W O R L D W I D E
wwPDB
PROTEIN DATA BANK

Full wwPDB NMR Structure Validation Report ⓘ

Oct 30, 2024 – 04:50 AM EDT

PDB ID	:	2LI1
BMRB ID	:	17874
Title	:	Mono-O-GalNAc glycosylated Mucin sequence based on MUC2 Mucin glyco-protein tandem repeat
Authors	:	Borgert, A.; Heimburg-Molinaro, J.; Lasanajak, Y.; Ju, T.; Liu, M.; Thompson, P.; Ragupathi, G.; Barany, G.; Cummings, R.; Smith, D.; Live, D.
Deposited on	:	2011-08-18

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
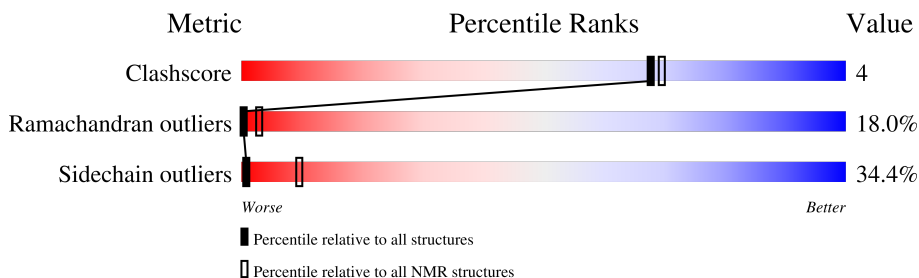http://www.wwpdb.org/validation/2017/FAQs#types.

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 99%.

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	Percentile Ranks	Value
Clashscore		4
Ramachandran outliers		18.0%
Sidechain outliers		34.4%

Worse   *Better*

▮ Percentile relative to all structures
▯ Percentile relative to all NMR structures

Metric	Whole archive (#Entries)	NMR archive (#Entries)
Clashscore	210492	14027
Ramachandran outliers	207382	12486
Sidechain outliers	206894	12463

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	9	56% 44%

2 Ensemble composition and analysis ⓘ

This entry contains 27 models.

Cyrange was unable to find well-defined residues.

Error message: The number of core atoms (3) was below the domain threshold value (8).

NmrClust was unable to cluster the ensemble.

Error message: Wrapper check: not enough residues in core to run NmrClust

3 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 147 atoms, of which 77 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called MUC2 Mucin Domain Peptide.

Mol	Chain	Residues	Atoms					Trace
			Total	C	H	N	O	
1	A	9	119	36	63	9	11	1

- Molecule 2 is 2-acetamido-2-deoxy-alpha-D-galactopyranose (three-letter code: A2G) (formula: $C_8H_{15}NO_6$).

A2G
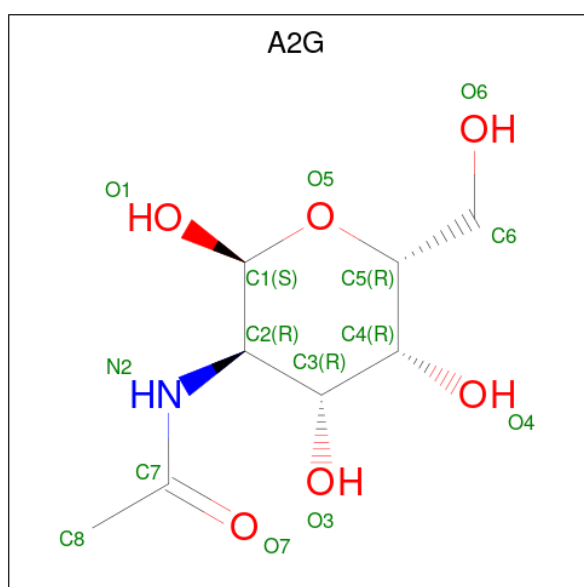
Mol	Chain	Residues	Atoms				
			Total	C	H	N	O
2	A	1	28	8	14	1	5

