# wwPDB NMR Structure Validation Summary Report (i)

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| PDB ID | : | 1KMG |
| Title | : | The Solution Structure Of Monomeric Copper-free Superoxide Dismutase |
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| Deposited on | : | 2001-12-15 |

This is a wwPDB NMR 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
http://wwpdb.org/validation/2016/NMRValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

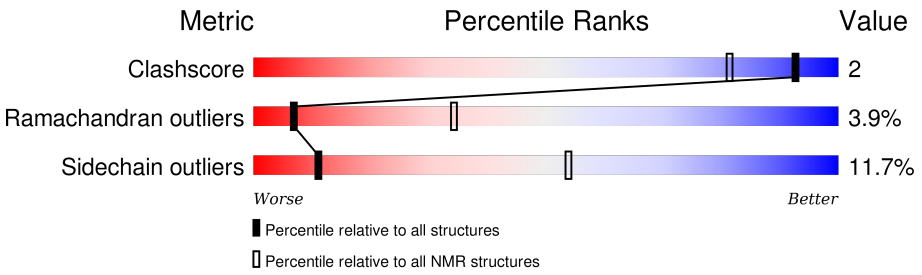
| | | |
|---|---|---|
| Cyrange | : | Kirchner and Güntert (2011) |
| NmrClust | : | Kelley et al. (1996) |
| MolProbity | : | 4.02b-467 |
| Mogul | : | unknown |
| Percentile statistics | : | 20151230.v01 (using entries in the PDB archive December 30th 2015) |
| RCI | : | v_1n_11_5_13_A (Berjanski et al., 2005) |
| PANAV | : | Wang et al. (2010) |
| ShiftChecker | : | rb-20027457 |
| Ideal geometry (proteins) | : | Engh & Huber (2001) |
| Ideal geometry (DNA, RNA) | : | Parkinson et al. (1996) |
| Validation Pipeline (wwPDB-VP) | : | rb-20027457 |

# 1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
*SOLUTION NMR*

The overall completeness of chemical shifts assignment was not calculated.

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) | NMR archive (#Entries) |
|---|---|---|
| Clashscore | 114402 | 11133 |
| Ramachandran outliers | 111179 | 9975 |
| Sidechain outliers | 111093 | 9958 |

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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 <=5%

| Mol | Chain | Length | Quality of chain |
|---|---|---|---|
| 1 | A | 153 | 80% 11% 9% |

# 2 Ensemble composition and analysis (i)

This entry contains 35 models. Model 22 is the overall representative, medoid model (most similar to other models).

The following residues are included in the computation of the global validation metrics.

| Well-defined (core) protein residues | | | |
|---|---|---|---|
| **Well-defined core** | **Residue range (total)** | **Backbone RMSD (Å)** | **Medoid model** |
| 1 | A:3-A:50, A:60-A:107, A:111-A:153 (139) | 0.46 | 22 |

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 5 clusters and 7 single-model clusters were found.

| Cluster number | Models |
|---|---|
| 1 | 1, 7, 9, 12, 13, 14, 15, 18, 22, 27, 31, 32, 33 |
| 2 | 3, 4, 5, 6, 8, 10, 11, 19, 26 |
| 3 | 17, 34 |
| 4 | 30, 35 |
| 5 | 16, 24 |
| Single-model clusters | 2; 20; 21; 23; 25; 28; 29 |

# 3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 2193 atoms, of which 1080 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Superoxide Dismutase.

| Mol | Chain | Residues | Atoms | | | | | | Trace |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | C | H | N | O | S | |
| 1 | A | 153 | 2192 | 678 | 1080 | 204 | 228 | 2 | 0 |

There are 5 discrepancies between the modelled and reference sequences:

| Chain | Residue | Modelled | Actual | Comment | Reference |
|---|---|---|---|---|---|
| A | 6 | ALA | CYS | ENGINEERED | UNP P00441 |
| A | 50 | GLU | PHE | ENGINEERED | UNP P00441 |
| A | 51 | GLU | GLY | ENGINEERED | UNP P00441 |
| A | 111 | SER | CYS | ENGINEERED | UNP P00441 |
| A | 133 | GLN | GLU | ENGINEERED | UNP P00441 |

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

| Mol | Chain | Residues | Atoms | |
|---|---|---|---|---|
| | | | Total | Zn |
| 2 | A | 1 | 1 | 1 |

# 4 Residue-property plots (i)

## 4.1 Average score per residue in the NMR ensemble

These plots are provided for all protein, RNA and DNA chains in the entry. The first graphic is the same as shown in the summary in section 1 of this report. The second graphic shows the sequence where residues are colour-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. Stretches of 2 or more consecutive residues without any outliers are shown as green connectors. Residues which are classified as ill-defined in the NMR ensemble, are shown in cyan with an underline colour-coded according to the previous scheme. Residues which were present in the experimental sample, but not modelled in the final structure are shown in grey.

- Molecule 1: Superoxide Dismutase

Chain A: 80% 11% 9%

A1 T2 K3 F20 T39 H43 H46 E49 E50 E51 D52 N53 T54 A55 G56 C57 T58 S59 R79 H80 D90 K91 V97 L106 S107 G108 D109 H110 R115 E121 E132 T137 A140 Q153

## 4.2 Residue scores for the representative (medoid) model from the NMR ensemble

The representative model is number 22. Colouring as in section 4.1 above.

- Molecule 1: Superoxide Dismutase

Chain A: 76% 14% • 9%

A1 T2 Q15 N19 F20 L38 H43 G44 F45 H46 E49 E50 E51 D52 N53 T54 A55 G56 C57 T58 S59 A60 F64 H71 R79 H80 V97 L106 S107 G108 D109 H110 I113 G114 R115 H120 N131 G138 N139 A140 R143 Q153

# 5 Refinement protocol and experimental data overview (i)

The models were refined using the following method: *torsion angle dynamics*.

Of the 400 calculated structures, 35 were deposited, based on the following criterion: *target function*.

The following table shows the software used for structure solution, optimisation and refinement.

| Software name | Classification | Version |
|---|---|---|
| DIANA | structure solution | 1.5 |
| AMBER | refinement | 5.0 |

No chemical shift data was provided. No validations of the models with respect to experimental NMR restraints is performed at this time.

# 6 Model quality (i)

## 6.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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 (average) 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 | 0.49±0.01 | 0±0/1034 (0.0±0.0%) | 0.98±0.02 | 0±1/1392 (0.0±0.0%) |
| All | All | 0.49 | 0/36190 (0.0%) | 0.98 | 12/48720 (0.0%) |

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 | Planarity |
|---|---|---|---|
| 1 | A | 0.0±0.0 | 3.7±1.5 |
| All | All | 0 | 131 |

There are no bond-length outliers.

5 of 6 unique angle outliers are listed below. They are sorted according to the Z-score of the worst occurrence in the ensemble.

| Mol | Chain | Res | Type | Atoms | Z | Observed($^o$) | Ideal($^o$) | Models | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Worst | Total |
| 1 | A | 20 | PHE | CB-CG-CD2 | -7.13 | 115.81 | 120.80 | 34 | 1 |
| 1 | A | 115 | ARG | NE-CZ-NH2 | -6.38 | 117.11 | 120.30 | 32 | 5 |
| 1 | A | 79 | ARG | NE-CZ-NH2 | -6.05 | 117.27 | 120.30 | 18 | 2 |
| 1 | A | 79 | ARG | NE-CZ-NH1 | 5.74 | 123.17 | 120.30 | 34 | 1 |
| 1 | A | 69 | ARG | NE-CZ-NH2 | -5.54 | 117.53 | 120.30 | 8 | 2 |

There are no chirality outliers.

5 of 22 unique planar outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

| Mol | Chain | Res | Type | Group | Models (Total) |
|---|---|---|---|---|---|
| 1 | A | 80 | HIS | Sidechain | 35 |

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| Mol | Chain | Res | Type | Group | Models (Total) |
|---|---|---|---|---|---|
| 1 | A | 43 | HIS | Sidechain | 24 |
| 1 | A | 115 | ARG | Sidechain | 13 |
| 1 | A | 79 | ARG | Sidechain,Peptide | 11 |
| 1 | A | 20 | PHE | Sidechain,Peptide | 9 |

## 6.2 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 each 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 averaged over the ensemble.

| Mol | Chain | Non-H | H(model) | H(added) | Clashes |
|---|---|---|---|---|---|
| 1 | A | 1018 | 1005 | 1004 | 4±2 |
| All | All | 35665 | 35175 | 35140 | 128 |

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 2.

5 of 53 unique clashes are listed below, sorted by their clash magnitude.

| Atom-1 | Atom-2 | Clash(Å) | Distance(Å) | Models | |
|---|---|---|---|---|---|
| | | | | Worst | Total |
| 1:A:46:HIS:CE1 | 1:A:140:ALA:HB2 | 0.67 | 2.25 | 1 | 19 |
| 1:A:47:VAL:HG11 | 1:A:115:ARG:CZ | 0.58 | 2.28 | 26 | 1 |
| 1:A:20:PHE:CE1 | 1:A:112:ILE:HD11 | 0.57 | 2.34 | 32 | 1 |
| 1:A:50:GLU:HB2 | 1:A:60:ALA:HB2 | 0.55 | 1.79 | 22 | 1 |
| 1:A:5:VAL:HG23 | 1:A:152:ALA:HB2 | 0.54 | 1.78 | 24 | 4 |

## 6.3 Torsion angles (i)

### 6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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 | 138/153 (90%) | 104±3 (75±2%) | 29±3 (21±2%) | 5±2 (4±1%) | 7 | 34 |
| All | All | 4830/5355 (90%) | 3631 (75%) | 1013 (21%) | 186 (4%) | 7 | 34 |

5 of 33 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

| Mol | Chain | Res | Type | Models (Total) |
|---|---|---|---|---|
| 1 | A | 90 | ASP | 19 |
| 1 | A | 121 | GLU | 18 |
| 1 | A | 79 | ARG | 18 |
| 1 | A | 49 | GLU | 14 |
| 1 | A | 91 | LYS | 10 |

### 6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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 | 108/118 (92%) | 95±3 (88±3%) | 13±3 (12±3%) | 11 54 |
| All | All | 3780/4130 (92%) | 3337 (88%) | 443 (12%) | 11 54 |

5 of 67 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

| Mol | Chain | Res | Type | Models (Total) |
|---|---|---|---|---|
| 1 | A | 97 | VAL | 29 |
| 1 | A | 20 | PHE | 24 |
| 1 | A | 106 | LEU | 23 |
| 1 | A | 39 | THR | 22 |
| 1 | A | 3 | LYS | 18 |

### 6.3.3 RNA (i)

There are no RNA molecules in this entry.

## 6.4 Non-standard residues in protein, DNA, RNA chains (i)

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

## 6.5 Carbohydrates (i)

There are no carbohydrates in this entry.

## 6.6 Ligand geometry (i)

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

## 6.7 Other polymers (i)

There are no such molecules in this entry.

## 6.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

# 7 Chemical shift validation (i)

No chemical shift data were provided