



wwPDB X-ray Structure Validation Summary Report

Mar 10, 2026 – 05:52 AM UTC

PDB ID : 2OFJ / pdb_00002ofj
Title : Crystal structure of the E190A mutant of o-succinylbenzoate synthase from Escherichia coli
Authors : Nagatani, R.A.; Gonzalez, A.; Shoichet, B.K.; Brinen, L.S.; Babbitt, P.C.
Deposited on : 2007-01-03
Resolution : 2.30 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
Xtrriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

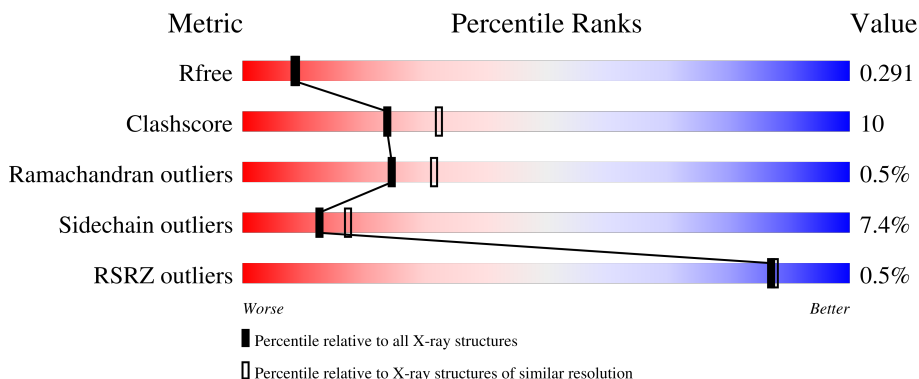
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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}	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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 $\leq 5\%$. 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	323	
1	B	323	
1	C	323	
1	D	323	

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 9602 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 O-succinylbenzoate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	300	2376	1502	422	442	10	0	3	0
1	B	300	2385	1507	424	444	10	0	4	0
1	C	296	2321	1471	403	437	10	0	1	0
1	D	298	2341	1483	408	440	10	0	2	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	cloning artifact	UNP P29208
A	-1	SER	-	cloning artifact	UNP P29208
A	0	ALA	-	cloning artifact	UNP P29208
A	190	ALA	GLU	engineered mutation	UNP P29208
B	-2	GLY	-	cloning artifact	UNP P29208
B	-1	SER	-	cloning artifact	UNP P29208
B	0	ALA	-	cloning artifact	UNP P29208
B	190	ALA	GLU	engineered mutation	UNP P29208
C	-2	GLY	-	cloning artifact	UNP P29208
C	-1	SER	-	cloning artifact	UNP P29208
C	0	ALA	-	cloning artifact	UNP P29208
C	190	ALA	GLU	engineered mutation	UNP P29208
D	-2	GLY	-	cloning artifact	UNP P29208
D	-1	SER	-	cloning artifact	UNP P29208
D	0	ALA	-	cloning artifact	UNP P29208
D	190	ALA	GLU	engineered mutation	UNP P29208

- Molecule 2 is water.

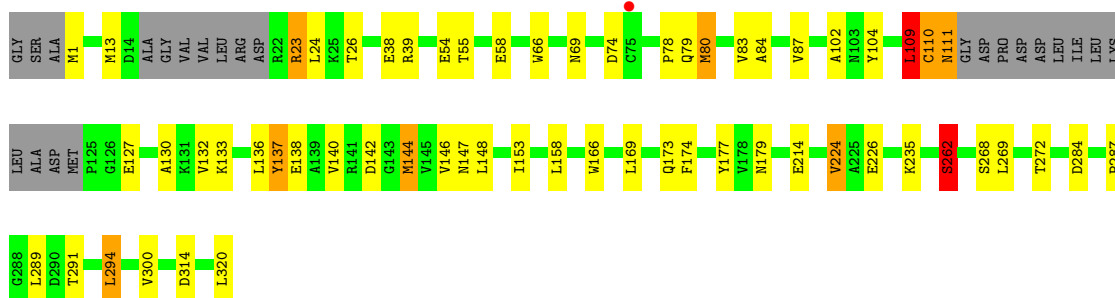
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	69	Total O 69 69	0	1
2	B	60	Total O 60 60	0	0
2	C	23	Total O 23 23	0	0
2	D	27	Total O 27 27	0	0

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.

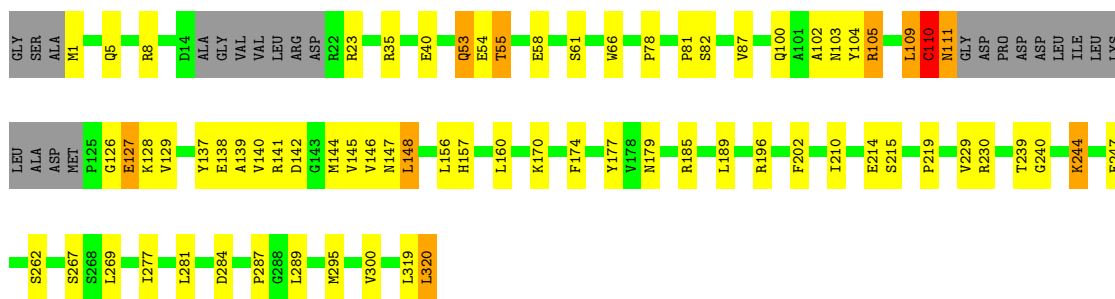
- Molecule 1: O-succinylbenzoate synthase

Chain A: 



