



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 06:15 AM GMT

PDB ID : 2WDQ  
Title : E. COLI SUCCINATE:QUINONE OXIDOREDUCTASE (SQR) WITH CAR-  
BOXIN BOUND  
Authors : Ruprecht, J.; Yankovskaya, V.; Maklashina, E.; Iwata, S.; Cecchini, G.  
Deposited on : 2009-03-25  
Resolution : 2.40 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

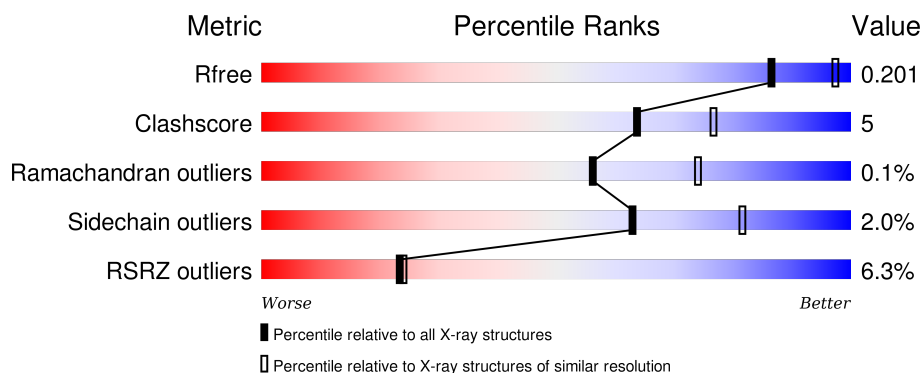
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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))
$R_{free}$	91344	2919 (2.40-2.40)
Clashscore	102246	3407 (2.40-2.40)
Ramachandran outliers	100387	3351 (2.40-2.40)
Sidechain outliers	100360	3352 (2.40-2.40)
RSRZ outliers	91569	2928 (2.40-2.40)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	588	<div> <div>4%</div> <div>89%</div> <div>10%</div> <div>•</div> </div>
1	E	588	<div> <div>5%</div> <div>90%</div> <div>10%</div> </div>
1	I	588	<div> <div>6%</div> <div>88%</div> <div>11%</div> </div>
2	B	238	<div> <div>6%</div> <div>93%</div> <div>7%</div> </div>
2	F	238	<div> <div>5%</div> <div>95%</div> <div>• •</div> </div>

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Mol	Chain	Length	Quality of chain
2	J	238	
3	C	129	
3	G	129	
3	K	129	
4	D	115	
4	H	115	
4	L	115	

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
6	TEO	E	1589	-	-	X	-
6	TEO	I	1589	-	-	X	-
8	SO4	A	1591	-	-	-	X
8	SO4	E	1591	-	-	-	X
8	SO4	I	1591	-	-	-	X

## 2 Entry composition

There are 14 unique types of molecules in this entry. The entry contains 26034 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 SUCCINATE DEHYDROGENASE FLAVOPROTEIN SUB-UNIT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	588	Total	C	N	O	S	0	0	0
			4522	2812	821	861	28			
1	E	588	Total	C	N	O	S	0	0	0
			4522	2812	821	861	28			
1	I	588	Total	C	N	O	S	0	0	0
			4522	2812	821	861	28			

- Molecule 2 is a protein called SUCCINATE DEHYDROGENASE IRON-SULFUR SUB-UNIT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	238	Total	C	N	O	S	0	0	0
			1869	1172	329	348	20			
2	F	238	Total	C	N	O	S	0	0	0
			1869	1172	329	348	20			
2	J	238	Total	C	N	O	S	0	0	0
			1869	1172	329	348	20			

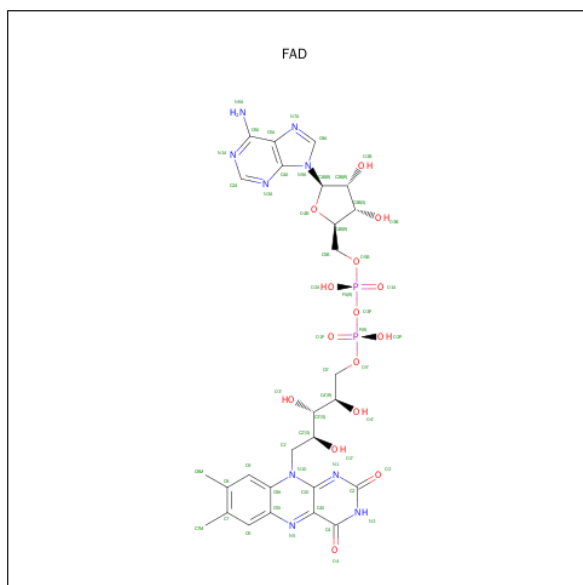
- Molecule 3 is a protein called SUCCINATE DEHYDROGENASE CYTOCHROME B556 SUBUNIT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	121	Total	C	N	O	S	0	0	0
			933	619	151	158	5			
3	G	121	Total	C	N	O	S	0	0	0
			933	619	151	158	5			
3	K	121	Total	C	N	O	S	0	0	0
			933	619	151	158	5			

- Molecule 4 is a protein called SUCCINATE DEHYDROGENASE HYDROPHOBIC MEMBRANE ANCHOR SUBUNIT.

