



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 7, 2026 – 02:30 AM UTC

PDB ID : 1HX0 / pdb_00001hx0
Title : Structure of pig pancreatic alpha-amylase complexed with the "truncate" acarbose molecule (pseudotrisaccharide)
Authors : Qian, M.; Payan, F.
Deposited on : 2001-01-11
Resolution : 1.38 Å(reported)

This is a wwPDB X-ray 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/XrayValidationReportHelp>

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
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

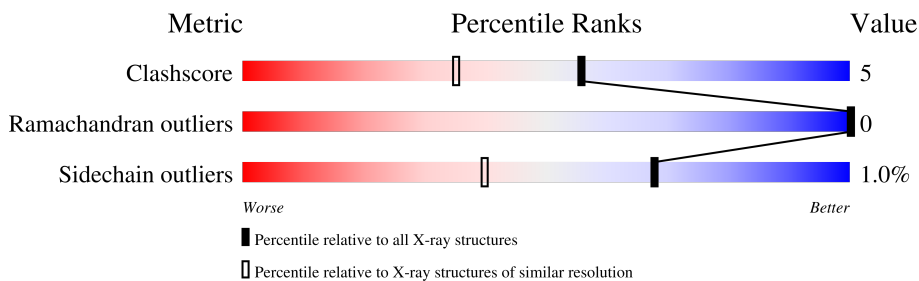
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.38 Å.

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)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	4528 (1.40-1.36)
Ramachandran outliers	187476	4459 (1.40-1.36)
Sidechain outliers	187428	4458 (1.40-1.36)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. 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 $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	496	 87% 12%
2	B	5	 80% 20%
3	C	2	 100%

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 5292 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called ALPHA AMYLASE (PPA).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	496	Total	C	N	O	S	0	48	0
			4178	2631	737	784	26			

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	123	ASN	SER	conflict	UNP P00690
A	243	LYS	GLN	conflict	UNP P00690
A	310	SER	ALA	conflict	UNP P00690
A	323	ILE	VAL	conflict	UNP P00690
A	404	GLN	GLU	conflict	UNP P00690

- Molecule 2 is an oligosaccharide called 4,6-dideoxy-4-[[[(1S,4R,5S,6S)-4,5,6-trihydroxy-3-(hydroxymethyl)cyclohex-2-en-1-yl]amino}-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-4,6-dideoxy-4-[[[(1S,4R,5S,6S)-4,5,6-trihydroxy-3-(hydroxymethyl)cyclohex-2-en-1-yl]amino}-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	4	Total	C	N	O	0	1	0
			77	44	2	31			

- Molecule 3 is an oligosaccharide called alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose.



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
3	C	2	Total	C	O	0	0	0
			22	12	10			

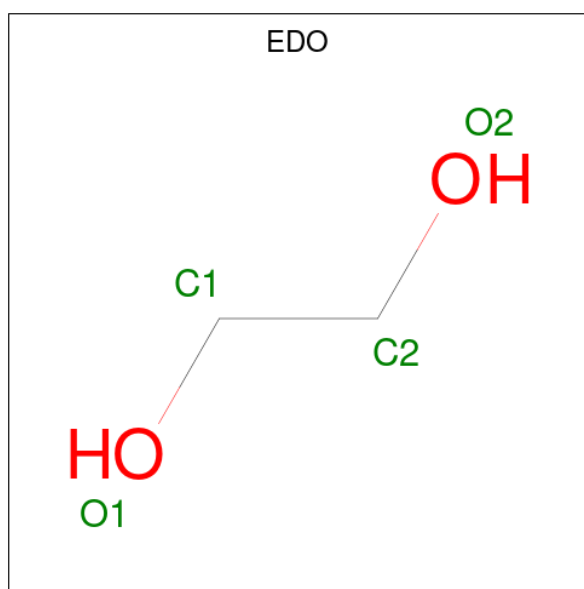
- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	4	Total Cl 4 4	0	0

- Molecule 5 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Ca 1 1	0	0

- Molecule 6 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 8 4 4	0	1
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 4 2 2	0	0
6	A	1	Total C O 4 2 2	0	0

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			4	2	2		
6	A	1	Total	C	O	0	0
			4	2	2		
6	A	1	Total	C	O	0	0
			4	2	2		
6	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	921	Total	O	0	37
			958	958		

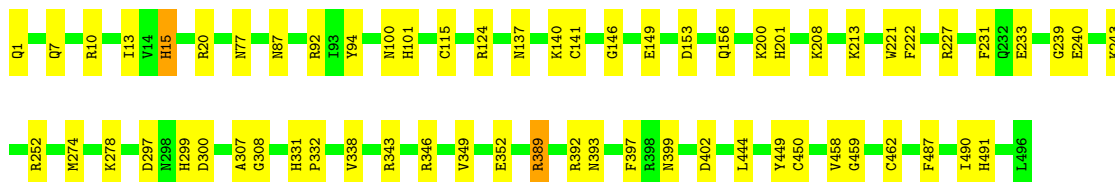
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-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 outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

Note EDS was not executed.

- Molecule 1: ALPHA AMYLASE (PPA)

Chain A: 

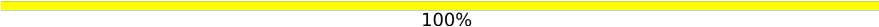


- Molecule 2: 4,6-dideoxy-4-[(1S,4R,5S,6S)-4,5,6-trihydroxy-3-(hydroxymethyl)cyclohex-2-en-1-yl]amino}-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose-(1-4)-4,6-dideoxy-4-[(1S,4R,5S,6S)-4,5,6-trihydroxy-3-(hydroxymethyl)cyclohex-2-en-1-yl]amino}-alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain B: 



- Molecule 3: alpha-D-glucopyranose-(1-4)-alpha-D-glucopyranose

Chain C: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	69.28Å 113.55Å 117.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	35.00 – 1.38	Depositor
% Data completeness (in resolution range)	97.0 (35.00-1.38)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	SHELXL-97	Depositor
R, R_{free}	0.108 , 0.130	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5292	wwPDB-VP
Average B, all atoms (Å ²)	23.0	wwPDB-VP

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PCA, BGC, GLC, AC1, CA, CL, EDO

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 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	0.75	0/4409	1.33	34/5983 (0.6%)

There are no bond length outliers.

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	308	GLY	CA-C-O	10.24	128.53	119.83
1	A	101	HIS	ND1-CE1-NE2	-9.82	98.58	108.40
1	A	308	GLY	O-C-N	-8.91	115.58	122.71
1	A	459	GLY	CA-C-N	8.28	140.88	121.52
1	A	459	GLY	C-N-CA	8.28	140.88	121.52

There are no chirality outliers.

There are no planarity outliers.

5.2 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 the 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 within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4178	0	3917	39	0
2	B	77	0	50	1	0
3	C	22	0	19	0	0
4	A	4	0	0	0	0
5	A	1	0	0	0	0
6	A	52	0	77	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	A	958	0	0	24	0
All	All	5292	0	4063	40	0

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 5.

The worst 5 of 40 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:240[A]:GLU:OE2	7:A:6946:HOH:O	1.96	0.82
1:A:153:ASP:OD1	1:A:156[B]:GLN:HG3	1.93	0.67
1:A:243:LYS:HE2	7:A:6364:HOH:O	1.96	0.64
1:A:140[A]:LYS:HE3	7:A:6302:HOH:O	1.97	0.63
1:A:450[B]:CYS:HB2	1:A:462:CYS:SG	2.42	0.60

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 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 X-ray entries followed by that with respect to entries of similar resolution.

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	543/496 (110%)	530 (98%)	13 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 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 X-ray entries followed by that with respect to entries of similar resolution.

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	457/412 (111%)	450 (98%)	7 (2%)	57 25

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	124[B]	ARG
1	A	137[A]	ASN
1	A	274	MET
1	A	137[B]	ASN
1	A	124[A]	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	15	HIS
1	A	363	ASN
1	A	373	ASN
1	A	476	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
1	PCA	A	1	1	7,8,9	1.82	1 (14%)	9,10,12	1.73	3 (33%)

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	PCA	A	1	1	-	0/0/11/13	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1	PCA	CD-N	4.34	1.45	1.34

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1	PCA	CB-CA-C	-3.12	108.38	112.66
1	A	1	PCA	O-C-CA	-2.50	118.35	124.77
1	A	1	PCA	OE-CD-CG	2.37	130.94	126.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates

7 monosaccharides are modelled in this entry.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	BGC	B	1[B]	2	12,12,12	0.64	0	17,17,17	1.73	4 (23%)
2	GLC	B	1[A]	2	12,12,12	0.62	0	17,17,17	1.72	4 (23%)
2	AC1	B	2	2	21,22,23	1.76	3 (14%)	22,32,34	1.87	5 (22%)
2	GLC	B	3	2	11,11,12	0.57	0	15,15,17	1.18	1 (6%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	AC1	B	4	2	21,22,23	1.56	3 (14%)	22,32,34	1.56	3 (13%)
3	GLC	C	1	6,3	11,11,12	0.79	0	15,15,17	2.50	8 (53%)
3	GLC	C	2	3	11,11,12	0.69	0	15,15,17	1.71	3 (20%)

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	BGC	B	1[B]	2	-	2/2/22/22	0/1/1/1
2	GLC	B	1[A]	2	-	0/2/22/22	0/1/1/1
2	AC1	B	2	2	-	2/6/43/46	0/2/2/2
2	GLC	B	3	2	-	0/2/19/22	0/1/1/1
2	AC1	B	4	2	-	2/6/43/46	0/2/2/2
3	GLC	C	1	6,3	-	0/2/19/22	0/1/1/1
3	GLC	C	2	3	-	2/2/19/22	0/1/1/1

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	2	AC1	C1B-N4A	5.35	1.57	1.47
2	B	4	AC1	C4A-C5B	5.28	1.55	1.51
2	B	2	AC1	C1B-C7B	3.52	1.55	1.50
2	B	2	AC1	O4-C4A	2.67	1.47	1.42
2	B	4	AC1	C1B-N4A	2.60	1.52	1.47

The worst 5 of 28 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2	AC1	O2B-C2B-C1B	-4.96	99.31	109.08
3	C	2	GLC	C1-O5-C5	4.90	118.76	112.19
3	C	1	GLC	O2-C2-C3	-4.53	100.76	110.15
3	C	1	GLC	C1-C2-C3	4.24	115.82	109.64
2	B	1[A]	GLC	O3-C3-C4	-4.17	100.54	110.38

