



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 12, 2024 – 04:46 AM EDT

PDB ID : 6NKQ  
Title : The structure of bovine beta-lactoglobulin in novel crystals grown at pH 3.8  
Authors : McPherson, A.  
Deposited on : 2019-01-07  
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](mailto: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	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

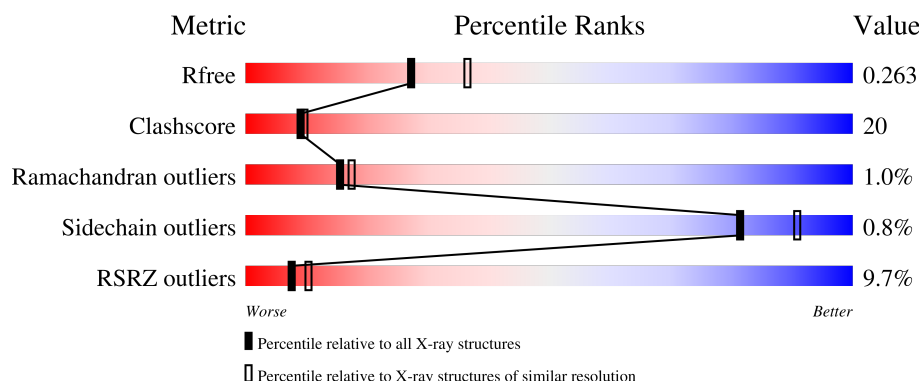
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 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))
$R_{free}$	130704	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (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  $\geq 3$ , 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	178	<div> <div>8%</div> <div>65%</div> <div>22%</div> <div>•</div> <div>11%</div> </div>
1	B	178	<div> <div>11%</div> <div>63%</div> <div>25%</div> <div>•</div> <div>10%</div> </div>
1	C	178	<div> <div>11%</div> <div>68%</div> <div>21%</div> <div>•</div> <div>11%</div> </div>
1	D	178	<div> <div>7%</div> <div>57%</div> <div>30%</div> <div>•</div> <div>11%</div> </div>
1	E	178	<div> <div>10%</div> <div>70%</div> <div>18%</div> <div>•</div> <div>11%</div> </div>

*Continued on next page...*

Continued from previous page...

Mol	Chain	Length	Quality of chain
1	F	178	<div><div></div><div>5%</div><div>62%</div><div>27%</div><div>11%</div></div>

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 7617 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 Beta-lactoglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	160	Total	C	N	O	S	0	0	0
			1260	802	204	245	9			
1	C	159	Total	C	N	O	S	0	2	0
			1262	806	201	246	9			
1	D	159	Total	C	N	O	S	0	2	0
			1267	807	203	248	9			
1	E	159	Total	C	N	O	S	0	0	0
			1250	796	201	244	9			
1	F	159	Total	C	N	O	S	0	1	0
			1261	803	203	246	9			
1	A	158	Total	C	N	O	S	0	0	0
			1248	794	202	243	9			

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Ca	0	0
			1	1		

- Molecule 3 is water.

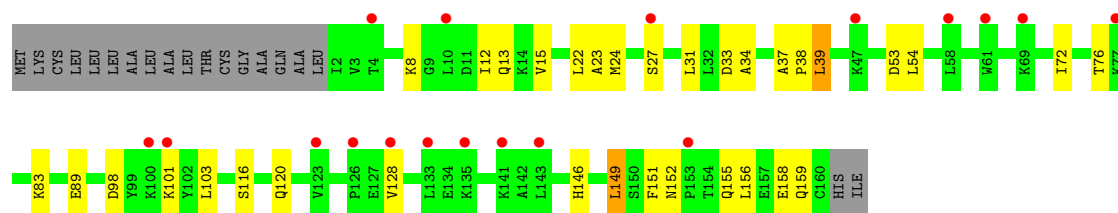
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	16	Total	O	0	0
			16	16		
3	C	12	Total	O	0	0
			12	12		
3	D	8	Total	O	0	1
			9	9		
3	E	7	Total	O	0	0
			7	7		
3	F	9	Total	O	0	0
			9	9		

*Continued on next page...*

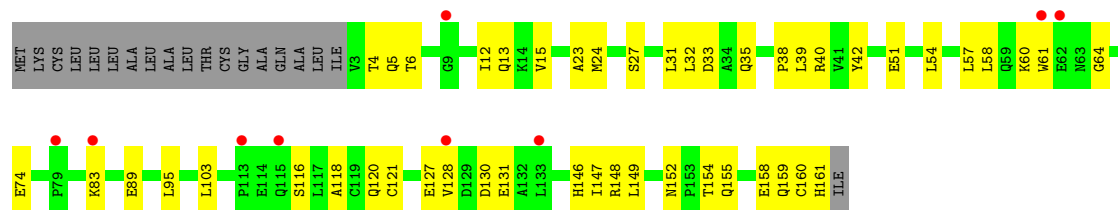
*Continued from previous page...*

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	15	Total	O	0	0
			15	15		

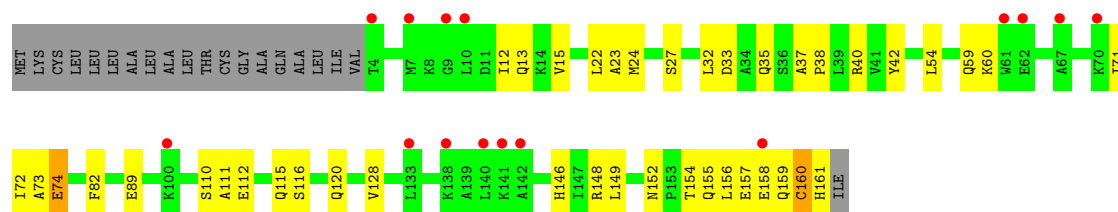




• Molecule 1: Beta-lactoglobulin



• Molecule 1: Beta-lactoglobulin



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	65.89Å 114.12Å 140.51Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	57.06 – 2.30 57.06 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.5 (57.06-2.30) 94.0 (57.06-2.20)	Depositor EDS
$R_{merge}$	0.20	Depositor
$R_{sym}$	0.19	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.16 (at 2.20Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, $R_{free}$	0.207 , 0.261 0.211 , 0.263	Depositor DCC
$R_{free}$ test set	2368 reflections (4.78%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	42.2	Xtriage
Anisotropy	0.956	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 41.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.36$ , $\langle L^2 \rangle = 0.18$	Xtriage
Estimated twinning fraction	0.448 for -1/2*h+1/2*k,3/2*h+1/2*k,-l 0.439 for -1/2*h-1/2*k,-3/2*h+1/2*k,-l 0.447 for 1/2*h+1/2*k,3/2*h-1/2*k,-l 0.437 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.467 for -h,-k,l	Xtriage
Reported twinning fraction	0.162 for H, K, L 0.159 for -h,-k,l 0.164 for -1/2H-1/2K, 3/2H-1/2K, L 0.175 for 1/2H-1/2K, 3/2H+1/2K, L 0.158 for 1/2H+1/2K, -3/2H+1/2K, L 0.183 for -1/2H+1/2K, -3/2H-1/2K, L	Depositor
Outliers	1 of 49499 reflections (0.002%)	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7617	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	100.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.07% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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:  
CA

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	1/1269 (0.1%)	0.66	0/1717
1	B	0.66	0/1281	0.67	0/1734
1	C	0.64	0/1289	0.66	0/1745
1	D	0.68	0/1294	0.70	0/1751
1	E	0.63	0/1270	0.66	0/1719
1	F	0.71	0/1285	0.73	0/1739
All	All	0.67	1/7688 (0.0%)	0.68	0/10405

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	B	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	74	GLU	CD-OE1	-6.44	1.18	1.25

There are no bond angle outliers.

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	158	GLU	Peptide
1	B	4	THR	Peptide

## 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	1248	0	1259	44	0
1	B	1260	0	1270	54	0
1	C	1262	0	1277	45	1
1	D	1267	0	1280	84	2
1	E	1250	0	1263	37	1
1	F	1261	0	1274	66	2
2	B	1	0	0	0	0
3	A	15	0	0	7	0
3	B	16	0	0	7	0
3	C	12	0	0	8	0
3	D	9	0	0	3	0
3	E	7	0	0	3	0
3	F	9	0	0	3	0
All	All	7617	0	7623	305	3

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 20.

The worst 5 of 305 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:B:155:GLN:O	1:B:161:HIS:HB2	1.17	1.32
1:D:60:LYS:HE3	1:D:61:TRP:N	1.48	1.26
1:F:131:GLU:OE2	3:F:201:HOH:O	1.56	1.21
1:F:155:GLN:O	1:F:161:HIS:HB3	1.43	1.13
1:B:155:GLN:O	1:B:161:HIS:CB	1.96	1.12

All (3) 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)
1:C:51:GLU:OE1	1:E:53:ASP:OD2[2_655]	2.11	0.09
1:D:53:ASP:OD2	1:F:51:GLU:OE1[2_656]	2.16	0.04
1:D:49:THR:OG1	1:F:51:GLU:OE2[2_656]	2.17	0.03

## 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	156/178 (88%)	139 (89%)	15 (10%)	2 (1%)	12	12
1	B	158/178 (89%)	140 (89%)	17 (11%)	1 (1%)	25	31
1	C	159/178 (89%)	142 (89%)	16 (10%)	1 (1%)	25	31
1	D	159/178 (89%)	141 (89%)	16 (10%)	2 (1%)	12	12
1	E	157/178 (88%)	139 (88%)	16 (10%)	2 (1%)	12	12
1	F	158/178 (89%)	141 (89%)	16 (10%)	1 (1%)	25	31
All	All	947/1068 (89%)	842 (89%)	96 (10%)	9 (1%)	15	17

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	39	LEU
1	A	160	CYS
1	D	128	VAL
1	B	128	VAL
1	C	128	VAL

### 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	139/154 (90%)	138 (99%)	1 (1%)	84	92
1	B	140/154 (91%)	139 (99%)	1 (1%)	84	92
1	C	141/154 (92%)	141 (100%)	0	100	100

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	142/154 (92%)	138 (97%)	4 (3%)	43	60
1	E	139/154 (90%)	138 (99%)	1 (1%)	84	92
1	F	141/154 (92%)	141 (100%)	0	100	100
All	All	842/924 (91%)	835 (99%)	7 (1%)	81	91

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	115	GLN
1	D	161	HIS
1	A	35	GLN
1	E	149	LEU
1	D	114	GLU

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

Mol	Chain	Res	Type
1	D	35	GLN
1	D	115	GLN
1	E	35	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

## 5.6 Ligand geometry ⓘ

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	158/178 (88%)	0.54	15 (9%) 8 11	50, 101, 139, 175	1 (0%)
1	B	160/178 (89%)	0.63	19 (11%) 4 6	42, 107, 143, 160	0
1	C	159/178 (89%)	0.70	20 (12%) 3 5	53, 103, 144, 192	0
1	D	159/178 (89%)	0.40	12 (7%) 14 19	33, 96, 136, 150	0
1	E	159/178 (89%)	0.55	18 (11%) 5 7	62, 103, 136, 155	0
1	F	159/178 (89%)	0.41	9 (5%) 23 30	28, 92, 125, 144	0
All	All	954/1068 (89%)	0.54	93 (9%) 7 10	28, 100, 138, 192	1 (0%)

The worst 5 of 93 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	61	TRP	11.3
1	F	61	TRP	10.2
1	A	4	THR	8.7
1	B	100	LYS	8.1
1	B	99	TYR	7.6

### 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 monosaccharides 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	CA	B	201	1/1	0.94	0.16	111,111,111,111	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.