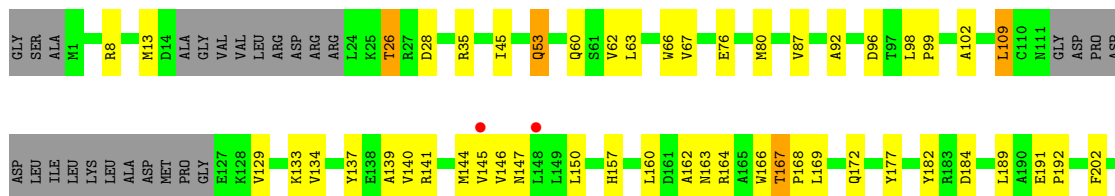
- Molecule 1: O-succinylbenzoate synthase

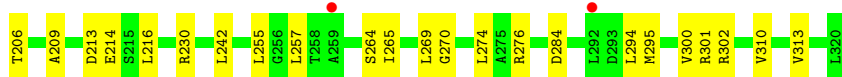
Chain B: 



- Molecule 1: O-succinylbenzoate synthase

Chain C: 





- Molecule 1: O-succinylbenzoate synthase

Chain D: 72% 18% 8%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	69.47Å 77.39Å 110.68Å 90.00° 90.08° 90.00°	Depositor
Resolution (Å)	43.29 – 2.30 43.29 – 2.30	Depositor EDS
% Data completeness (in resolution range)	97.5 (43.29-2.30) 97.1 (43.29-2.30)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 2.29Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.222 , 0.290 0.225 , 0.291	Depositor DCC
R_{free} test set	2598 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å ²)	38.9	Xtrriage
Anisotropy	0.051	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 27.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.457 for h,-k,-l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	9602	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.14% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 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 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	0.70	0/2424	0.91	6/3295 (0.2%)
1	B	0.72	0/2433	0.93	1/3307 (0.0%)
1	C	0.61	0/2368	0.85	2/3223 (0.1%)
1	D	0.60	0/2389	0.83	0/3252
All	All	0.66	0/9614	0.88	9/13077 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	1	1
1	B	1	2
1	D	0	3
All	All	2	6

There are no bond length outliers.

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	80	MET	CA-C-N	7.67	127.22	119.24
1	A	80	MET	C-N-CA	7.67	127.22	119.24
1	B	105	ARG	N-CA-CB	5.89	118.62	109.97
1	A	153	ILE	CA-C-N	5.75	127.03	119.84
1	A	153	ILE	C-N-CA	5.75	127.03	119.84

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	111	ASN	CA
1	B	111	ASN	CA

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	109	LEU	Peptide
1	B	110	CYS	Peptide
1	B	126	GLY	Peptide
1	D	136	LEU	Peptide
1	D	137	TYR	Peptide

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	2376	0	2378	53	0
1	B	2385	0	2385	61	0
1	C	2321	0	2315	53	0
1	D	2341	0	2334	47	0
2	A	69	0	0	2	0
2	B	60	0	0	3	0
2	C	23	0	0	2	0
2	D	27	0	0	2	0
All	All	9602	0	9412	189	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 10.

The worst 5 of 189 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:D:285:THR:HG22	2:D:328:HOH:O	1.61	0.99
1:B:53:GLN:NE2	1:B:54:GLU:OE1	2.04	0.89
1:D:302:ARG:HE	1:D:310:VAL:HG21	1.39	0.86
1:B:269:LEU:HD12	1:B:300:VAL:HB	1.62	0.81
1:C:109:LEU:HD11	1:C:133:LYS:NZ	1.96	0.81

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	297/323 (92%)	280 (94%)	13 (4%)	4 (1%)	9	10
1	B	298/323 (92%)	285 (96%)	10 (3%)	3 (1%)	12	15
1	C	291/323 (90%)	278 (96%)	13 (4%)	0	100	100
1	D	294/323 (91%)	272 (92%)	21 (7%)	1 (0%)	36	46
All	All	1180/1292 (91%)	1115 (94%)	57 (5%)	8 (1%)	24	23

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	23[A]	ARG
1	A	23[B]	ARG
1	A	110	CYS
1	B	23[A]	ARG
1	B	23[B]	ARG

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	250/264 (95%)	230 (92%)	20 (8%)	11	15
1	B	251/264 (95%)	233 (93%)	18 (7%)	13	18
1	C	245/264 (93%)	228 (93%)	17 (7%)	14	20
1	D	247/264 (94%)	228 (92%)	19 (8%)	12	16
All	All	993/1056 (94%)	919 (92%)	74 (8%)	13	17

5 of 74 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	100	GLN
1	D	246	ARG
1	D	136	LEU
1	D	170	LYS
1	B	61	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	273	GLN
1	D	100	GLN
1	D	299	GLN
1	D	273	GLN
1	B	103	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

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

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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, 95th 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	300/323 (92%)	-0.73	1 (0%) 90 90	15, 35, 47, 55	5 (1%)
1	B	300/323 (92%)	-0.72	0 100 100	14, 34, 47, 55	6 (2%)
1	C	296/323 (91%)	-0.48	4 (1%) 73 75	22, 45, 55, 62	4 (1%)
1	D	298/323 (92%)	-0.54	1 (0%) 90 90	22, 46, 56, 68	3 (1%)
All	All	1194/1292 (92%)	-0.62	6 (0%) 87 87	14, 41, 53, 68	18 (1%)

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	145	VAL	4.5
1	C	259	ALA	4.0
1	A	75	CYS	3.1
1	C	292	LEU	2.5
1	C	148	LEU	2.1

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.