



wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 17, 2024 – 10:30 AM EST

PDB ID : 4I5U
Title : Crystal structure of a fungal chimeric cellobiohydrolase Cel6A
Authors : Arnold, F.H.; Wu, I.
Deposited on : 2012-11-29
Resolution : 1.22 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 : 4.02b-467
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 1.20.1
EDS : 3.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4 : 9.0.003 (Gargrove)
Density-Fitness : 1.0.11
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

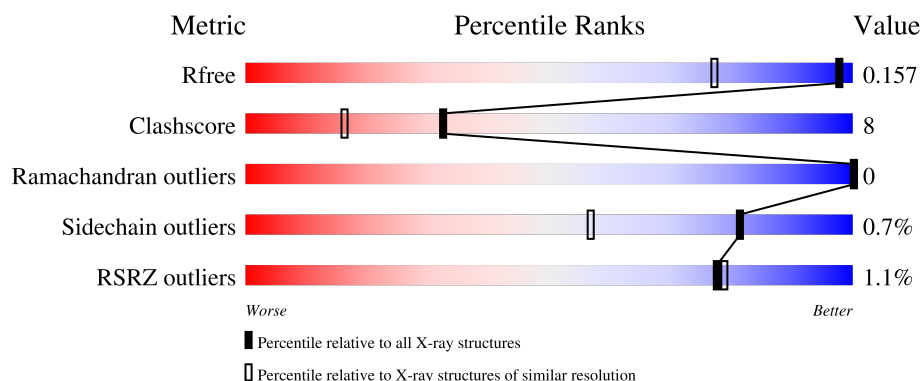
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.22 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}	164625	1745 (1.24-1.20)
Clashscore	180529	1895 (1.24-1.20)
Ramachandran outliers	177936	1845 (1.24-1.20)
Sidechain outliers	177891	1844 (1.24-1.20)
RSRZ outliers	164620	1744 (1.24-1.20)

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	364	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	507	-	-	X	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	509	-	-	X	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 3236 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 Chimeric cel6A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	358	Total	C	N	O	S	0	17	0
			2833	1814	477	535	7			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	128	ALA	VAL	engineered mutation	UNP Q9C1S9
A	135	LEU	MET	engineered mutation	UNP P07987
A	277	LEU	GLN	engineered mutation	UNP P07987
A	317	PRO	SER	engineered mutation	UNP Q5G2D4
A	406	PRO	SER	engineered mutation	UNP P07987
A	413	PRO	SER	engineered mutation	UNP P07987
A	448	HIS	-	expression tag	UNP P07987
A	449	HIS	-	expression tag	UNP P07987
A	450	HIS	-	expression tag	UNP P07987
A	451	HIS	-	expression tag	UNP P07987
A	452	HIS	-	expression tag	UNP P07987
A	453	HIS	-	expression tag	UNP P07987

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula: C₂H₃O₂).



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

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



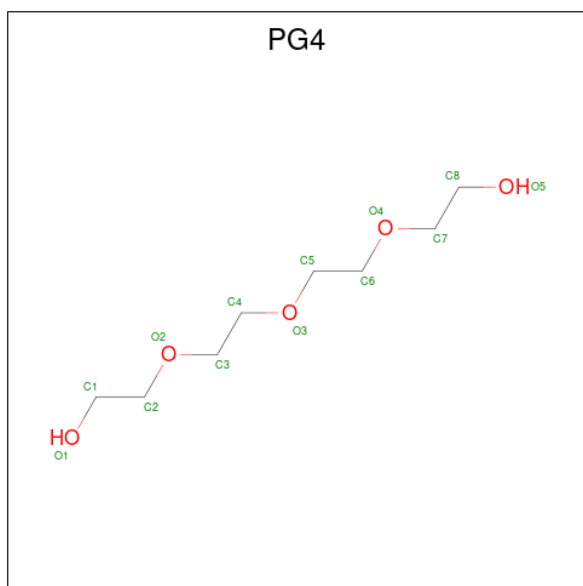
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 4 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula: $C_8H_{18}O_5$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			11	7	4		

- Molecule 5 is TRIETHYLENE GLYCOL (three-letter code: PGE) (formula: $C_6H_{14}O_4$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			10	6	4		
5	A	1	Total	C	O	0	0
			7	4	3		