4 Residue-property plots ⓘ

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: MUC2 Mucin Domain Peptide

Chain A:

4.2 Scores per residue for each member of the ensemble
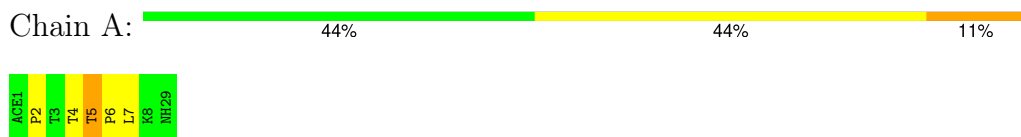
Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.2 Score per residue for model 2

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.3 Score per residue for model 3

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.4 Score per residue for model 4

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.5 Score per residue for model 5

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.6 Score per residue for model 6

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

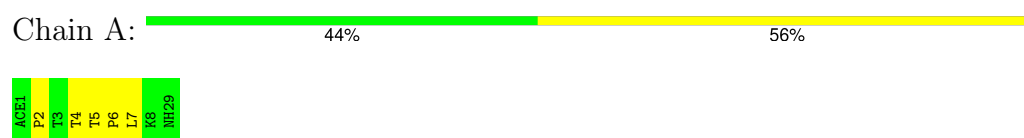#### 4.2.7 Score per residue for model 7

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.8 Score per residue for model 8

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.9 Score per residue for model 9

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.10 Score per residue for model 10

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.11 Score per residue for model 11

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.12 Score per residue for model 12

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.13 Score per residue for model 13

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

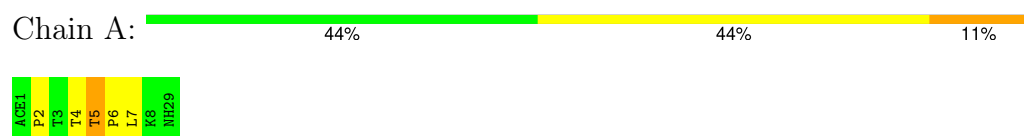#### 4.2.14 Score per residue for model 14

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.15 Score per residue for model 15

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.16 Score per residue for model 16

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.17 Score per residue for model 17

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.18　Score per residue for model 18
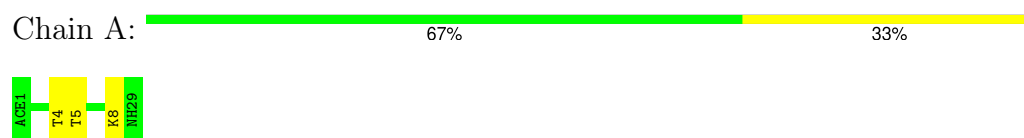
• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.19　Score per residue for model 19

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.20　Score per residue for model 20