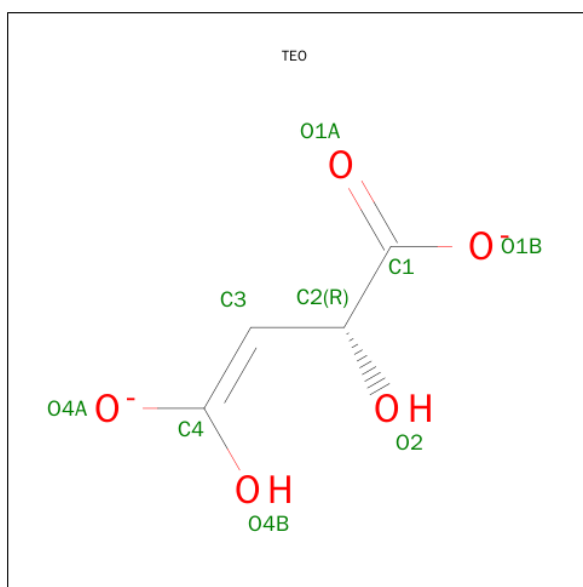
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	105	Total	C	N	O	S	0	0	0
			836	577	123	133	3			
4	H	105	Total	C	N	O	S	0	0	0
			836	577	123	133	3			
4	L	105	Total	C	N	O	S	0	0	0
			836	577	123	133	3			

- Molecule 5 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
5	E	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
5	I	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 6 is MALATE LIKE INTERMEDIATE (three-letter code: TEO) (formula:  $C_4H_4O_5$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			9	4	5		
6	E	1	Total	C	O	0	0
			9	4	5		
6	I	1	Total	C	O	0	0
			9	4	5		

- Molecule 7 is SODIUM ION (three-letter code: NA) (formula: Na).

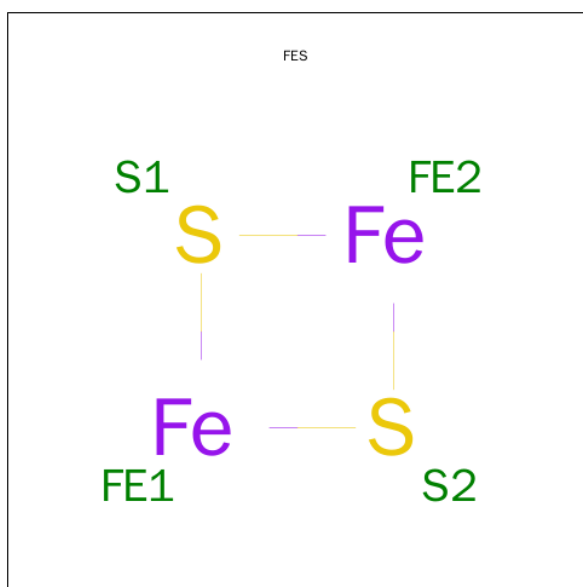
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	I	1	Total	Na	0	0
			1	1		
7	A	1	Total	Na	0	0
			1	1		
7	E	1	Total	Na	0	0
			1	1		

- Molecule 8 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	A	1	Total	O	S	0	0
			5	4	1		
8	E	1	Total	O	S	0	0
			5	4	1		
8	I	1	Total	O	S	0	0
			5	4	1		

- Molecule 9 is FE2/S2 (INORGANIC) CLUSTER (three-letter code: FES) (formula:  $\text{Fe}_2\text{S}_2$ ).



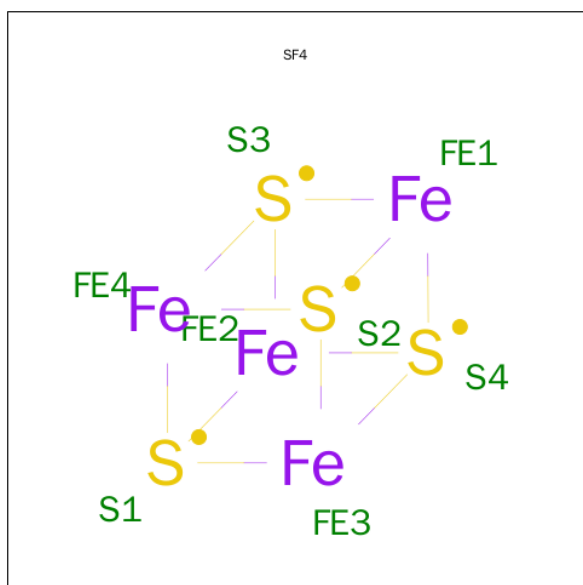
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	B	1	Total	Fe	S	0	0
			4	2	2		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	F	1	Total	Fe	S	0	0
			4	2	2		
9	J	1	Total	Fe	S	0	0
			4	2	2		

