PDB ID : 1HUA
Title : THE SOLUTION CONFORMATION OF HYALURONAN: A COMBINED NMR AND MOLECULAR DYNAMICS STUDY
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Deposited on : 1994-01-31

This is a Full wwPDB NMR Structure Validation 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/NMRValidationReportHelp
with specific help available everywhere you see the symbol.

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

- Cyrange : Kirchner and Güntert (2011)
- NmrClust : Kelley et al. (1996)
- MolProbity : 4.02b-467
- Mogul : 1.7.3 (157068), CSD as539be (2018)
- Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
- RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
- PANAV : Wang et al. (2010)
- ShiftChecker : trunk30686
- Ideal geometry (proteins) : Engh & Huber (2001)
- Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
- Validation Pipeline (wwPDB-VP) : trunk30686
1 Overall quality at a glance

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 | 136279 | 12091 |

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

<table>
<thead>
<tr>
<th>Mol</th>
<th>Chain</th>
<th>Compound</th>
<th>Res</th>
<th>Total models with violations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chirality</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>NGA</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
2 Ensemble composition and analysis

This entry contains 2 models. Identification of well-defined residues and clustering analysis are not possible.
There are 3 unique types of molecules in this entry. The entry contains 60 atoms, of which 22 are hydrogens and 0 are deuteriums.

- Molecule 1 is BETA-D-GLUCOPYRANURONIC ACID (three-letter code: BDP) (formula: C₆H₁₀O₇).

- Molecule 2 is N-ACETYL-D-GALACTOSAMINE (three-letter code: NGA) (formula: C₈H₁₅NO₆).
- Molecule 3 is 2,6-ANHYDRO-L-GULONIC ACID (three-letter code: GC1) (formula: C₆H₁₀O₆).
4 Residue-property plots

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.

4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

4.2.1 Score per residue for model 1

There is no protein, DNA or RNA molecules in this entry to show sequence plots.

4.2.2 Score per residue for model 2

There is no protein, DNA or RNA molecules in this entry to show sequence plots.
5 Refinement protocol and experimental data overview

Of the ? calculated structures, 2 were deposited, based on the following criterion: ?. The authors did not provide any information on software used for structure solution, optimization or refinement.

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

6.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GC1, BDP, NGA

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no planarity outliers.

6.2 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 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.

<table>
<thead>
<tr>
<th>Mol</th>
<th>Chain</th>
<th>Non-H</th>
<th>H(model)</th>
<th>H(added)</th>
<th>Clashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>76</td>
<td>44</td>
<td>54</td>
<td>-</td>
</tr>
</tbody>
</table>

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 -.

There are no clashes.

6.3 Torsion angles

6.3.1 Protein backbone

There are no protein molecules in this entry.

6.3.2 Protein sidechains

There are no protein molecules in this entry.

6.3.3 RNA

There are no RNA molecules in this entry.
6.4 Non-standard residues in protein, DNA, RNA chains

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

6.5 Carbohydrates

There are no carbohydrates in this entry.

6.6 Ligand geometry

3 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds for which Mogul statistics could be retrieved, the number of bonds that are observed in the model and the number of bonds 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 is the number of standard deviations the observed value is removed from the expected value. A bond length with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond lengths.

<table>
<thead>
<tr>
<th>Mol</th>
<th>Type</th>
<th>Chain</th>
<th>Res</th>
<th>Link</th>
<th>Bond lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Counts</td>
</tr>
<tr>
<td>1</td>
<td>BDP</td>
<td>A</td>
<td>1</td>
<td>2</td>
<td>10,13,13</td>
</tr>
<tr>
<td>2</td>
<td>NGA</td>
<td>A</td>
<td>2</td>
<td>1,3</td>
<td>14,14,15</td>
</tr>
<tr>
<td>3</td>
<td>GC1</td>
<td>A</td>
<td>3</td>
<td>2</td>
<td>8,11,12</td>
</tr>
</tbody>
</table>

In the following table, the Counts columns list the number of angles for which Mogul statistics could be retrieved, the number of angles that are observed in the model and the number of 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 angle is the number of standard deviations the observed value is removed from the expected value. A bond angle with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the average root-mean-square of all Z scores of the bond angles.

<table>
<thead>
<tr>
<th>Mol</th>
<th>Type</th>
<th>Chain</th>
<th>Res</th>
<th>Link</th>
<th>Bond angles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Counts</td>
</tr>
<tr>
<td>1</td>
<td>BDP</td>
<td>A</td>
<td>1</td>
<td>2</td>
<td>15,19,19</td>
</tr>
<tr>
<td>2</td>
<td>NGA</td>
<td>A</td>
<td>2</td>
<td>1,3</td>
<td>17,19,21</td>
</tr>
<tr>
<td>3</td>
<td>GC1</td>
<td>A</td>
<td>3</td>
<td>2</td>
<td>9,15,17</td>
</tr>
</tbody>
</table>

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.
<table>
<thead>
<tr>
<th>Mol</th>
<th>Type</th>
<th>Chain</th>
<th>Res</th>
<th>Link</th>
<th>Chirals</th>
<th>Torsions</th>
<th>Rings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BDP</td>
<td>A</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>0±0,0,24,24</td>
<td>0±0,1,1,1</td>
</tr>
<tr>
<td>2</td>
<td>NGA</td>
<td>A</td>
<td>2</td>
<td>1,3</td>
<td>-</td>
<td>0±0,6,22,26</td>
<td>0±0,1,1,1</td>
</tr>
<tr>
<td>3</td>
<td>GC1</td>
<td>A</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>0±0,0,17,21</td>
<td>0±0,1,1,1</td>
</tr>
</tbody>
</table>

There are no bond-length outliers.

There are no bond-angle outliers.

All unique chiral outliers are listed below.

<table>
<thead>
<tr>
<th>Mol</th>
<th>Chain</th>
<th>Res</th>
<th>Type</th>
<th>Atoms</th>
<th>Models (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>A</td>
<td>2</td>
<td>NGA</td>
<td>C4</td>
<td>1</td>
</tr>
</tbody>
</table>

There are no torsion outliers.

There are no ring outliers.

6.7 Other polymers

There are no such molecules in this entry.

6.8 Polymer linkage issues

There are no chain breaks in this entry.
7 Chemical shift validation

No chemical shift data were provided