IT IS IN THE SUGAR

International researchers collaborated and utilized vastly different experimental techniques to understand how to augment cell membranes for specific tasks. They could be utilized in detergents.

Rhamnolipids (RLs) are among the most important lipids integrated into microorganisms' cell membranes, performing important tasks such as surface augmentation or signaling. Apart from their physical ability to reduce the surface tension of water, they show functionalities regarding cellular immunosuppression when integrated into human and animal cell membranes and trigger a better resistance to fungal pathogens in plants. This represents huge potential for cosmetic and pharmaceutical applications or in detergents. RLs' biological functionalities possibly come from the changes they make to the cell membranes during integration. However, this process's molecular mechanism is still unknown, although RLs have been shown to affect membrane stability, thickness and permeability, among other things.

Sugars are the driving forces

For their work, the researchers used small-angle X-ray scattering, neutron reflectometry and molecular dynamics simulations to investigate how the most abundant RL variant (diRL) integrates into planar or curved cell membranes. The presence of a specific type of membrane molecule (GM1) in the standard phospholipid layer is necessary to facilitate the insertion of diRL. The scientists found the interactions between the sugar side-chains of diRL and GM1 to be the driving force of this process. diRL also induces modifications like increasing local membrane curvature upon integration. Additionally, neutron reflectometry proved to be a new tool to investigate these problems.

The science is not yet done

Although this work focused on the mechanics of diRL, other RLs might have different specific effects on their host membranes. Further research might reveal RLs' role for specific applications, like in diRL-based drug delivery by utilizing the lock-and-key related sugar-sugar interaction.

V. Rondelli, L. Mollica, A. Koutsioubas, N. Nasir, M. Trapp, E. Deboever, P. Brocca, M. Deleu, Carbohydrate-carbohydrate interaction drives the preferential insertion of dirhamnolipid into glycosphingolipid enriched membranes, J. Colloid Interface Sci, 616, 739 (2022)
DOI: 10.1016/j.jcis.2022.02.120

The experiments were carried out at MARIA.