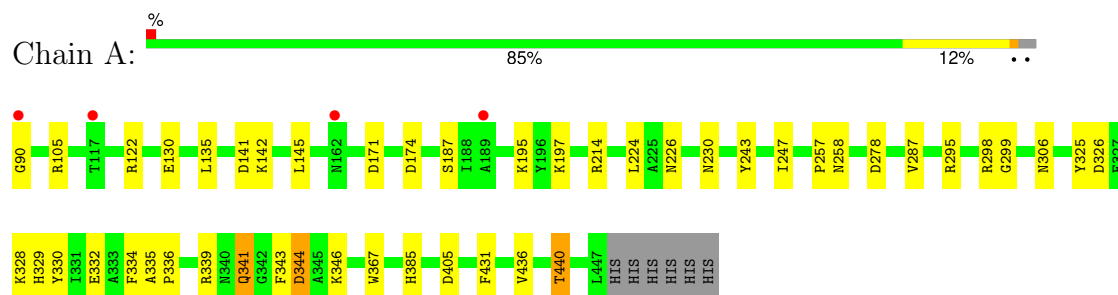
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	327	Total	O	0	0
			327	327		

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: Chimeric cel6A



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	158.60Å 45.41Å 58.19Å 90.00° 95.47° 90.00°	Depositor
Resolution (Å)	35.31 – 1.22 35.31 – 1.22	Depositor EDS
% Data completeness (in resolution range)	87.0 (35.31-1.22) 87.0 (35.31-1.22)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.03	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.77 (at 1.22Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.143 , 0.158 0.142 , 0.157	Depositor DCC
R_{free} test set	5345 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	10.3	Xtriage
Anisotropy	0.060	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 43.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.98	EDS
Total number of atoms	3236	wwPDB-VP
Average B, all atoms (Å ²)	13.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.13% 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: ACT, PGE, EDO, PG4

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	1.35	6/2955 (0.2%)	1.29	23/4050 (0.6%)

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	440	THR	CB-OG1	-6.31	1.30	1.43
1	A	341	GLN	CG-CD	-6.24	1.36	1.51
1	A	332	GLU	CD-OE1	-6.05	1.19	1.25
1	A	325	TYR	CZ-OH	5.51	1.47	1.37
1	A	325	TYR	CE1-CZ	-5.13	1.31	1.38

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	141	ASP	CB-CG-OD1	8.81	126.23	118.30
1	A	141	ASP	CB-CG-OD2	-8.27	110.85	118.30
1	A	214	ARG	NE-CZ-NH1	8.15	124.38	120.30
1	A	122	ARG	NE-CZ-NH2	8.09	124.35	120.30
1	A	295	ARG	NE-CZ-NH1	-7.64	116.48	120.30

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	2833	0	2740	34	0
2	A	8	0	6	1	0
3	A	40	0	60	12	0
4	A	11	0	13	6	0
5	A	17	0	23	7	0
6	A	327	0	0	16	0
All	All	3236	0	2842	45	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 8.

The worst 5 of 45 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:306[B]:ASN:ND2	1:A:306[B]:ASN:CG	1.71	1.43
5:A:514:PGE:H42	6:A:709:HOH:O	1.34	1.25
1:A:339:ARG:HE	3:A:509:EDO:H11	1.17	1.08
1:A:195:LYS:HZ2	4:A:513:PG4:H52	1.31	0.96
1:A:197[B]:LYS:NZ	6:A:642:HOH:O	1.98	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	372/364 (102%)	363 (98%)	9 (2%)	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	298/290 (103%)	296 (99%)	2 (1%)	81	57

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	187	SER
1	A	431	PHE

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	226	ASN
1	A	240	GLN
1	A	329	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](#)

15 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$
5	PGE	A	515	-	6,6,9	0.86	0	5,5,8	0.63	0
2	ACT	A	501	-	3,3,3	1.54	1 (33%)	3,3,3	1.05	0
3	EDO	A	508	-	3,3,3	0.70	0	2,2,2	0.91	0
3	EDO	A	506	-	3,3,3	0.57	0	2,2,2	0.87	0
3	EDO	A	507	-	3,3,3	0.67	0	2,2,2	0.92	0
5	PGE	A	514	-	9,9,9	1.16	0	8,8,8	1.13	0
3	EDO	A	509	-	3,3,3	1.99	1 (33%)	2,2,2	0.07	0
3	EDO	A	511	-	3,3,3	0.15	0	2,2,2	1.47	0
3	EDO	A	512	-	3,3,3	0.65	0	2,2,2	0.48	0
3	EDO	A	510	-	3,3,3	1.25	0	2,2,2	0.79	0
4	PG4	A	513	-	10,10,12	1.46	3 (30%)	9,9,11	2.68	5 (55%)
2	ACT	A	502	-	3,3,3	1.02	0	3,3,3	1.25	0
3	EDO	A	505	-	3,3,3	0.70	0	2,2,2	0.51	0
3	EDO	A	504	-	3,3,3	0.94	0	2,2,2	1.56	1 (50%)
3	EDO	A	503	-	3,3,3	0.56	0	2,2,2	0.41	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
5	PGE	A	515	-	-	3/4/4/7	-
3	EDO	A	508	-	-	0/1/1/1	-
3	EDO	A	507	-	-	1/1/1/1	-
3	EDO	A	506	-	-	1/1/1/1	-
5	PGE	A	514	-	-	3/7/7/7	-
3	EDO	A	509	-	-	1/1/1/1	-
3	EDO	A	512	-	-	0/1/1/1	-
3	EDO	A	510	-	-	1/1/1/1	-
4	PG4	A	513	-	-	0/8/8/10	-
3	EDO	A	511	-	-	1/1/1/1	-
3	EDO	A	505	-	-	0/1/1/1	-
3	EDO	A	504	-	-	1/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	EDO	A	503	-	-	1/1/1/1	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	509	EDO	O1-C1	2.88	1.56	1.42
4	A	513	PG4	O3-C4	2.66	1.53	1.42
4	A	513	PG4	C6-C5	-2.10	1.38	1.49
4	A	513	PG4	O2-C3	2.08	1.52	1.40
2	A	501	ACT	CH3-C	2.01	1.57	1.49

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	513	PG4	O3-C4-C3	5.87	137.13	110.35
4	A	513	PG4	O4-C6-C5	3.15	124.70	110.35
4	A	513	PG4	O3-C5-C6	2.62	122.27	110.35
4	A	513	PG4	O2-C3-C4	2.58	129.91	111.00
3	A	504	EDO	O1-C1-C2	-2.16	95.91	112.39

There are no chirality outliers.

5 of 13 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	514	PGE	C6-C5-O3-C4
5	A	515	PGE	O2-C3-C4-O3
3	A	509	EDO	O1-C1-C2-O2
3	A	503	EDO	O1-C1-C2-O2
3	A	506	EDO	O1-C1-C2-O2

There are no ring outliers.

6 monomers are involved in 26 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	515	PGE	2	0
2	A	501	ACT	1	0
3	A	507	EDO	8	0
5	A	514	PGE	5	0
3	A	509	EDO	4	0
4	A	513	PG4	6	0

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	358/364 (98%)	-0.35	4 (1%) 77 79	4, 10, 21, 29	18 (5%)

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	90[A]	GLY	2.8
1	A	189	ALA	2.3
1	A	162	ASN	2.2
1	A	117	THR	2.2

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 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, 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(Å ²)	Q<0.9
3	EDO	A	511	4/4	0.74	0.24	36,38,41,42	0
3	EDO	A	510	4/4	0.77	0.18	29,30,30,37	0
3	EDO	A	512	4/4	0.79	0.20	40,41,41,44	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
5	PGE	A	515	7/10	0.82	0.19	30,41,44,44	0
3	EDO	A	509	4/4	0.84	0.12	18,23,28,29	0
4	PG4	A	513	11/13	0.86	0.15	18,24,32,36	0
3	EDO	A	504	4/4	0.86	0.14	19,21,29,43	0
2	ACT	A	501	4/4	0.88	0.12	25,25,32,40	0
5	PGE	A	514	10/10	0.89	0.12	23,29,38,41	0
3	EDO	A	503	4/4	0.89	0.15	41,45,47,48	0
3	EDO	A	506	4/4	0.90	0.13	35,39,41,43	0
3	EDO	A	507	4/4	0.91	0.14	16,22,34,48	0
3	EDO	A	508	4/4	0.92	0.10	28,30,34,39	0
3	EDO	A	505	4/4	0.92	0.13	14,16,22,22	0
2	ACT	A	502	4/4	0.93	0.09	21,24,27,27	0

6.5 Other polymers [i](#)

There are no such residues in this entry.