:HA3	0.65	1.68	13	6
1:A:42:ARG:HB3	1:A:54:GLY:HA3	0.61	1.72	4	6
1:A:66:LEU:HB3	1:B:73:LEU:HD21	0.60	1.71	4	11
1:A:42:ARG:HH11	1:A:42:ARG:HG3	0.56	1.60	20	1
1:A:25:LYS:HD2	1:B:61:GLU:HG2	0.53	1.80	2	2
1:A:42:ARG:HD3	1:A:51:MET:HB2	0.52	1.80	15	2
1:B:42:ARG:HD3	1:B:51:MET:HB2	0.50	1.83	2	4
1:A:25:LYS:HG3	1:B:55:ILE:HD11	0.50	1.84	10	1
1:A:13:LEU:HB3	1:B:72:LYS:HE3	0.49	1.83	16	2
1:B:17:SER:HB3	1:B:25:LYS:HB3	0.48	1.84	17	1
1:A:45:SER:HB3	1:A:50:LYS:HB2	0.47	1.86	7	4
1:A:61:GLU:HG2	1:B:17:SER:HB2	0.47	1.87	8	1
1:B:53:LYS:H	1:B:53:LYS:HD2	0.46	1.70	8	1
1:A:28:ASN:ND2	1:A:30:VAL:HG23	0.44	2.27	14	1
1:A:49:GLU:HG3	1:A:50:LYS:HG3	0.43	1.90	8	1
1:B:45:SER:HB3	1:B:50:LYS:HB2	0.43	1.88	19	5
1:A:13:LEU:HB3	1:B:72:LYS:HE2	0.43	1.91	20	1
1:A:42:ARG:HD3	1:A:52:GLY:H	0.43	1.73	2	1
1:A:68:GLU:O	1:A:72:LYS:HG3	0.43	2.13	16	3
1:A:72:LYS:HE3	1:B:13:LEU:HB3	0.42	1.89	1	2
1:B:69:LEU:O	1:B:73:LEU:HG	0.42	2.15	8	2
1:A:73:LEU:HD21	1:B:66:LEU:HB3	0.42	1.92	9	2
1:B:69:LEU:HD23	1:B:72:LYS:HD3	0.42	1.90	9	1
1:A:6:LYS:HB2	1:A:33:ASN:HA	0.42	1.92	9	1
1:B:50:LYS:HA	1:B:50:LYS:HE2	0.42	1.91	10	1
1:B:32:TRP:HZ2	1:B:42:ARG:HH12	0.41	1.59	16	1
1:B:10:ILE:HG13	1:B:37:PRO:HB3	0.41	1.92	8	1
1:A:69:LEU:O	1:A:73:LEU:HG	0.40	2.16	20	1
1:B:45:SER:OG	1:B:50:LYS:HB2	0.40	2.15	16	2
1:B:26:GLU:HG3	1:B:28:ASN:ND2	0.40	2.32	20	1
1:B:68:GLU:O	1:B:72:LYS:HG2	0.40	2.17	7	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	68/80 (85%)	64±2 (94±2%)	4±2 (6±2%)	0±0 (0±1%)	44 80
1	B	68/80 (85%)	63±2 (93±3%)	5±2 (7±3%)	0±0 (0±1%)	44 80
All	All	2720/3200 (85%)	2533 (93%)	181 (7%)	6 (0%)	44 80

All 4 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	23	TRP	2
1	B	23	TRP	2
1	A	72	LYS	1
1	B	72	LYS	1

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	61/72 (85%)	59±1 (97±2%)	2±1 (3±2%)	41 88
1	B	61/72 (85%)	60±1 (98±2%)	1±1 (2±2%)	52 92
All	All	2440/2880 (85%)	2387 (98%)	53 (2%)	45 90

All 19 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	28	ASN	10
1	B	28	ASN	7
1	A	50	LYS	6

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Mol	Chain	Res	Type	Models (Total)
1	B	49	GLU	4
1	A	56	THR	4
1	A	26	GLU	3
1	A	21	LYS	2
1	B	21	LYS	2
1	A	38	LYS	2
1	A	61	GLU	2
1	B	56	THR	2
1	B	50	LYS	2
1	A	53	LYS	1
1	A	49	GLU	1
1	B	53	LYS	1
1	B	61	GLU	1
1	B	26	GLU	1
1	B	67	LYS	1
1	A	42	ARG	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](#)

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

6.5 Carbohydrates [i](#)

There are no oligosaccharides 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

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 46% for the well-defined parts and 42% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

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	953
Number of shifts mapped to atoms	953
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	1

7.1.2 Chemical shift referencing i

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	73	-0.30 ± 0.20	None needed (< 0.5 ppm)
$^{13}\text{C}_\beta$	68	-0.02 ± 0.20	None needed (< 0.5 ppm)
$^{13}\text{C}'$	70	-0.02 ± 0.15	None needed (< 0.5 ppm)
^{15}N	68	0.69 ± 0.60	None needed (imprecise)

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 46%, i.e. 895 atoms were assigned a chemical shift out of a possible 1938. 0 out of 22 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^1H	^{13}C	^{15}N
Backbone	337/682 (49%)	138/278 (50%)	134/272 (49%)	65/132 (49%)
Sidechain	490/1110 (44%)	332/712 (47%)	152/356 (43%)	6/42 (14%)

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	Total	¹H	¹³C	¹⁵N
Aromatic	68/146 (47%)	34/72 (47%)	31/64 (48%)	3/10 (30%)
Overall	895/1938 (46%)	504/1062 (47%)	317/692 (46%)	74/184 (40%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 42%, i.e. 953 atoms were assigned a chemical shift out of a possible 2292. 0 out of 24 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹H	¹³C	¹⁵N
Backbone	357/802 (45%)	146/326 (45%)	143/320 (45%)	68/156 (44%)
Sidechain	528/1248 (42%)	358/802 (45%)	164/402 (41%)	6/44 (14%)
Aromatic	68/242 (28%)	34/120 (28%)	31/88 (35%)	3/34 (9%)
Overall	953/2292 (42%)	538/1248 (43%)	338/810 (42%)	77/234 (33%)

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.

List Id	Chain	Res	Type	Atom	Shift, ppm	Expected range, ppm	Z-score
1	A	45	SER	HB3	2.39	2.49 – 5.20	-5.4

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. If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:

