wwPDB X-ray Structure Validation Summary Report (i)

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PDB ID	:	8SKQ / pdb_00008skq
Title	:	RNA oligonucleotide containing an alpha-(L)-threofuranosyl nucleic acid (TNA)
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Deposited on	:	2023-04-20
Resolution	:	1.35 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 (i) 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 (i)) were used in the production of this report:

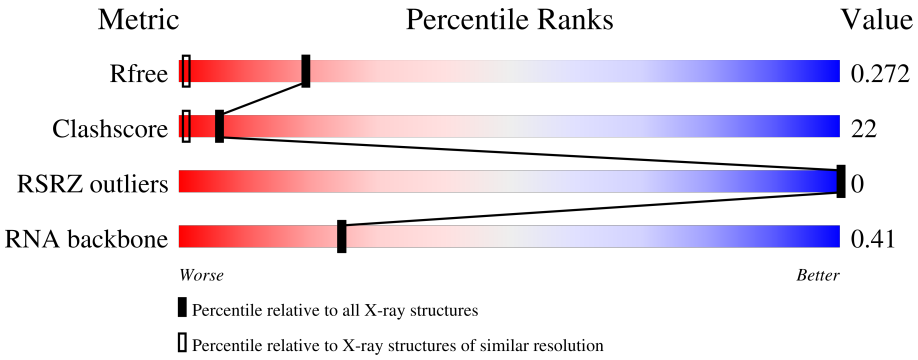
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.006 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.44

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.35 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))
R_{free}	164625	1089 (1.36-1.36)
Clashscore	180529	1157 (1.36-1.36)
RSRZ outliers	164620	1088 (1.36-1.36)
RNA backbone	3690	1007 (2.16-0.62)

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 <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	45	13% 16% 53% 18%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1011 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 RNA chain called TNA-containing RNA oligonucleotide.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	Br	C	N	O	P			
1	A	12	1002	6	456	180	318	42	0	12	0

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	9	9	9	0	0

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). 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.

- Molecule 1: TNA-containing RNA oligonucleotide

Chain A:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	32.66Å 39.77Å 25.73Å 90.00° 107.85° 90.00°	Depositor
Resolution (Å)	19.89 – 1.35 19.89 – 1.35	Depositor EDS
% Data completeness (in resolution range)	98.4 (19.89-1.35) 98.9 (19.89-1.35)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.58 (at 1.35Å)	Xtriage
Refinement program	PHENIX 1.19.2-4158-000	Depositor
R, R_{free}	0.240 , 0.271 0.239 , 0.272	Depositor DCC
R_{free} test set	366 reflections (4.75%)	wwPDB-VP
Wilson B-factor (Å^2)	17.6	Xtriage
Anisotropy	0.205	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 22.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.35$	Xtriage
Estimated twinning fraction	0.460 for -1/2*h+1/2*k-l,1/2*h-1/2*k-l,-1/2*h-1/2*k 0.450 for -1/2*h-1/2*k-l,-1/2*h-1/2*k+l,-1/2*h+1/2*k	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	1011	wwPDB-VP
Average B, all atoms (Å^2)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 40.44 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.7343e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CBV, TFT

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	0.38	0/839	0.59	0/1228

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 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	1002	0	534	10	0
2	A	9	0	0	0	0
All	All	1011	0	534	10	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 22.

The worst 5 of 10 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:1[A]:CBV:HN41	1:A:2[A]:G:N2	1.95	0.64
1:A:4[A]:A:H8	1:A:4[A]:A:O5'	1.85	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:11[A]:A:O5'	1:A:11[A]:A:H8	1.86	0.58
1:A:4[A]:A:H2'	1:A:5[A]:U:H6	1.72	0.53
1:A:4[A]:A:H2'	1:A:5[A]:U:C6	2.46	0.49

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

There are no protein molecules in this entry.

5.3.2 Protein sidechains (i)

There are no protein molecules in this entry.

5.3.3 RNA (i)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	23/45 (51%)	2 (8%)	0

All (2) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	A	1[C]	U
1	A	2[D]	U

There are no RNA pucker outliers to report.