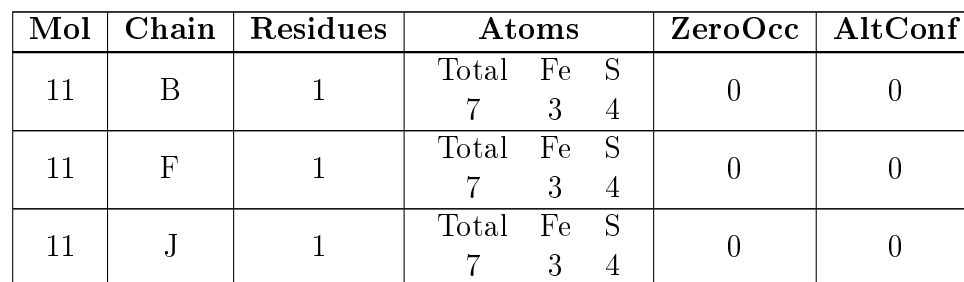
- Molecule 10 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula:  $\text{Fe}_4\text{S}_4$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
10	B	1	Total	Fe	S	0	0
			8	4	4		
10	F	1	Total	Fe	S	0	0
			8	4	4		
10	J	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 11 is FE3-S4 CLUSTER (three-letter code: F3S) (formula:  $\text{Fe}_3\text{S}_4$ ).

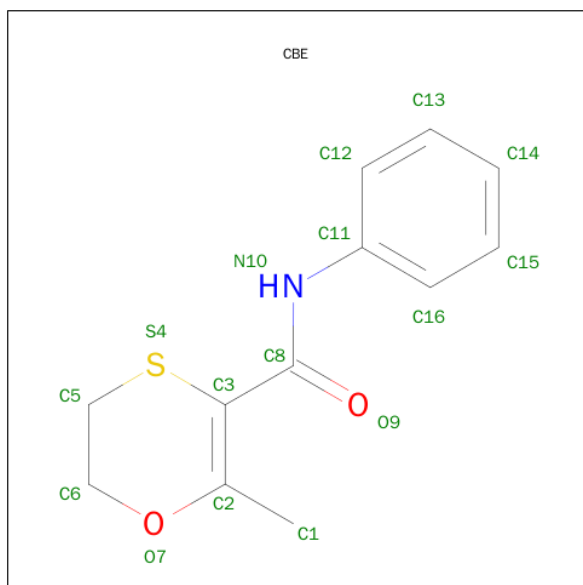




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- Chemical structure of Heme (HEM) showing a central iron atom coordinated by four nitrogen atoms in a porphyrin-like ring, with various side chains and a central heme group.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
12	C	1	Total	C	Fe	N	O	
			43	34	1	4	4	
12	G	1	Total	C	Fe	N	O	
			43	34	1	4	4	
12	K	1	Total	C	Fe	N	O	
			43	34	1	4	4	

- Molecule 13 is 2-METHYL-N-PHENYL-5,6-DIHYDRO-1,4-OXATHIINE-3-CARBOXAMIDE (three-letter code: CBE) (formula:  $C_{12}H_{13}NO_2S$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
13	C	1	Total	C	N	O	S	
			16	12	1	2	1	
13	G	1	Total	C	N	O	S	
			16	12	1	2	1	
13	K	1	Total	C	N	O	S	
			16	12	1	2	1	

- Molecule 14 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
14	A	258	Total	O		
			258	258	0	0
14	B	128	Total	O		
			128	128	0	0
14	C	22	Total	O		
			22	22	0	0

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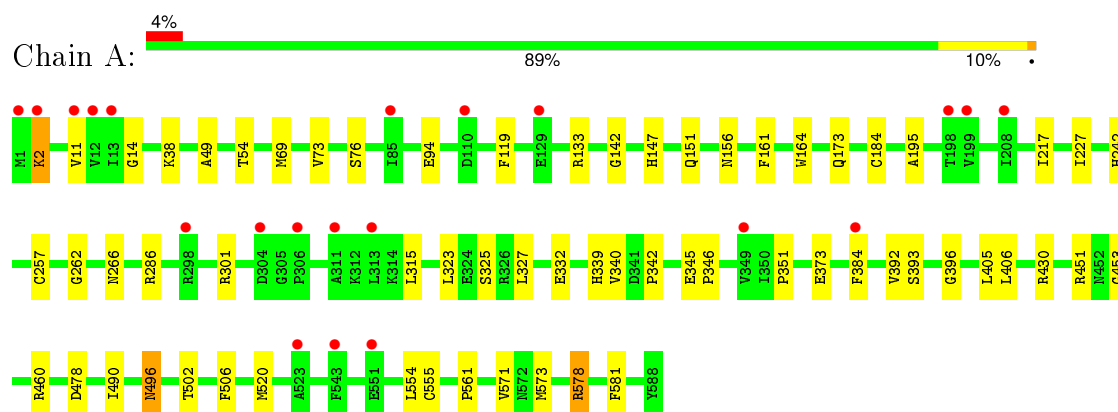
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
14	D	10	Total 10	O 10	0	0
14	E	234	Total 234	O 234	0	0
14	F	116	Total 116	O 116	0	0
14	G	17	Total 17	O 17	0	0
14	H	4	Total 4	O 4	0	0
14	I	197	Total 197	O 197	0	0
14	J	107	Total 107	O 107	0	0
14	K	17	Total 17	O 17	0	0
14	L	6	Total 6	O 6	0	0

