WORLDWIDE PDB

PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Oct 23, 2021 – 02:49 PM EDT

PDB ID	:	1F4B
Title	:	CRYSTAL STRUCTURE OF ESCHERICHIA COLI THYMIDYLATE SYN-THASE
Authors	:	Erlanson, D.A.; Braisted, A.C.; Raphael, D.R.; Randal, M.; Stroud, R.M.; Gordon, E.; Wells, J.A.
Deposited on	:	2000-06-07
Resolution	:	1.75 Å(reported)

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

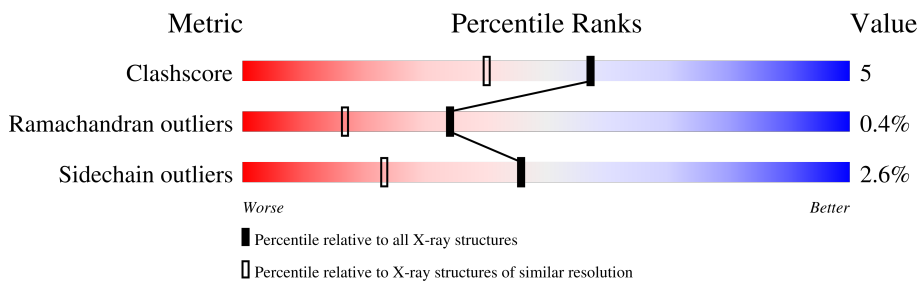|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 1.75 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	Percentile Ranks	Value
Clashscore		5
Ramachandran outliers		0.4%
Sidechain outliers		2.6%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	2466 (1.76-1.76)
Ramachandran outliers	138981	2437 (1.76-1.76)
Sidechain outliers	138945	2437 (1.76-1.76)

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%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	264	84% 14% •

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 2452 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 THYMIDYLATE SYNTHASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	264	Total 2163	C 1383	N 372	O 396	S 12	0	2	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	CXM	MET	engineered mutation	UNP P0A884

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total 5	O 4	S 1	0	0
2	A	1	Total 5	O 4	S 1	0	0
2	A	1	Total 5	O 4	S 1	0	0

• Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total 6	C 3	O 3	0	0
3	A	1	Total 6	C 3	O 3	0	0

• Molecule 4 is water.

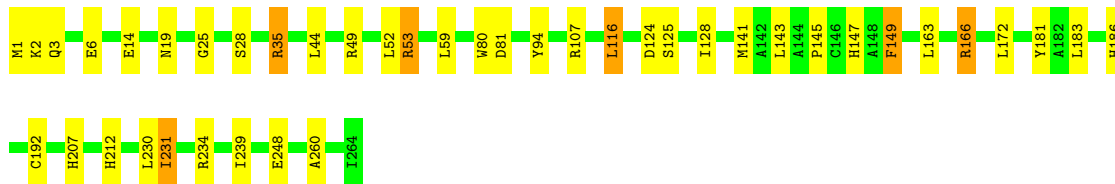| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	262	Total 262	O 262	0	0

3 Residue-property plots ⓘ

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: THYMIDYLATE SYNTHASE

Chain A:

84%   14%   •

M1 K2 Q3 E6 E14 N19 G25 S28 R35 L44 R49 L52 R53 L59 W80 D81 Y94 R107 L116 D124 S125 I128 M141 A142 L143 A144 P145 C146 H147 A148 F149 L163 R166 L172 Y181 A182 L183 H186

C192 H207 H212 L230 I231 R234 I239 E248 A260 I264

4 Data and refinement statistics ⓘ

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

Property	Value	Source
Space group	I 21 3	Depositor
Cell constants a, b, c, α, β, γ	131.17Å 131.17Å 131.17Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.75	Depositor
% Data completeness (in resolution range)	96.7 (10.00-1.75)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.198 , 0.244	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2452	wwPDB-VP
Average B, all atoms (Å^2)	37.0	wwPDB-VP