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

12 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	TFT	A	2[C]	1	17,20,21	1.47	3 (17%)	23,29,32	2.78	10 (43%)
1	CBV	A	6[D]	1	19,19,23	1.54	4 (21%)	27,28,35	0.97	1 (3%)
1	TFT	A	10[C]	1	17,20,21	1.36	3 (17%)	23,29,32	2.21	5 (21%)
1	CBV	A	2[B]	1	19,22,23	1.54	5 (26%)	26,32,35	0.97	2 (7%)
1	TFT	A	6[A]	1	17,20,21	1.45	4 (23%)	23,29,32	2.74	9 (39%)
1	TFT	A	3[D]	-	17,20,21	1.70	5 (29%)	23,29,32	2.59	9 (39%)
1	CBV	A	10[B]	1	19,19,23	1.52	6 (31%)	27,28,35	1.23	2 (7%)
1	CBV	A	5[C]	1	19,19,23	1.56	5 (26%)	27,28,35	1.01	1 (3%)
1	CBV	A	1[A]	-	19,19,23	1.42	6 (31%)	27,28,35	1.40	4 (14%)
1	TFT	A	11[D]	-	17,20,21	1.66	5 (29%)	23,29,32	2.41	10 (43%)
1	CBV	A	9[A]	1	19,19,23	1.47	4 (21%)	27,28,35	0.85	1 (3%)
1	TFT	A	7[B]	1	17,20,21	1.50	3 (17%)	23,29,32	2.78	7 (30%)

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	TFT	A	2[C]	1	-	1/5/21/22	0/2/2/2
1	CBV	A	6[D]	1	-	1/6/22/26	0/2/2/2
1	TFT	A	10[C]	1	-	2/5/21/22	0/2/2/2
1	CBV	A	2[B]	1	-	0/7/25/26	0/2/2/2
1	TFT	A	6[A]	1	-	1/5/21/22	0/2/2/2
1	TFT	A	3[D]	-	-	0/5/21/22	0/2/2/2
1	CBV	A	10[B]	1	-	0/6/22/26	0/2/2/2
1	CBV	A	5[C]	1	-	0/6/22/26	0/2/2/2
1	CBV	A	1[A]	-	-	1/6/22/26	0/2/2/2
1	TFT	A	11[D]	-	-	1/5/21/22	0/2/2/2
1	CBV	A	9[A]	1	-	0/6/22/26	0/2/2/2
1	TFT	A	7[B]	1	-	0/5/21/22	0/2/2/2

The worst 5 of 53 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	2[B]	CBV	C4-N3	4.69	1.41	1.34
1	A	6[D]	CBV	C4-N3	4.33	1.41	1.34

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	2[C]	TFT	C4-C5	-3.82	1.38	1.44
1	A	5[C]	CBV	C4-N3	3.80	1.40	1.34
1	A	10[B]	CBV	C4-N3	3.65	1.40	1.34

The worst 5 of 61 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	6[A]	TFT	O4T-C1T-N1	-7.27	99.66	108.90
1	A	7[B]	TFT	C4-N3-C2	-6.57	118.72	127.34
1	A	7[B]	TFT	C5-C4-N3	6.48	120.96	115.32
1	A	2[C]	TFT	C4-N3-C2	-5.90	119.60	127.34
1	A	7[B]	TFT	O4-C4-C5	-5.89	118.18	124.92

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	1[A]	CBV	O4'-C4'-C5'-O5'
1	A	2[C]	TFT	C2T-C3T-O3T-P
1	A	6[A]	TFT	C2T-C3T-O3T-P
1	A	11[D]	TFT	C2T-C3T-O3T-P
1	A	6[D]	CBV	O4'-C4'-C5'-O5'

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	6[A]	TFT	1	0
1	A	1[A]	CBV	2	0
1	A	9[A]	CBV	1	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

There are no ligands in this entry.

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	9

The worst 5 of 9 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	2[D]:U	O3'	3[D]:TFT	P	4.66
1	A	7[D]:G	O3'	8[D]:A	P	3.19
1	A	0[D]:A	O3'	1[D]:A	P	3.05
1	A	4[B]:A	O3'	5[B]:A	P	3.03
1	A	10[D]:U	O3'	11[D]:TFT	P	2.95

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95^{th} percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	0/45	-	-	-	-

There are no RSRZ outliers to report.

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

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
1	TFT	A	6[A]	19/20	0.97	0.09	5,20,32,33	19
1	CBV	A	2[B]	21/22	-	-	9,16,25,29	21
1	TFT	A	2[C]	19/20	-	-	14,20,28,32	19
1	TFT	A	3[D]	19/20	-	-	12,20,26,27	19
1	CBV	A	5[C]	18/22	-	-	9,13,19,32	18
1	CBV	A	1[A]	18/22	0.98	0.07	8,12,26,34	18
1	CBV	A	6[D]	18/22	-	-	15,21,34,74	18
1	TFT	A	7[B]	19/20	-	-	12,19,31,45	19
1	CBV	A	9[A]	18/22	0.98	0.09	10,15,26,45	18
1	CBV	A	10[B]	18/22	-	-	11,18,22,32	18
1	TFT	A	10[C]	19/20	-	-	9,16,24,25	19
1	TFT	A	11[D]	19/20	-	-	8,20,23,24	19

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.