University of Stuttgart

Colloquium of the Institute of Physical Chemistry

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Artificial membrane systems as tailor-made tools to study complex membrane proteins

Biological membranes are mainly formed from bilayers of amphiphilic phospholipid molecules and harbour small hydrophobic components, such as vitamins, quinones and pigments. In addition, they can host a huge range of membrane proteins from small, peripherally bound proteins to integral multicomponent megaDalton complexes.[1] The total protein content of a membrane increases with the complexity of the biochemical functions it helps to sustain.
The innate complexity of densely packed biological membranes makes targeted functional studies of individual membrane proteins in their native cellular environment challenging. To overcome this problem, mimetic systems ranging from membrane-monolayers to lipid vesicles (known as liposomes) have been employed.[2] Such systems enable membrane proteins to be studied in relatively simple, well-defined environments while still being orientated and inserted inside a lipid environment needed for full activity.
In my talk, I will cover the main principles of preparing liposomes and how to incorporate purified isolated membrane proteins to form proteoliposomes (PLs). These PLs allow systematic studies to correlate the impact of lipid composition on protein functioning. To visualise this principle, I present recently published work focusing on the catalytic activity of respiratory complex I (R-CI), an essential membrane protein in respiration which oxidises NADH and reduces ubiquinone to contribute to the proton-motive force powering ATP synthesis.[3]

Literature

[1] A. M. Amati, S. Graf, S. Deutschmann, N. Dolder and C. von Ballmoos, Biochem. Soc. Trans., 2020, 48, 1473–1492

[2] P. A. Beales, S. Khan, S. P. Muench and L. J. C. Jeuken, Biochem. Soc. Trans., 2017, 45, 15–26

[3] J. Eisermann, J. J. Wright, J. D. E. T., J. Hirst, M. M. Roessler, RSC Chemical Biology, 2023, DOI: 10.1039/D2CB00158F (accepted manuscript)

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