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, CXM, GOL

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	0.54	0/2223	1.27	16/3018 (0.5%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	53	ARG	NE-CZ-NH2	-14.85	112.88	120.30
1	A	35	ARG	NE-CZ-NH2	-8.99	115.80	120.30
1	A	28	SER	N-CA-CB	-8.14	98.28	110.50
1	A	166	ARG	NE-CZ-NH2	-7.47	116.57	120.30
1	A	53	ARG	NE-CZ-NH1	6.40	123.50	120.30
1	A	234	ARG	NE-CZ-NH2	-6.25	117.17	120.30
1	A	107	ARG	NE-CZ-NH2	-6.12	117.24	120.30
1	A	149[A]	PHE	CA-CB-CG	5.90	128.06	113.90
1	A	149[B]	PHE	CA-CB-CG	5.90	128.06	113.90
1	A	81	ASP	CB-CG-OD1	5.86	123.57	118.30
1	A	124	ASP	CB-CG-OD2	-5.64	113.22	118.30
1	A	124	ASP	CB-CG-OD1	5.27	123.04	118.30
1	A	49	ARG	NE-CZ-NH1	5.11	122.86	120.30
1	A	149[A]	PHE	CB-CG-CD1	5.08	124.35	120.80
1	A	149[B]	PHE	CB-CG-CD1	5.08	124.35	120.80
1	A	181	TYR	CB-CG-CD1	-5.05	117.97	121.00

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	2163	0	2089	21	0
2	A	15	0	0	0	0
3	A	12	0	16	3	0
4	A	262	0	0	3	0
All	All	2452	0	2105	21	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.

All (21) 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:166:ARG:HH12	3:A:301:GOL:H11	1.33	0.94
1:A:3[A]:GLN:NE2	1:A:35:ARG:O	2.08	0.85
1:A:166:ARG:NH1	3:A:301:GOL:H11	2.11	0.60
1:A:59:LEU:HD23	1:A:183:LEU:HD23	1.88	0.55
1:A:19:ASN:HD22	1:A:25:GLY:HA2	1.72	0.54
1:A:183:LEU:HD22	4:A:551:HOH:O	2.09	0.52
1:A:147:HIS:HB2	1:A:163:LEU:HD11	1.92	0.51
1:A:2:LYS:HG2	1:A:6:GLU:OE2	2.11	0.49
1:A:2:LYS:HE2	1:A:6:GLU:OE2	2.11	0.49
1:A:248:GLU:HA	3:A:302:GOL:H12	1.94	0.49
1:A:231:ILE:O	1:A:231:ILE:HG13	2.13	0.47
1:A:207:HIS:HE1	4:A:382:HOH:O	1.99	0.45
1:A:116:LEU:HD12	1:A:192:CYS:SG	2.58	0.44
1:A:44:LEU:HD13	1:A:52:LEU:HD21	2.00	0.43
1:A:125:SER:HB3	1:A:128:ILE:HG13	2.01	0.43
1:A:141:MET:SD	1:A:145:PRO:HD3	2.59	0.42
1:A:3[A]:GLN:HG3	4:A:307:HOH:O	2.19	0.42
1:A:80:TRP:CZ3	1:A:143:LEU:HD21	2.55	0.42
1:A:116:LEU:HD21	1:A:239:ILE:HB	2.02	0.42
1:A:186:HIS:CG	1:A:230:LEU:HD23	2.57	0.40
1:A:212:HIS:CD2	1:A:260:ALA:HB1	2.57	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 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 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	264/264 (100%)	258 (98%)	5 (2%)	1 (0%)	34	17

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	94	TYR

5.3.2 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 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	234/232 (101%)	227 (97%)	7 (3%)	41	18

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	GLU
1	A	53	ARG
1	A	116	LEU
1	A	149[A]	PHE
1	A	149[B]	PHE
1	A	172	LEU
1	A	231	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	19	ASN
1	A	190	GLN
1	A	207	HIS

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	CXM	A	1	1	6,10,11	2.35	1 (16%)	5,11,13	1.35	1 (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
1	CXM	A	1	1	-	0/7/10/12	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1	CXM	CA-N	-5.46	1.38	1.46

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	1	CXM	O-C-CA	-2.26	118.86	124.78

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 (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

5 ligands 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	SO4	A	304	-	4,4,4	0.62	0	6,6,6	0.27	0
2	SO4	A	303	-	4,4,4	0.57	0	6,6,6	0.26	0
3	GOL	A	302	-	5,5,5	1.17	0	5,5,5	0.94	0
3	GOL	A	301	-	5,5,5	0.49	0	5,5,5	1.05	1 (20%)
2	SO4	A	305	-	4,4,4	0.55	0	6,6,6	0.25	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
3	GOL	A	302	-	-	2/4/4/4	-
3	GOL	A	301	-	-	0/4/4/4	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	301	GOL	O3-C3-C2	2.15	120.49	110.20

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	302	GOL	C1-C2-C3-O3
3	A	302	GOL	O2-C2-C3-O3

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	302	GOL	1	0
3	A	301	GOL	2	0

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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.