



wwPDB X-ray Structure Validation Summary Report ⓘ

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PDB ID : 3O31 / pdb_00003o31
Title : E81Q mutant of MtNAS in complex with a reaction intermediate
Authors : Dreyfus, C.; Pignol, D.; Arnoux, P.
Deposited on : 2010-07-23
Resolution : 1.70 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)	:	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

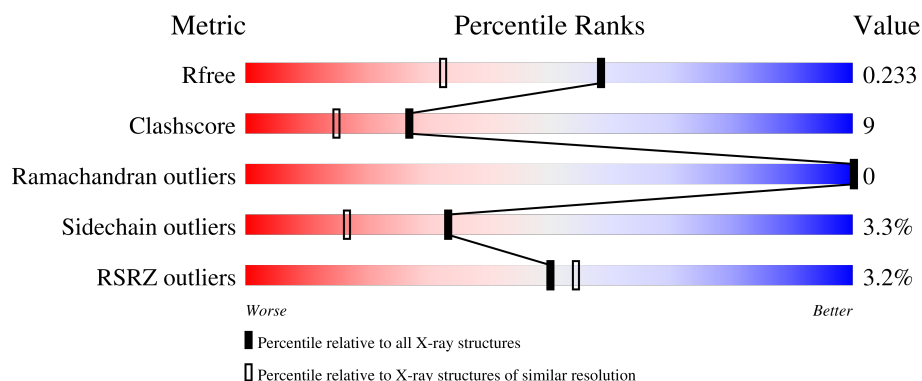
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (1.70-1.70)

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	296	2% 79% 9% 11%
1	B	296	4% 75% 12% 11%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5223 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 ThermoNicotianamine Synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	264	Total	C	N	O	S	0	0	0
			2111	1347	360	393	11			
1	B	264	Total	C	N	O	S	0	0	0
			2111	1347	360	393	11			

There are 66 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	81	GLN	GLU	engineered mutation	UNP O26771
A	266	LYS	-	expression tag	UNP O26771
A	267	GLY	-	expression tag	UNP O26771
A	268	GLU	-	expression tag	UNP O26771
A	269	LEU	-	expression tag	UNP O26771
A	270	ASN	-	expression tag	UNP O26771
A	271	SER	-	expression tag	UNP O26771
A	272	LYS	-	expression tag	UNP O26771
A	273	LEU	-	expression tag	UNP O26771
A	274	GLU	-	expression tag	UNP O26771
A	275	GLY	-	expression tag	UNP O26771
A	276	LYS	-	expression tag	UNP O26771
A	277	PRO	-	expression tag	UNP O26771
A	278	ILE	-	expression tag	UNP O26771
A	279	PRO	-	expression tag	UNP O26771
A	280	ASN	-	expression tag	UNP O26771
A	281	PRO	-	expression tag	UNP O26771
A	282	LEU	-	expression tag	UNP O26771
A	283	LEU	-	expression tag	UNP O26771
A	284	GLY	-	expression tag	UNP O26771
A	285	LEU	-	expression tag	UNP O26771
A	286	ASP	-	expression tag	UNP O26771
A	287	SER	-	expression tag	UNP O26771
A	288	THR	-	expression tag	UNP O26771
A	289	ARG	-	expression tag	UNP O26771

