



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 28, 2026 – 08:34 PM UTC

PDB ID : 5MKB / pdb_00005mkb
Title : Maltodextrin binding protein MalE1 from *L. casei* BL23 without ligand
Authors : Homburg, C.; Bommer, M.; Wuttge, S.; Hobe, C.; Beck, S.; Dobbek, H.;
Deutscher, J.; Licht, A.; Schneider, E.
Deposited on : 2016-12-03
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
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

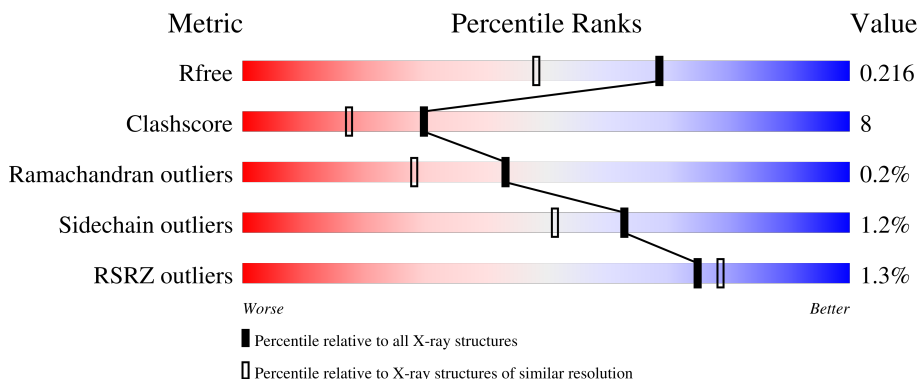
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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.



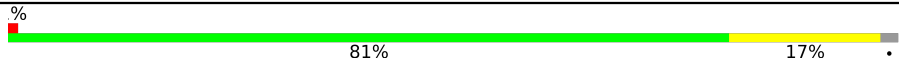

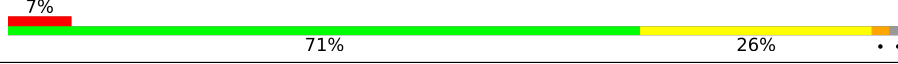
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	5551 (1.70-1.70)
Clashscore	190562	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)
RSRZ outliers	180081	5554 (1.70-1.70)

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	379	 82% 15% ..
1	B	379	 89% 9% .
1	C	379	 83% 16% .
1	D	379	 84% 13% ..
1	E	379	 88% 11% .

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Mol	Chain	Length	Quality of chain
1	F	379	 <p>% 81% 17% .</p>
1	G	379	 <p>% 79% 18% ..</p>
1	H	379	 <p>7% 71% 26% ..</p>

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 24739 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 MalE1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	373	2803	1779	469	545	10	0	0	0
1	B	373	2803	1779	469	545	10	0	0	0
1	C	373	2803	1779	469	545	10	0	0	0
1	D	373	2803	1779	469	545	10	0	0	0
1	E	373	2803	1779	469	545	10	0	0	0
1	F	373	2803	1779	469	545	10	0	0	0
1	G	373	2803	1779	469	545	10	0	0	0
1	H	373	2803	1779	469	545	10	0	0	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	10	GLY	-	expression tag	UNP B0L7B0
A	11	SER	-	expression tag	UNP B0L7B0
A	12	HIS	-	expression tag	UNP B0L7B0
A	13	MET	-	expression tag	UNP B0L7B0
B	10	GLY	-	expression tag	UNP B0L7B0
B	11	SER	-	expression tag	UNP B0L7B0
B	12	HIS	-	expression tag	UNP B0L7B0
B	13	MET	-	expression tag	UNP B0L7B0
C	10	GLY	-	expression tag	UNP B0L7B0
C	11	SER	-	expression tag	UNP B0L7B0
C	12	HIS	-	expression tag	UNP B0L7B0
C	13	MET	-	expression tag	UNP B0L7B0
D	10	GLY	-	expression tag	UNP B0L7B0

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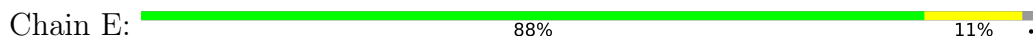
Chain	Residue	Modelled	Actual	Comment	Reference
D	11	SER	-	expression tag	UNP B0L7B0
D	12	HIS	-	expression tag	UNP B0L7B0
D	13	MET	-	expression tag	UNP B0L7B0
E	10	GLY	-	expression tag	UNP B0L7B0
E	11	SER	-	expression tag	UNP B0L7B0
E	12	HIS	-	expression tag	UNP B0L7B0
E	13	MET	-	expression tag	UNP B0L7B0
F	10	GLY	-	expression tag	UNP B0L7B0
F	11	SER	-	expression tag	UNP B0L7B0
F	12	HIS	-	expression tag	UNP B0L7B0
F	13	MET	-	expression tag	UNP B0L7B0
G	10	GLY	-	expression tag	UNP B0L7B0
G	11	SER	-	expression tag	UNP B0L7B0
G	12	HIS	-	expression tag	UNP B0L7B0
G	13	MET	-	expression tag	UNP B0L7B0
H	10	GLY	-	expression tag	UNP B0L7B0
H	11	SER	-	expression tag	UNP B0L7B0
H	12	HIS	-	expression tag	UNP B0L7B0
H	13	MET	-	expression tag	UNP B0L7B0

- Molecule 2 is water.

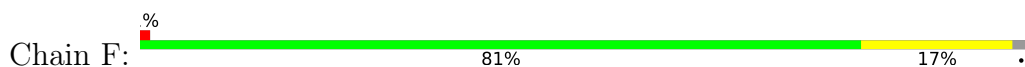
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	336	Total O 336 336	0	0
2	B	312	Total O 312 312	0	0
2	C	302	Total O 302 302	0	0
2	D	290	Total O 290 290	0	0
2	E	338	Total O 338 338	0	0
2	F	310	Total O 310 310	0	0
2	G	223	Total O 223 223	0	0
2	H	204	Total O 204 204	0	0



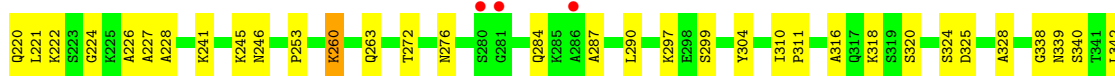
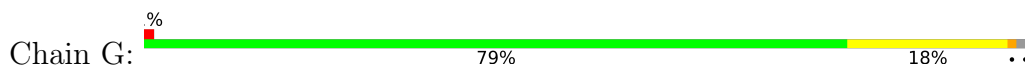
• Molecule 1: MalE1



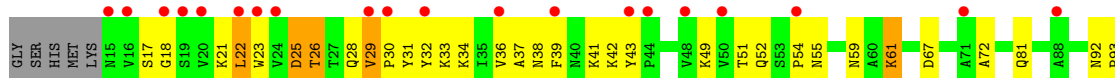
• Molecule 1: MalE1

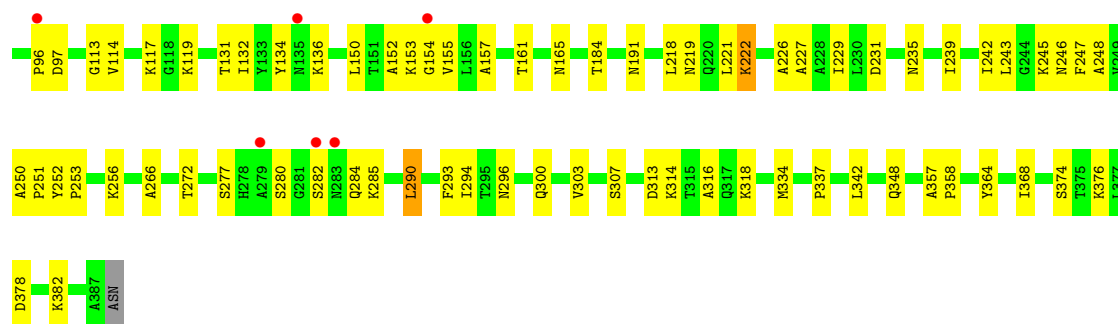


• Molecule 1: MalE1



• Molecule 1: MalE1





4 Data and refinement statistics i

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	41.04Å 124.94Å 143.74Å 74.51° 89.61° 89.86°	Depositor
Resolution (Å)	46.17 – 1.70 46.17 – 1.70	Depositor EDS
% Data completeness (in resolution range)	96.9 (46.17-1.70) 95.2 (46.17-1.70)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.81 (at 1.70Å)	Xtrriage
Refinement program	PHENIX 1.9_1690	Depositor
R, R_{free}	0.178 , 0.218 (Not available) , 0.216	Depositor DCC
R_{free} test set	14709 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	18.2	Xtrriage
Anisotropy	0.545	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 31.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.23$	Xtrriage
Estimated twinning fraction	0.437 for h,-k,-l	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	24739	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 44.47 % 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 1.5194e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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	0.33	0/2862	0.77	2/3885 (0.1%)
1	B	0.32	0/2862	0.74	0/3885
1	C	0.31	0/2862	0.75	0/3885
1	D	0.33	0/2862	0.75	1/3885 (0.0%)
1	E	0.32	0/2862	0.74	0/3885
1	F	0.35	0/2862	0.77	0/3885
1	G	0.33	0/2862	0.77	2/3885 (0.1%)
1	H	0.35	0/2862	0.84	4/3885 (0.1%)
All	All	0.33	0/22896	0.77	9/31080 (0.0%)

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	H	43	TYR	CA-C-N	6.67	126.37	119.56
1	H	43	TYR	C-N-CA	6.67	126.37	119.56
1	H	67	ASP	CA-C-N	6.12	126.30	119.32
1	H	67	ASP	C-N-CA	6.12	126.30	119.32
1	A	29	VAL	CA-C-N	-6.05	112.28	119.84

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	2803	0	2800	51	0
1	B	2803	0	2800	23	0
1	C	2803	0	2800	42	0
1	D	2803	0	2800	49	0
1	E	2803	0	2800	27	0
1	F	2803	0	2800	50	0
1	G	2803	0	2800	59	0
1	H	2803	0	2800	82	0
2	A	336	0	0	23	1
2	B	312	0	0	9	0
2	C	302	0	0	19	1
2	D	290	0	0	32	0
2	E	338	0	0	10	1
2	F	310	0	0	25	0
2	G	223	0	0	30	0
2	H	204	0	0	32	0
All	All	24739	0	22400	380	2

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 8.

The worst 5 of 380 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:G:113:GLY:HA2	1:G:342:LEU:HD21	1.54	0.90
1:H:36:VAL:HA	1:H:39:PHE:HB2	1.56	0.85
1:E:132:ILE:HD11	1:E:253:PRO:HD3	1.60	0.84
1:B:113:GLY:HA2	1:B:342:LEU:HD21	1.58	0.83
1:D:132:ILE:HD11	1:D:253:PRO:HD3	1.59	0.83

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:403:HOH:O	2:A:530:HOH:O[1_455]	2.16	0.04
2:C:691:HOH:O	2:E:622:HOH:O[1_655]	2.16	0.04

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	371/379 (98%)	363 (98%)	8 (2%)	0	100	100
1	B	371/379 (98%)	363 (98%)	8 (2%)	0	100	100
1	C	371/379 (98%)	363 (98%)	7 (2%)	1 (0%)	36	22
1	D	371/379 (98%)	365 (98%)	6 (2%)	0	100	100
1	E	371/379 (98%)	363 (98%)	8 (2%)	0	100	100
1	F	371/379 (98%)	365 (98%)	5 (1%)	1 (0%)	36	22
1	G	371/379 (98%)	360 (97%)	10 (3%)	1 (0%)	36	22
1	H	371/379 (98%)	357 (96%)	12 (3%)	2 (0%)	24	12
All	All	2968/3032 (98%)	2899 (98%)	64 (2%)	5 (0%)	43	28

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	F	27	THR
1	G	27	THR
1	C	25	ASP
1	H	25	ASP
1	H	96	PRO

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	297/302 (98%)	292 (98%)	5 (2%)	53	38

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	297/302 (98%)	296 (100%)	1 (0%)	86	83
1	C	297/302 (98%)	296 (100%)	1 (0%)	86	83
1	D	297/302 (98%)	292 (98%)	5 (2%)	53	38
1	E	297/302 (98%)	297 (100%)	0	100	100
1	F	297/302 (98%)	294 (99%)	3 (1%)	68	58
1	G	297/302 (98%)	291 (98%)	6 (2%)	48	32
1	H	297/302 (98%)	289 (97%)	8 (3%)	39	23
All	All	2376/2416 (98%)	2347 (99%)	29 (1%)	63	51

5 of 29 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	321	LYS
1	H	256	LYS
1	G	29	VAL
1	H	61	LYS
1	G	26	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 36 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	15	ASN
1	H	278	HIS
1	G	28	GLN
1	G	278	HIS
1	D	105	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 [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	373/379 (98%)	-0.51	2 (0%) 87 89	11, 19, 35, 93	0
1	B	373/379 (98%)	-0.62	1 (0%) 90 91	10, 18, 33, 56	0
1	C	373/379 (98%)	-0.31	2 (0%) 87 89	13, 24, 41, 84	0
1	D	373/379 (98%)	-0.46	1 (0%) 90 91	11, 18, 29, 87	0
1	E	373/379 (98%)	-0.69	1 (0%) 90 91	11, 19, 33, 64	0
1	F	373/379 (98%)	-0.51	2 (0%) 87 89	12, 20, 33, 100	0
1	G	373/379 (98%)	-0.27	4 (1%) 78 81	12, 27, 50, 75	0
1	H	373/379 (98%)	0.32	26 (6%) 22 24	16, 35, 79, 122	0
All	All	2984/3032 (98%)	-0.38	39 (1%) 75 79	10, 21, 47, 122	0

The worst 5 of 39 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	32	TYR	4.6
1	H	43	TYR	4.0
1	H	39	PHE	3.8
1	H	22	LEU	3.6
1	F	27	THR	3.6

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

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.