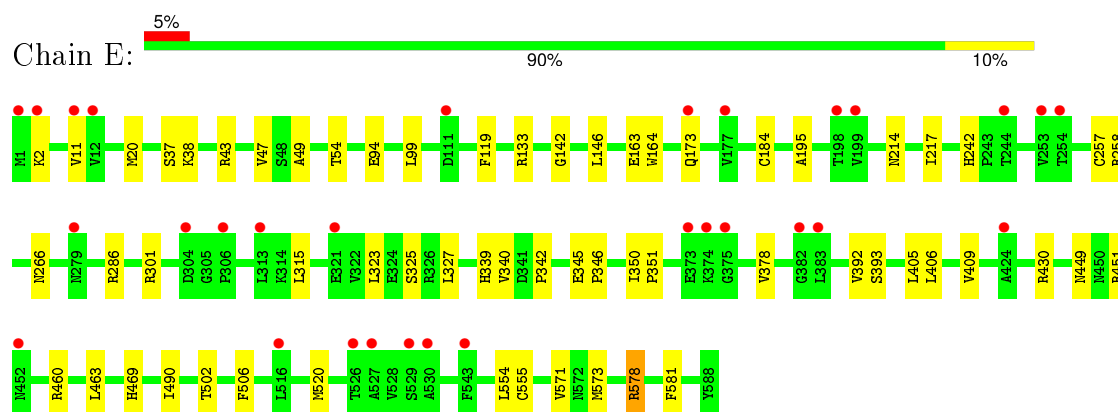
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

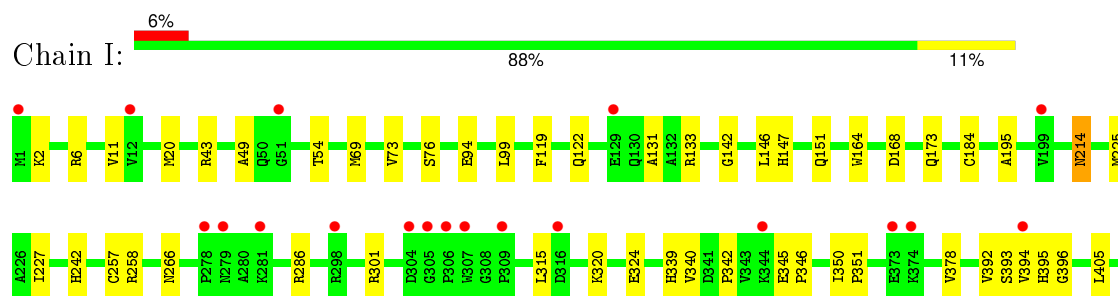
#### • Molecule 1: SUCCINATE DEHYDROGENASE FLAVOPROTEIN SUBUNIT

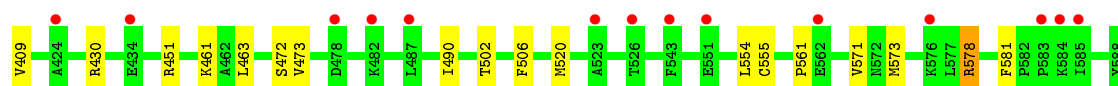


#### • Molecule 1: SUCCINATE DEHYDROGENASE FLAVOPROTEIN SUBUNIT



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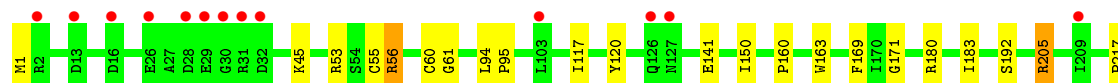
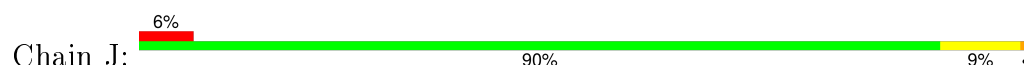
• Molecule 2: SUCCINATE DEHYDROGENASE IRON-SULFUR SUBUNIT