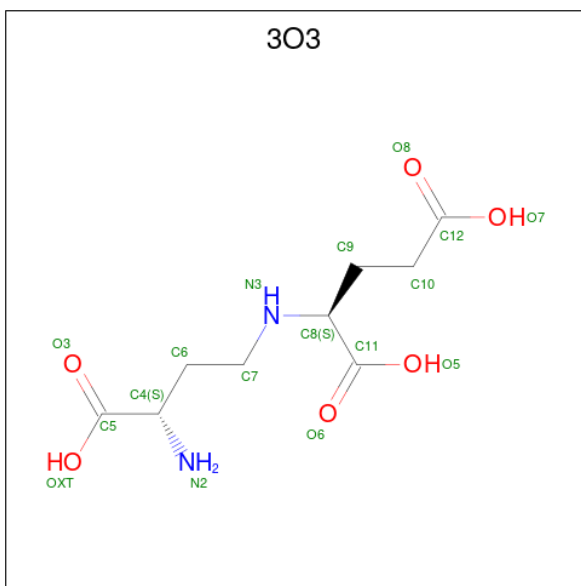
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Chain	Residue	Modelled	Actual	Comment	Reference
A	290	THR	-	expression tag	UNP O26771
A	291	GLY	-	expression tag	UNP O26771
A	292	HIS	-	expression tag	UNP O26771
A	293	HIS	-	expression tag	UNP O26771
A	294	HIS	-	expression tag	UNP O26771
A	295	HIS	-	expression tag	UNP O26771
A	296	HIS	-	expression tag	UNP O26771
A	297	HIS	-	expression tag	UNP O26771
B	81	GLN	GLU	engineered mutation	UNP O26771
B	266	LYS	-	expression tag	UNP O26771
B	267	GLY	-	expression tag	UNP O26771
B	268	GLU	-	expression tag	UNP O26771
B	269	LEU	-	expression tag	UNP O26771
B	270	ASN	-	expression tag	UNP O26771
B	271	SER	-	expression tag	UNP O26771
B	272	LYS	-	expression tag	UNP O26771
B	273	LEU	-	expression tag	UNP O26771
B	274	GLU	-	expression tag	UNP O26771
B	275	GLY	-	expression tag	UNP O26771
B	276	LYS	-	expression tag	UNP O26771
B	277	PRO	-	expression tag	UNP O26771
B	278	ILE	-	expression tag	UNP O26771
B	279	PRO	-	expression tag	UNP O26771
B	280	ASN	-	expression tag	UNP O26771
B	281	PRO	-	expression tag	UNP O26771
B	282	LEU	-	expression tag	UNP O26771
B	283	LEU	-	expression tag	UNP O26771
B	284	GLY	-	expression tag	UNP O26771
B	285	LEU	-	expression tag	UNP O26771
B	286	ASP	-	expression tag	UNP O26771
B	287	SER	-	expression tag	UNP O26771
B	288	THR	-	expression tag	UNP O26771
B	289	ARG	-	expression tag	UNP O26771
B	290	THR	-	expression tag	UNP O26771
B	291	GLY	-	expression tag	UNP O26771
B	292	HIS	-	expression tag	UNP O26771
B	293	HIS	-	expression tag	UNP O26771
B	294	HIS	-	expression tag	UNP O26771
B	295	HIS	-	expression tag	UNP O26771
B	296	HIS	-	expression tag	UNP O26771
B	297	HIS	-	expression tag	UNP O26771

- Molecule 2 is N-[(3S)-3-amino-3-carboxypropyl]-L-glutamic acid (CCD ID: 3O3) (formula:

$C_9H_{16}N_2O_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			17	9	2	6		
2	B	1	Total	C	N	O	0	0
			17	9	2	6		

- Molecule 3 is BROMIDE ION (CCD ID: BR) (formula: Br).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	4	Total	Br	0	0
			4	4		
3	B	2	Total	Br	0	0
			2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	461	Total	O	0	0
			461	461		
4	B	500	Total	O	0	0
			500	500		

- Molecule 1: ThermoNicotianamine Synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.37Å 67.90Å 147.41Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.39 – 1.70 32.39 – 1.70	Depositor EDS
% Data completeness (in resolution range)	97.3 (32.39-1.70) 97.3 (32.39-1.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.54 (at 1.70Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.188 , 0.233 0.187 , 0.233	Depositor DCC
R_{free} test set	3493 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	13.5	Xtriage
Anisotropy	0.044	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 54.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5223	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.47% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 3O3, BR

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	0.67	0/2153	0.83	0/2912
1	B	0.70	0/2153	0.86	0/2912
All	All	0.68	0/4306	0.84	0/5824

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	2111	0	2108	32	0
1	B	2111	0	2108	47	0
2	A	17	0	13	0	0
2	B	17	0	13	0	0
3	A	4	0	0	1	0
3	B	2	0	0	0	0
4	A	461	0	0	18	0
4	B	500	0	0	21	0
All	All	5223	0	4242	78	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 9.

