

Neutron micelle measurements lend insights into improved drug delivery

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Tyler Cooksey, a graduate researcher at the University of Houston, uses ORNL's Bio-SANS instrument at the High Flux Isotope Reactor to understand how micelles can be improved to create more effective drugs. Credit: ORNL/Genevieve Martin

Micelles are unique biological structures in that they are an assembly of

molecules with properties that both attract and repel water. They form around other molecules to help them travel and "push" through wet environments, making micelles a key enabler of cellular function throughout the human body. Not surprisingly, their ability to transport molecules has made micelles a highly appealing topic to pharmaceutical companies.

To learn more about interactions between [drug molecules](#) and micelles, Associate Professor Megan Robertson and graduate students Tyler Cooksey and Tzu-Han Li from the University of Houston (UH) are using neutrons at the Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL).

The researchers say understanding how micelles assemble around drug molecules could lead to improved drug delivery methods, as well as improvements in products like shampoos, detergents, and cosmetics, for which micelles also have applications.

"We want to understand how a drug molecule can impact the assembly of micelles," said Robertson. "The size of the micelles and the number of molecules that form the micelles are important parameters that we believe will be impacted by the presence of the drug molecule."

When medication is taken, drug molecules are released into the body and travel to the part of the body that requires treatment. Neutrons' unique ability to penetrate materials without damaging them, as well as their sensitivity to hydrogen, makes them an ideal probe for biological studies like this that require realistic environments and temperatures.

Using the Biological Small-Angle Neutron Scattering (Bio-SANS) instrument at ORNL's High Flux Isotope Reactor (HFIR), the research team probed the micelles and investigated how the presence of drug molecules changed their structure and assembly.

The UH researchers and their collaborator, Louis Madsen, associate professor at Virginia Tech, also used nuclear magnetic resonance spectrometry to reveal specific chemical information on the composition of the micelles. This, in addition to the structural data from neutron scattering, allowed them to compile a more complete picture of how different molecules interact with the micelles.

"We anticipate that when we look at micelles containing different [drug molecules](#), we're going to see big differences in the assembly and the structural parameters of these [micelles](#)," said Robertson. "If we can understand how the drug molecule impacts the micelle, then it could be possible to develop more robust therapeutics."

Provided by Oak Ridge National Laboratory

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