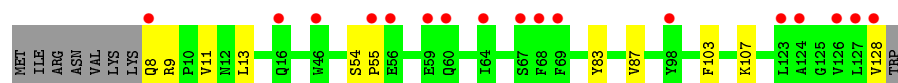
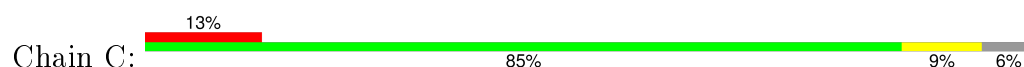
• Molecule 2: SUCCINATE DEHYDROGENASE IRON-SULFUR SUBUNIT



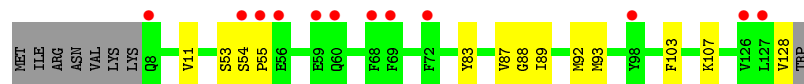
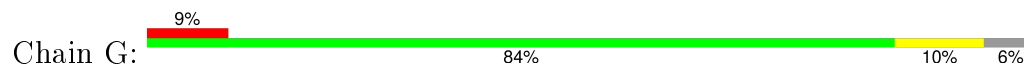
• Molecule 2: SUCCINATE DEHYDROGENASE IRON-SULFUR SUBUNIT



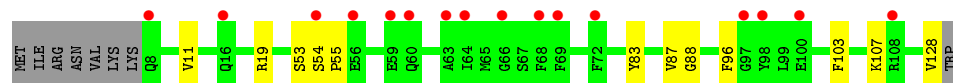
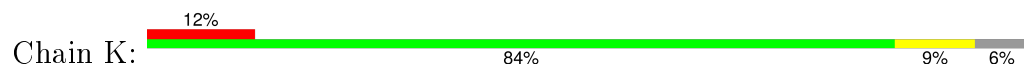
• Molecule 3: SUCCINATE DEHYDROGENASE CYTOCHROME B556 SUBUNIT




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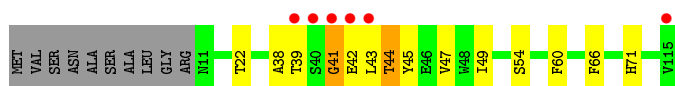


• Molecule 3: SUCCINATE DEHYDROGENASE CYTOCHROME B556 SUBUNIT




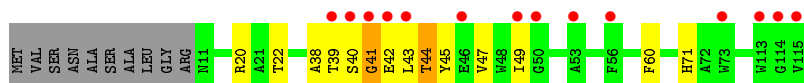
• Molecule 4: SUCCINATE DEHYDROGENASE HYDROPHOBIC MEMBRANE ANCHOR SUBUNIT

Chain D: 




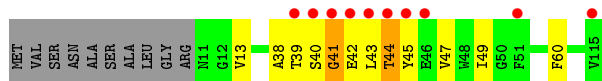
• Molecule 4: SUCCINATE DEHYDROGENASE HYDROPHOBIC MEMBRANE ANCHOR SUBUNIT

Chain H: 



• Molecule 4: SUCCINATE DEHYDROGENASE HYDROPHOBIC MEMBRANE ANCHOR SUBUNIT

Chain L: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	119.40Å 178.46Å 200.94Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	133.63 – 2.40 22.96 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.5 (133.63-2.40) 99.7 (22.96-2.40)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.42 (at 2.41Å)	Xtriage
Refinement program	REFMAC 5.4.0067	Depositor
R, $R_{free}$	0.171 , 0.200 0.172 , 0.201	Depositor DCC
$R_{free}$ test set	8380 reflections (5.29%)	DCC
Wilson B-factor (Å <sup>2</sup> )	34.5	Xtriage
Anisotropy	0.440	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 48.8	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	1 of 166874 reflections (0.001%)	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	26034	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.16% 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, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CBE, NA, SF4, TEO, F3S, SO4, HEM, FAD, FES

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	0.74	2/4611 (0.0%)	0.70	1/6237 (0.0%)
1	E	0.69	1/4611 (0.0%)	0.70	1/6237 (0.0%)
1	I	0.64	0/4611	0.66	0/6237
2	B	0.72	0/1908	0.72	1/2578 (0.0%)
2	F	0.66	0/1908	0.71	1/2578 (0.0%)
2	J	0.66	0/1908	0.71	1/2578 (0.0%)
3	C	0.55	0/953	0.55	0/1293
3	G	0.56	0/953	0.56	0/1293
3	K	0.52	0/953	0.57	0/1293
4	D	0.56	0/859	0.56	0/1175
4	H	0.52	0/859	0.57	0/1175
4	L	0.53	0/859	0.55	0/1175
All	All	0.66	3/24993 (0.0%)	0.67	5/33849 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	332	GLU	CG-CD	5.47	1.60	1.51
1	E	449	ASN	CG-ND2	-5.38	1.19	1.32
1	A	496	ASN	CB-CG	5.08	1.62	1.51

