Comparison of two disaccharides and their saccharide components in AOT reverse micelles: Impacts of D-trehalose and D-sucrose

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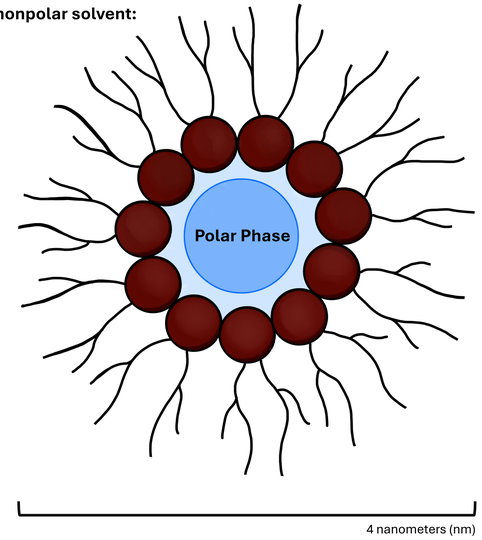
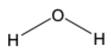
Summer 2024

Reverse micelles encapsulate a polar phase at the nanoscale

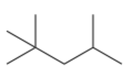
Reverse micelle in a nonpolar solvent:



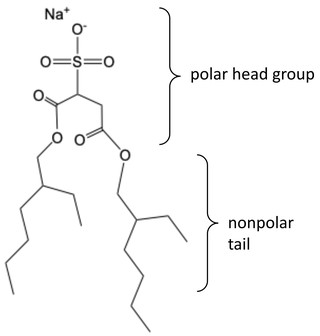
water (polar phase)



isooctane (nonpolar solvent)



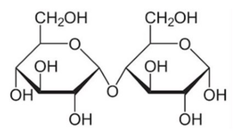
AOT (surfactant)



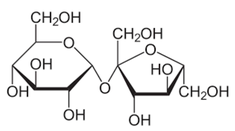
$$W_0 = \frac{[water]}{[surfactant]} = \frac{4\pi r^3}{3(4\pi r^2)} = \frac{r}{3}$$

Saccharides studied in AOT reverse micelles

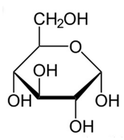
D-trehalose



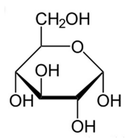
D-sucrose



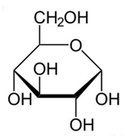
D-glucose



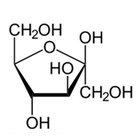
D-glucose



D-glucose



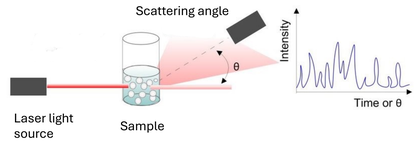
D-fructose



Denoted as "D-GF" in tables and figures

Dynamic Light Scattering (DLS) measurements reveal an impact on reverse micelle size

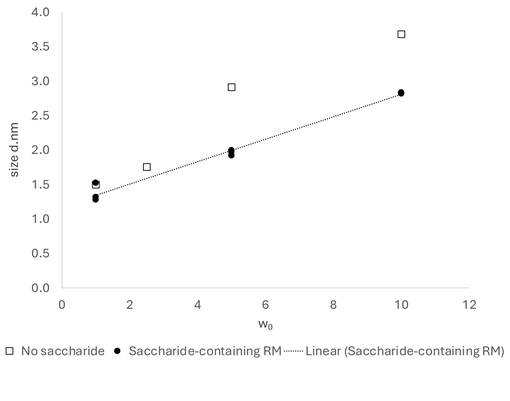
Schematic of DLS from Nikolova, R^G (2019):



DLS averages (d.nm) obtained for saccharide-containing reverse micelles:

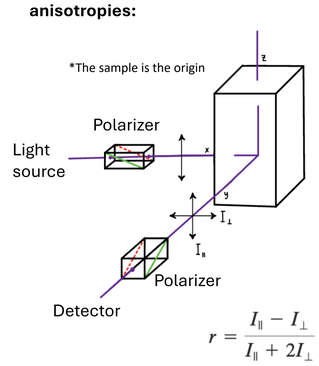
w_0	30:1 d-glucose	30:1 d-GF	60:1 d-trehalose	60:1 sucrose
1	1.281	1.523	1.315	-
5	1.975	1.995	1.924	1.922
10	2.820	2.832	2.819	2.834

Effect of Saccharide on Reverse Micelle Size



Fluorescence Anisotropy reveals slower relaxation processes

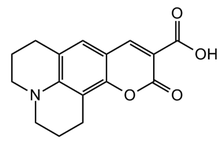
Schematic of instrument measuring anisotropies:



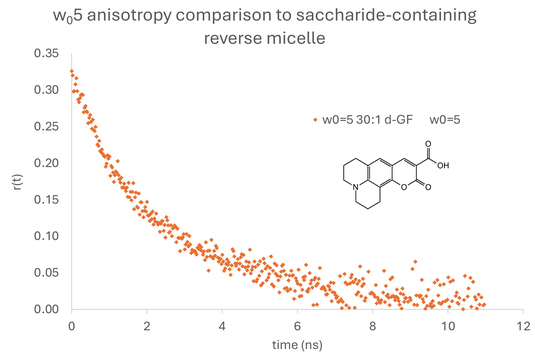
$$r = \frac{I_{\parallel} - I_{\perp}}{I_{\parallel} + 2I_{\perp}}$$

Fluorescent molecular probe:

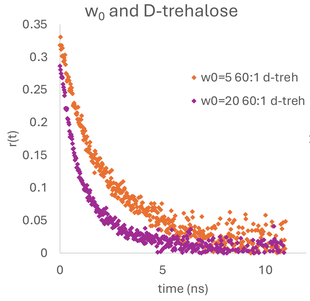
Coumarin 343 (C343)



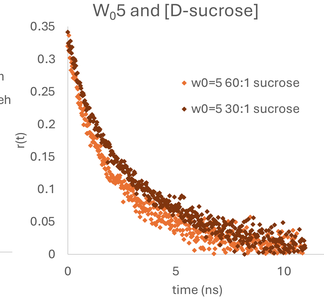
$w_0$5 anisotropy comparison to saccharide-containing reverse micelle



w_0 and D-trehalose



$W_0$5 and [D-sucrose]



Reverse Micelles encapsulate a polar phase at the nanoscale

- In a nonpolar solvent, the use of a surfactant (AOT) allows for water to be encapsulated at the nanoscale
- w_0 represents a ratio of water to surfactant, and we use this parameter in relation to size

Saccharides studied in AOT reverse micelles

- Prepared by sonication with 0.1 M AOT, 30:1 monosaccharide solutions, and 60:1 disaccharide solutions for at least 10 minutes
- Stirring and heating at 60 degrees C was applied for no more than 3 minutes for select samples in addition to sonication for 10 minutes

Dynamic Light Scattering measurements reveal an impact on reverse micelle size

- DLS determines the size of the reverse micelles for each ratio of water to surfactant (w_0)
- Plotted is a comparison of averages of newly reported saccharide RM size to RM with no saccharide. The trendline for saccharide RMs reveals that saccharides do not only make reverse micelles smaller, but they also impact reverse micelles differently as w0 increases

Fluorescence Anisotropy reveals slower relaxation processes

- Fluorescence anisotropy uses polarized excitation and emission to measure the rotational dynamics of a fluorescent molecule
- Plotted are 3 modes of analysis: saccharide RMs vs water only RMs, varying w_0, and varying saccharide concentration
- The top plot shows that rotational dynamics are slower in saccharide RMs
- The lower plots show that smaller reverse micelles and higher concentrations of reverse micelles result in slower rotational dynamics

Acknowledgements

Thank you to the National Science Foundation (Award #1956198 and #1956323) and to Professor Gourley for her continued support, great mentorship, and encouragement.