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

4.2.21　Score per residue for model 21

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:
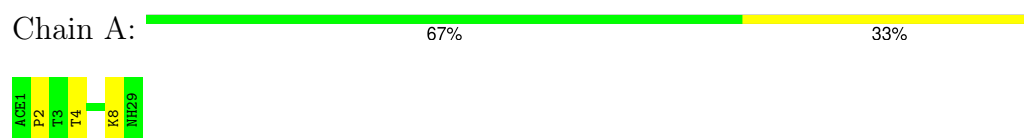
4.2.22　Score per residue for model 22
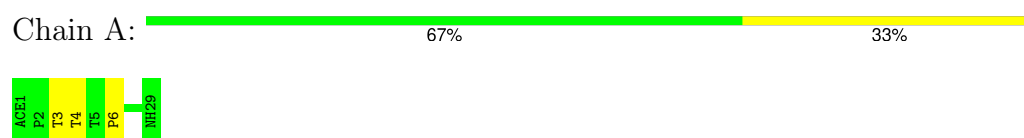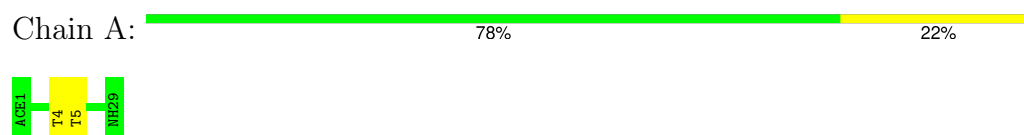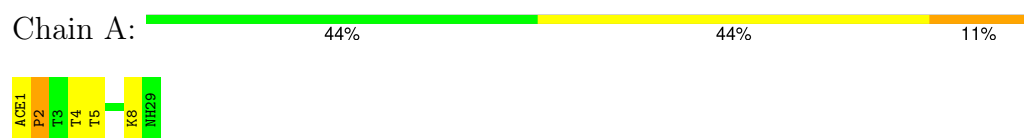
• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:
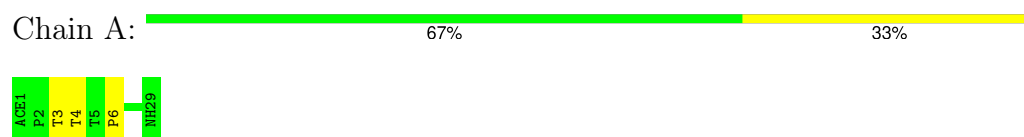
4.2.23 Score per residue for model 23

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

78%   22%

ACE1 P2 T3 T4 NH29
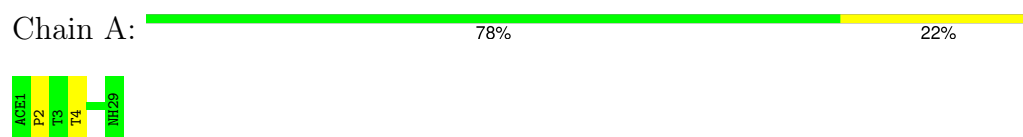
4.2.24 Score per residue for model 24

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

56%   44%

ACE1 P2 T3 T4 T5 P6 L7 K8 NH29

4.2.25 Score per residue for model 25

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

67%   33%

ACE1 T4 T5 K8 NH29
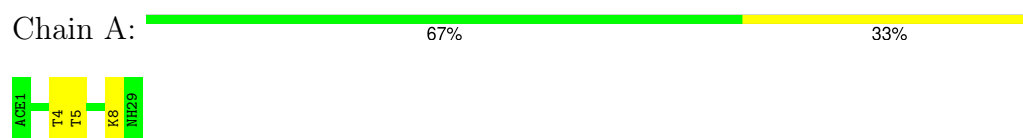
4.2.26 Score per residue for model 26

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

56%   44%

ACE1 T4 T5 P6 L7 K8 NH29

4.2.27 Score per residue for model 27

• Molecule 1: MUC2 Mucin Domain Peptide

Chain A:

67%   33%

ACE1 T4 T5 P6 NH29
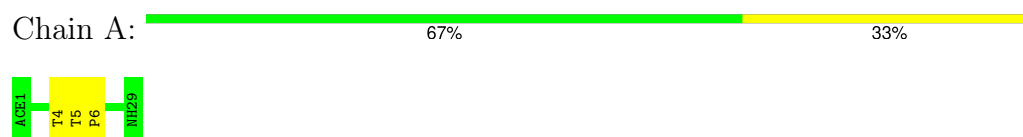
5 Refinement protocol and experimental data overview ⓘ

The models were refined using the following method: *torsion space simulated annealing.*

Of the 100 calculated structures, 27 were deposited, based on the following criterion: *structures with the least restraint violations.*

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

Software name	Classification	Version
CNS	structure solution	
XPLOR-NIH	refinement	

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	105
Number of shifts mapped to atoms	105
Number of unparsed shifts	0
Number of shifts with mapping errors	0
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	99%