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	205	ARG	NE-CZ-NH2	-6.66	116.97	120.30
1	A	460	ARG	NE-CZ-NH2	-5.94	117.33	120.30
2	J	205	ARG	NE-CZ-NH2	-5.25	117.68	120.30
1	E	460	ARG	NE-CZ-NH2	-5.14	117.73	120.30
2	B	193	ARG	NE-CZ-NH2	-5.12	117.74	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	4522	0	4426	45	0
1	E	4522	0	4426	43	0
1	I	4522	0	4426	50	0
2	B	1869	0	1850	10	0
2	F	1869	0	1850	9	0
2	J	1869	0	1850	15	0
3	C	933	0	979	14	0
3	G	933	0	979	12	0
3	K	933	0	979	11	0
4	D	836	0	875	10	0
4	H	836	0	875	12	0
4	L	836	0	875	9	0
5	A	53	0	29	6	0
5	E	53	0	30	7	0
5	I	53	0	29	7	0
6	A	9	0	3	3	0
6	E	9	0	3	4	0
6	I	9	0	3	4	0
7	A	1	0	0	0	0
7	E	1	0	0	0	0
7	I	1	0	0	0	0
8	A	5	0	0	0	0
8	E	5	0	0	0	0
8	I	5	0	0	0	0
9	B	4	0	0	0	0
9	F	4	0	0	0	0
9	J	4	0	0	0	0
10	B	8	0	0	0	0
10	F	8	0	0	0	0
10	J	8	0	0	1	0
11	B	7	0	0	0	0
11	F	7	0	0	0	0
11	J	7	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
12	C	43	0	30	6	0
12	G	43	0	30	5	0
12	K	43	0	30	6	0
13	C	16	0	13	2	0
13	G	16	0	13	1	0
13	K	16	0	13	2	0
14	A	258	0	0	5	0
14	B	128	0	0	0	0
14	C	22	0	0	1	0
14	D	10	0	0	1	0
14	E	234	0	0	3	0
14	F	116	0	0	0	0
14	G	17	0	0	0	0
14	H	4	0	0	0	0
14	I	197	0	0	4	0
14	J	107	0	0	1	0
14	K	17	0	0	1	0
14	L	6	0	0	0	0
All	All	26034	0	24616	257	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 5.

The worst 5 of 257 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:502:THR:HG22	14:A:2215:HOH:O	1.41	1.17
12:C:1129:HEM:HBC2	12:C:1129:HEM:HHD	1.35	1.09
1:E:502:THR:HG22	14:E:2187:HOH:O	1.70	0.92
1:I:490:ILE:HG22	1:I:520:MET:HE3	1.52	0.89
1:I:490:ILE:HG22	1:I:520:MET:CE	2.02	0.89

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	586/588 (100%)	571 (97%)	15 (3%)	0	100	100
1	E	586/588 (100%)	571 (97%)	15 (3%)	0	100	100
1	I	586/588 (100%)	572 (98%)	14 (2%)	0	100	100
2	B	236/238 (99%)	228 (97%)	8 (3%)	0	100	100
2	F	236/238 (99%)	227 (96%)	9 (4%)	0	100	100
2	J	236/238 (99%)	229 (97%)	7 (3%)	0	100	100
3	C	119/129 (92%)	116 (98%)	3 (2%)	0	100	100
3	G	119/129 (92%)	115 (97%)	4 (3%)	0	100	100
3	K	119/129 (92%)	115 (97%)	4 (3%)	0	100	100
4	D	103/115 (90%)	96 (93%)	6 (6%)	1 (1%)	19	28
4	H	103/115 (90%)	96 (93%)	6 (6%)	1 (1%)	19	28
4	L	103/115 (90%)	97 (94%)	5 (5%)	1 (1%)	19	28
All	All	3132/3210 (98%)	3033 (97%)	96 (3%)	3 (0%)	56	74

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	H	41	GLY
4	L	41	GLY
4	D	41	GLY

### 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	473/473 (100%)	466 (98%)	7 (2%)	72	87
1	E	473/473 (100%)	464 (98%)	9 (2%)	65	83
1	I	473/473 (100%)	465 (98%)	8 (2%)	68	85
2	B	208/208 (100%)	204 (98%)	4 (2%)	65	83

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	F	208/208 (100%)	202 (97%)	6 (3%)	50	71
2	J	208/208 (100%)	202 (97%)	6 (3%)	50	71
3	C	101/109 (93%)	100 (99%)	1 (1%)	82	93
3	G	101/109 (93%)	100 (99%)	1 (1%)	82	93
3	K	101/109 (93%)	100 (99%)	1 (1%)	82	93
4	D	88/96 (92%)	84 (96%)	4 (4%)	34	52
4	H	88/96 (92%)	85 (97%)	3 (3%)	44	65
4	L	88/96 (92%)	85 (97%)	3 (3%)	44	65
All	All	2610/2658 (98%)	2557 (98%)	53 (2%)	63	81