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

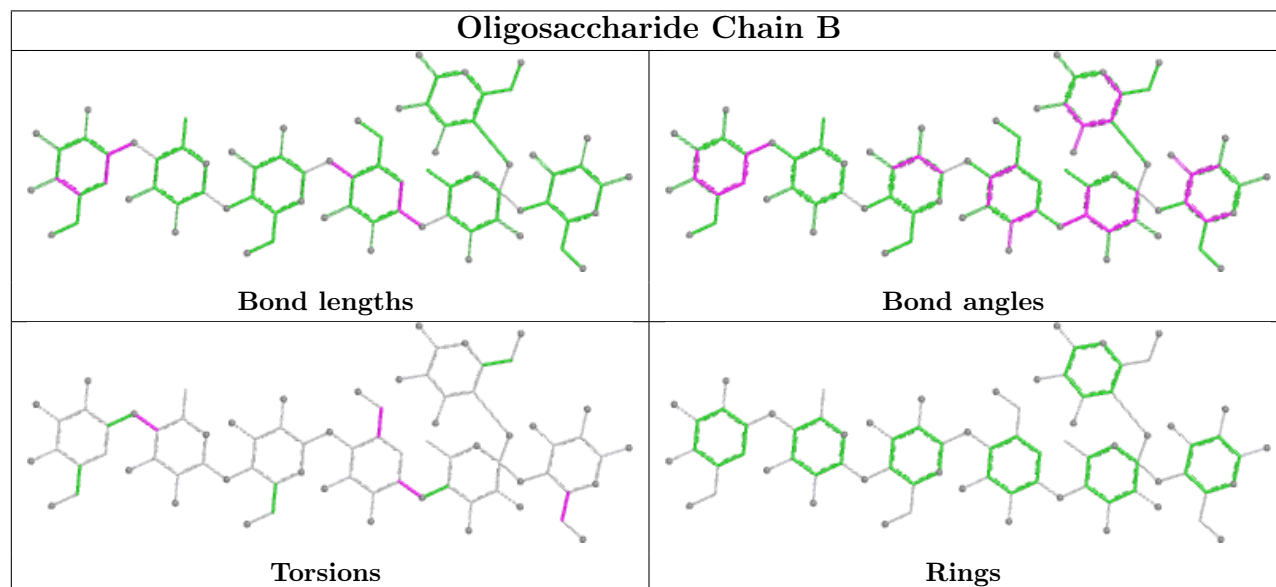
Mol	Chain	Res	Type	Atoms
2	B	2	AC1	C7B-C1B-N4A-C4
2	B	2	AC1	C7B-C5B-C6B-O6B
2	B	4	AC1	C5-C4-N4A-C1B
2	B	1[B]	BGC	O5-C5-C6-O6
3	C	2	GLC	O5-C5-C6-O6

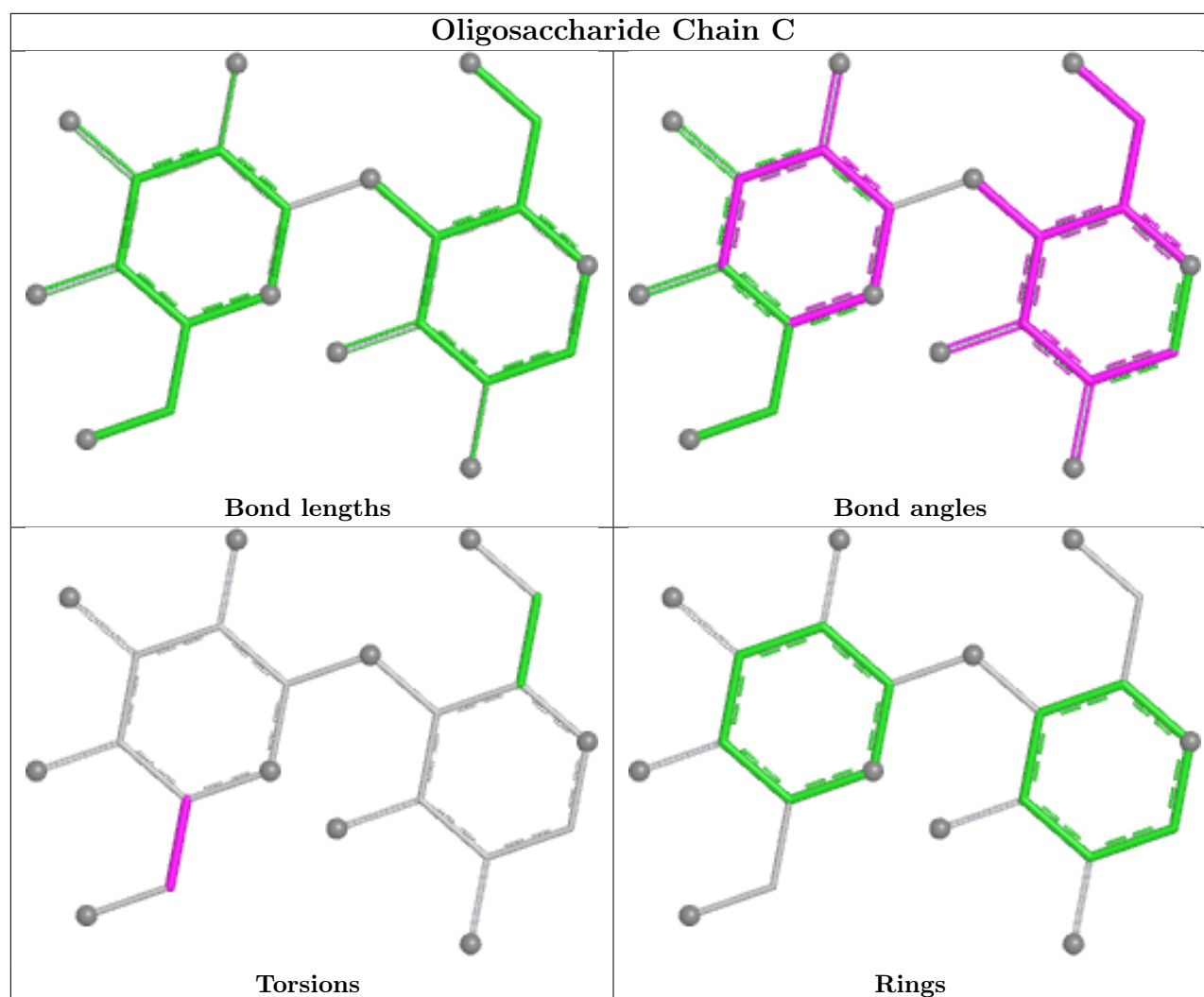
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	2	AC1	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.





5.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 5 are monoatomic - leaving 13 for Mogul analysis.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
6	EDO	A	5013	3	3,3,3	0.46	0	2,2,2	0.36	0
6	EDO	A	5006	-	3,3,3	0.51	0	2,2,2	0.43	0
6	EDO	A	5010	-	3,3,3	0.34	0	2,2,2	0.44	0
6	EDO	A	5004	-	3,3,3	0.71	0	2,2,2	1.30	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	EDO	A	5005	-	3,3,3	0.28	0	2,2,2	0.53	0
6	EDO	A	5014	-	3,3,3	0.65	0	2,2,2	0.65	0
6	EDO	A	5002[B]	-	3,3,3	0.53	0	2,2,2	0.78	0
6	EDO	A	5001	-	3,3,3	0.43	0	2,2,2	0.02	0
6	EDO	A	5008	-	3,3,3	0.56	0	2,2,2	0.78	0
6	EDO	A	5002[A]	-	3,3,3	0.42	0	2,2,2	0.43	0
6	EDO	A	5003	-	3,3,3	0.44	0	2,2,2	0.64	0
6	EDO	A	5007	-	3,3,3	0.69	0	2,2,2	0.30	0
6	EDO	A	5000	-	3,3,3	0.59	0	2,2,2	0.08	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
6	EDO	A	5013	3	-	1/1/1/1	-
6	EDO	A	5006	-	-	1/1/1/1	-
6	EDO	A	5010	-	-	0/1/1/1	-
6	EDO	A	5004	-	-	1/1/1/1	-
6	EDO	A	5005	-	-	0/1/1/1	-
6	EDO	A	5014	-	-	0/1/1/1	-
6	EDO	A	5002[B]	-	-	0/1/1/1	-
6	EDO	A	5001	-	-	0/1/1/1	-
6	EDO	A	5008	-	-	1/1/1/1	-
6	EDO	A	5002[A]	-	-	0/1/1/1	-
6	EDO	A	5003	-	-	0/1/1/1	-
6	EDO	A	5007	-	-	0/1/1/1	-
6	EDO	A	5000	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	A	5013	EDO	O1-C1-C2-O2
6	A	5008	EDO	O1-C1-C2-O2
6	A	5006	EDO	O1-C1-C2-O2
6	A	5004	EDO	O1-C1-C2-O2

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	5013	EDO	1	0
6	A	5010	EDO	1	0
6	A	5007	EDO	2	0

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.