6   Model quality ⓘ

6.1   Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: ACE, NH2, A2G

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 ⓘ

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	56	63	61	1±1
All	All	1890	2079	1971	14

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.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models Worst	Models Total
1:A:5:THR:O	1:A:7:LEU:N	0.68	2.26	9	5
1:A:5:THR:O	1:A:5:THR:HG23	0.66	1.89	4	1
1:A:3:THR:HG22	1:A:3:THR:O	0.64	1.91	24	1
1:A:3:THR:O	1:A:3:THR:CG2	0.47	2.62	24	1
1:A:5:THR:O	1:A:5:THR:CG2	0.43	2.61	4	1
1:A:5:THR:O	1:A:7:LEU:CD2	0.43	2.67	13	1
1:A:7:LEU:HD12	1:A:7:LEU:C	0.42	2.34	24	1
1:A:1:ACE:O	1:A:2:PRO:O	0.42	2.38	20	1
1:A:5:THR:O	1:A:7:LEU:HD22	0.41	2.16	13	1
1:A:8:LYS:O	1:A:8:LYS:CG	0.41	2.68	3	1

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6.3 Torsion angles ⓘ

6.3.1 Protein backbone ⓘ

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	7/9 (78%)	3±1 (48±12%)	2±1 (34±11%)	1±1 (18±9%)	0	3
All	All	189/243 (78%)	91 (48%)	64 (34%)	34 (18%)	0	3

All 3 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	6	PRO	20
1	A	2	PRO	13
1	A	8	LYS	1

6.3.2 Protein sidechains ⓘ

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	7/7 (100%)	5±1 (66±14%)	2±1 (34±14%)	1	9
All	All	189/189 (100%)	124 (66%)	65 (34%)	1	9

All 5 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	4	THR	26
1	A	5	THR	17
1	A	8	LYS	10
1	A	3	THR	7
1	A	7	LEU	5

6.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

6.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.6 Ligand geometry ⓘ

1 ligand 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
2	A2G	A	10	1	14,14,15	0.64±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	A2G	A	10	1	17,19,21	1.05±0.02	1±0 (7±2%)

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	A2G	A	10	1	-	0±0,6,23,26	0±0,1,1,1

There are no bond-length outliers.

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
2	A	10	A2G	C1-O5-C5	2.91	108.28	112.19	19	27
2	A	10	A2G	O5-C1-C2	2.23	107.84	111.29	19	6

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

6.7 Other polymers ⓘ

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 ⓘ

The completeness of assignment taking into account all chemical shift lists is 99% for the well-defined parts and 99% 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 ⓘ

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	105
Number of shifts mapped to atoms	105
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 ⓘ

No chemical shift referencing corrections were calculated (not enough data).

7.1.3 Completeness of resonance assignments ⓘ

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 99%, i.e. 92 atoms were assigned a chemical shift out of a possible 93. 0 out of 1 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	31/31 (100%)	12/12 (100%)	14/14 (100%)	5/5 (100%)
Sidechain	61/62 (98%)	41/41 (100%)	20/20 (100%)	0/1 (0%)
Overall	92/93 (99%)	53/53 (100%)	34/34 (100%)	5/6 (83%)

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 99%, i.e. 92 atoms were assigned a chemical shift out of a possible 93. 0 out of 1 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	^{1}H	^{13}C	^{15}N
Backbone	31/31 (100%)	12/12 (100%)	14/14 (100%)	5/5 (100%)
Sidechain	61/62 (98%)	41/41 (100%)	20/20 (100%)	0/1 (0%)
Overall	92/93 (99%)	53/53 (100%)	34/34 (100%)	5/6 (83%)

7.1.4 Statistically unusual chemical shifts ⓘ

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	4	THR	CB	78.31	61.12 – 78.27	5.0

7.1.5 Random Coil Index (RCI) plots ⓘ

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: