Determined the Effect of Galectin Insertion on Membrane Organization

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Background

The role of lectin protein and glycolipid interactions is a current and emerging interest in biochemistry due to their implications in biological functioning and pathology. Lectins are glucan-binding proteins that exist on the extracellular surface of membranes and recognize glycoconjugates on neighboring cells. Lectins more specifically exhibit conserved β-galactoside-binding sites unique to this family of lectins. Glycolipids are lipids that are covalently bound to sugar molecules at their head group and protrude from the cell membrane. Gangliosides are glycolipids covalently bound to complex oligosaccharides containing a sialic group. The use of specific saccharides at the cell surface by glycolipids to convey information is referred to as the ‘sugar code’ or glycoconjugate. This code is read by lectin proteins to induce cellular changes. Lectins have extremely stereospecific carbohydrate binding domains that allow for lectins to bind with only a very specific glycolipid. This incredible binding specificity and different combinations of glycolipids per cluster allows for many complex signals to be read and interpreted by lectins, and translated into cellular change. The cellular responses regulated by the sugar code can have pathological implications when mutations and environmental conditions alter the lectin/glycolipid interactions causing cellular dysfunction. Lectins themselves are involved in inflammation, immune responses, cell migration, autophagy, and signaling. Their mutations are linked to heart disease, cystic fibrosis, cancer, as well as many other neurological diseases.

Methods /Techniques

Table 1

<table>
<thead>
<tr>
<th>Slab</th>
<th>Area (Å²)</th>
<th>Location (Å)</th>
<th>Lattice Spacing (Å)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slab 1</td>
<td>95:5 DPPC:GM1 + WT Gal-1</td>
<td>1.3871752</td>
<td>14.89626</td>
</tr>
<tr>
<td>Slab 2</td>
<td>95:5 DPPC:GM1 + WT Gal-1</td>
<td>9.5221032</td>
<td>4.6273</td>
</tr>
<tr>
<td>Slab 3</td>
<td>95:5 DPPC:GM1</td>
<td>64.459</td>
<td>-0.2</td>
</tr>
</tbody>
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Results

Langmuir Trough – WT Gal-1 Insertion Into Membrane

WT Gal-1 inserts into the membrane, evidenced by increase in surface pressure under constant area conditions.

X-Ray Reflectivity – WT Gal-1 Inserts Into 95:5 DPPC:GM1

WT Gal-1 inserts into head groups of monolayer containing 95:5 DPPC:GM1.

Fluorescence Microscopy of Langmuir Film – WT Gal-1 Shrinks Condensed Domains

WT Gal-1 causes reduction in LC domain size. Liquid expanded (LE) is fluorescent red, and liquid condensed (LC) is seen as black patches.

Grazing Incidence X-ray Diffraction – WT Gal-1 Impacts Lipid Packing

WT Gal-1 reorganizes lipid packing structure of 95:5 DPPC:GM1 membrane.

Discussion

- Gal-1 insertion into the 95:5 DPPC:GM1 membrane yields membrane reorganization.
- Data collected from multiple experiments verifies interactions with the lipid head groups and galectin protein.
- Further analysis of different mutant galectin proteins in different membrane conditions using collected XRD data will determine differences in membrane reorganization correlating to different galectin structure.

References and Acknowledgements

References:

Acknowledgments:

NSF’s ChemMatCARS Sector 15 is supported by the Division of Chemistry (OEC) and Materials Research (DMR), National Science Foundation, under grant number CHE-1804750. Use of the Advanced Photon Source, an Office of Science User Facility operated for the U.S. Department of Energy (DOE) Office of Science by Argonne National Laboratory, was supported by the U.S. DOE under Contract No. DE-AC02-06CH11357.

National Science Foundation: Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

UCCS start-up funds from the Department of Chemistry and Biochemistry

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