5 of 53 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	506	PHE
2	F	180	ARG
2	J	192	SER
1	E	578	ARG
2	F	53	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 27 ligands modelled in this entry, 3 are monoatomic - leaving 24 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
6	TEO	A	1589	-	0,8,8	0.00	-	1,10,10	2.23	1 (100%)
8	SO4	A	1591	-	4,4,4	0.28	0	6,6,6	0.14	0
5	FAD	A	601	1	48,58,58	1.30	5 (10%)	54,89,89	2.50	11 (20%)
9	FES	B	302	2	0,4,4	0.00	-	0,4,4	0.00	-
10	SF4	B	303	2	0,12,12	0.00	-	0,24,24	0.00	-
11	F3S	B	304	2	0,9,9	0.00	-	0,15,15	0.00	-
12	HEM	C	1129	3,4	30,50,50	2.35	7 (23%)	24,82,82	2.22	8 (33%)
13	CBE	C	1130	-	15,17,17	1.13	1 (6%)	17,22,22	1.80	2 (11%)
6	TEO	E	1589	-	0,8,8	0.00	-	1,10,10	1.11	0
8	SO4	E	1591	-	4,4,4	0.26	0	6,6,6	0.22	0
5	FAD	E	601	1	48,58,58	1.25	5 (10%)	54,89,89	2.34	12 (22%)
9	FES	F	302	2	0,4,4	0.00	-	0,4,4	0.00	-
10	SF4	F	303	2	0,12,12	0.00	-	0,24,24	0.00	-
11	F3S	F	304	2	0,9,9	0.00	-	0,15,15	0.00	-
12	HEM	G	1129	3,4	30,50,50	2.17	6 (20%)	24,82,82	2.15	10 (41%)
13	CBE	G	1130	-	15,17,17	1.22	1 (6%)	17,22,22	1.94	2 (11%)
6	TEO	I	1589	-	0,8,8	0.00	-	1,10,10	1.35	0
8	SO4	I	1591	-	4,4,4	0.34	0	6,6,6	0.40	0
5	FAD	I	601	1	48,58,58	1.33	7 (14%)	54,89,89	2.09	14 (25%)
9	FES	J	302	2	0,4,4	0.00	-	0,4,4	0.00	-
10	SF4	J	303	2	0,12,12	0.00	-	0,24,24	0.00	-
11	F3S	J	304	2	0,9,9	0.00	-	0,15,15	0.00	-
12	HEM	K	1129	3,4	30,50,50	2.33	7 (23%)	24,82,82	2.32	10 (41%)
13	CBE	K	1130	-	15,17,17	1.21	2 (13%)	17,22,22	1.60	2 (11%)

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
6	TEO	A	1589	-	-	0/1/8/8	0/0/0/0
8	SO4	A	1591	-	-	0/0/0/0	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	FAD	A	601	1	-	0/30/50/50	0/6/6/6
9	FES	B	302	2	-	0/0/4/4	0/1/1/1
10	SF4	B	303	2	-	0/0/48/48	0/6/5/5
11	F3S	B	304	2	-	0/0/24/24	0/0/3/3
12	HEM	C	1129	3,4	-	0/10/54/54	0/0/8/8
13	CBE	C	1130	-	-	0/6/19/19	0/1/2/2
6	TEO	E	1589	-	-	0/1/8/8	0/0/0/0
8	SO4	E	1591	-	-	0/0/0/0	0/0/0/0
5	FAD	E	601	1	-	0/30/50/50	0/6/6/6
9	FES	F	302	2	-	0/0/4/4	0/1/1/1
10	SF4	F	303	2	-	0/0/48/48	0/6/5/5
11	F3S	F	304	2	-	0/0/24/24	0/0/3/3
12	HEM	G	1129	3,4	-	0/10/54/54	0/0/8/8
13	CBE	G	1130	-	-	0/6/19/19	0/1/2/2
6	TEO	I	1589	-	-	0/1/8/8	0/0/0/0
8	SO4	I	1591	-	-	0/0/0/0	0/0/0/0
5	FAD	I	601	1	-	0/30/50/50	0/6/6/6
9	FES	J	302	2	-	0/0/4/4	0/1/1/1
10	SF4	J	303	2	-	0/0/48/48	0/6/5/5
11	F3S	J	304	2	-	0/0/24/24	0/0/3/3
12	HEM	K	1129	3,4	-	0/10/54/54	0/0/8/8
13	CBE	K	1130	-	-	0/6/19/19	0/1/2/2

The worst 5 of 41 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	K	1129	HEM	C3B-C4B	-8.84	1.44	1.51
12	C	1129	HEM	C3B-C4B	-8.18	1.44	1.51
12	G	1129	HEM	C3B-C4B	-7.00	1.45	1.51
12	C	1129	HEM	C3D-C4D	-5.54	1.44	1.51
12	G	1129	HEM	C3D-C4D	-5.39	1.44	1.51

The worst 5 of 72 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	601	FAD	N3A-C2A-N1A	-12.92	119.00	128.89
5	E	601	FAD	N3A-C2A-N1A	-12.67	119.19	128.89
5	I	601	FAD	N3A-C2A-N1A	-9.29	121.78	128.89
13	K	1130	CBE	C11-N10-C8	-3.84	120.85	127.61
12	C	1129	HEM	C3C-CAC-CBC	-3.63	118.88	124.46

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

13 monomers are involved in 50 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	1589	TEO	3	0
5	A	601	FAD	6	0
12	C	1129	HEM	6	0
13	C	1130	CBE	2	0
6	E	1589	TEO	4	0
5	E	601	FAD	7	0
12	G	1129	HEM	5	0
13	G	1130	CBE	1	0
6	I	1589	TEO	4	0
5	I	601	FAD	7	0
10	J	303	SF4	1	0
12	K	1129	HEM	6	0
13	K	1130	CBE	2	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, 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	588/588 (100%)	0.25	21 (3%)	46	47	33, 39, 52, 72	0
1	E	588/588 (100%)	0.30	30 (5%)	32	32	33, 39, 52, 72	0
1	I	588/588 (100%)	0.37	33 (5%)	28	28	33, 39, 52, 72	0
2	B	238/238 (100%)	0.31	14 (5%)	26	26	28, 35, 49, 69	0
2	F	238/238 (100%)	0.28	12 (5%)	32	33	28, 34, 49, 69	0
2	J	238/238 (100%)	0.28	14 (5%)	26	26	28, 35, 49, 69	0
3	C	121/129 (93%)	0.37	17 (14%)	4	4	45, 54, 67, 73	0
3	G	121/129 (93%)	0.27	12 (9%)	9	9	45, 54, 67, 73	0
3	K	121/129 (93%)	0.51	16 (13%)	4	4	45, 54, 67, 73	0
4	D	105/115 (91%)	0.20	6 (5%)	27	27	44, 49, 69, 72	0
4	H	105/115 (91%)	0.49	14 (13%)	4	4	44, 50, 69, 72	0
4	L	105/115 (91%)	0.38	10 (9%)	10	10	44, 49, 69, 72	0
All	All	3156/3210 (98%)	0.32	199 (6%)	23	24	28, 40, 61, 73	0

The worst 5 of 199 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	H	115	VAL	6.7
3	G	68	PHE	6.2
3	K	68	PHE	6.1
4	L	42	GLU	6.1
4	L	40	SER	6.0

### 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 ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
8	SO4	E	1591	5/5	0.97	0.24	5.85	66,66,68,69	0
8	SO4	I	1591	5/5	0.97	0.23	3.64	58,59,60,62	0
8	SO4	A	1591	5/5	0.97	0.21	2.14	70,70,71,71	0
12	HEM	C	1129	43/43	0.97	0.14	-0.26	36,40,53,57	0
13	CBE	C	1130	16/16	0.96	0.14	-0.58	37,39,42,43	0
12	HEM	G	1129	43/43	0.97	0.12	-0.70	36,41,52,57	0
13	CBE	K	1130	16/16	0.96	0.13	-0.79	39,44,47,47	0
13	CBE	G	1130	16/16	0.95	0.11	-0.88	34,38,41,41	0
12	HEM	K	1129	43/43	0.97	0.11	-1.25	42,46,57,63	0
6	TEO	I	1589	9/9	0.94	0.12	-1.29	45,46,49,51	0
6	TEO	E	1589	9/9	0.96	0.12	-1.44	32,35,37,40	0
5	FAD	E	601	53/53	0.98	0.10	-1.52	25,30,38,40	0
5	FAD	I	601	53/53	0.97	0.09	-1.93	29,33,41,43	0
5	FAD	A	601	53/53	0.98	0.09	-2.03	21,29,34,37	0
6	TEO	A	1589	9/9	0.96	0.10	-2.47	36,40,42,46	0
10	SF4	J	303	8/8	0.98	0.06	-2.69	30,32,34,36	0
11	F3S	F	304	7/7	0.96	0.07	-2.80	32,34,35,36	0
9	FES	F	302	4/4	0.98	0.06	-2.91	28,28,29,31	0
11	F3S	B	304	7/7	0.97	0.07	-2.98	31,32,34,37	0
10	SF4	F	303	8/8	0.99	0.05	-2.99	30,31,32,33	0
9	FES	J	302	4/4	0.98	0.07	-3.06	30,32,32,33	0
9	FES	B	302	4/4	0.98	0.05	-3.20	29,29,31,31	0
11	F3S	J	304	7/7	0.97	0.07	-3.67	32,35,37,38	0
7	NA	E	1590	1/1	0.97	0.05	-3.70	24,24,24,24	0
10	SF4	B	303	8/8	0.98	0.06	-3.74	28,29,33,33	0
7	NA	I	1590	1/1	0.96	0.05	-5.24	29,29,29,29	0
7	NA	A	1590	1/1	0.98	0.06	-6.34	22,22,22,22	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.