The worst 5 of 78 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)
4:A:902:HOH:O	1:B:56:ILE:HG21	1.36	1.23
1:A:147:MET:SD	4:A:826:HOH:O	2.03	1.17
1:B:63:ASN:HB2	4:B:488:HOH:O	1.44	1.17
1:B:112:LYS:HE2	4:B:395:HOH:O	1.60	0.98
1:B:27:MET:HB2	1:B:79:LYS:HD2	1.47	0.95

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	262/296 (88%)	260 (99%)	2 (1%)	0	100	100
1	B	262/296 (88%)	257 (98%)	5 (2%)	0	100	100
All	All	524/592 (88%)	517 (99%)	7 (1%)	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	229/257 (89%)	224 (98%)	5 (2%)	45	29

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	229/257 (89%)	219 (96%)	10 (4%)	25	10
All	All	458/514 (89%)	443 (97%)	15 (3%)	33	17

5 of 15 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	56	ILE
1	B	197	LEU
1	B	121	ARG
1	B	226	MET
1	B	182	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	113	ASN
1	B	175	ASN
1	B	207	ASN
1	A	207	ASN
1	B	64	HIS

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](#)

Of 8 ligands modelled in this entry, 6 are monoatomic - leaving 2 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
2	3O3	B	1	-	15,16,16	1.05	1 (6%)	14,20,20	1.09	1 (7%)
2	3O3	A	1	-	15,16,16	0.93	0	14,20,20	1.42	2 (14%)

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	3O3	B	1	-	-	6/19/19/19	-
2	3O3	A	1	-	-	5/19/19/19	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1	3O3	O5-C11	-2.05	1.24	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1	3O3	C7-N3-C8	2.74	118.67	113.76
2	A	1	3O3	C10-C9-C8	2.41	117.60	113.16
2	B	1	3O3	C10-C9-C8	2.04	116.93	113.16

There are no chirality outliers.

5 of 11 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1	3O3	C11-C8-N3-C7
2	B	1	3O3	C11-C8-N3-C7
2	B	1	3O3	C9-C8-N3-C7
2	A	1	3O3	O6-C11-C8-C9
2	B	1	3O3	O5-C11-C8-C9

There are no ring outliers.

No monomer is involved in short contacts.

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 [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	264/296 (89%)	0.08	6 (2%) 61 65	7, 13, 21, 29	0
1	B	264/296 (89%)	0.03	11 (4%) 40 45	7, 12, 21, 26	0
All	All	528/592 (89%)	0.06	17 (3%) 50 54	7, 12, 21, 29	0

The worst 5 of 17 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	265	PRO	5.2
1	A	265	PRO	4.4
1	B	48	ILE	3.7
1	A	237	ASP	3.5
1	B	2	SER	3.2

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](#)

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, 95th 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($\text{\AA}^2$)	Q<0.9
2	3O3	B	1	17/17	0.94	0.07	9,11,15,16	0
2	3O3	A	1	17/17	0.95	0.07	9,12,16,17	0
3	BR	A	300	1/1	0.98	0.07	25,25,25,25	0
3	BR	A	298	1/1	0.99	0.02	16,16,16,16	0
3	BR	A	301	1/1	0.99	0.06	25,25,25,25	0
3	BR	B	298	1/1	0.99	0.02	16,16,16,16	0
3	BR	B	299	1/1	0.99	0.04	20,20,20,20	0
3	BR	A	299	1/1	1.00	0.01	13,13,13,13	0

6.5 Other polymers [i](#)

There are no such residues in this entry.