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Plant plasma membrane models to study the molecular mechanism underlining rhamnolipid sensing by plant cells

Content

Mono- and di-rhamnolipids (MonoRL and DiRL) produced by Pseudomonas aeruginosa are two congeners of glycolipidic biosurfactants differing by the number of rhamnose glycosyl in their polar head, one and two respectively. They present a variety of activities among which the capacity to elicit the plant defense responses giving rise to plant protection against various fungal pathogens. The perception of an elicitor occurs at the plant plasma membrane. In the case of rhamnolipids (RLs), one hypothesis is that their sensing is occurring via binding to the lipid fraction of the plant plasma membrane.
To get further insights into the molecular mechanisms underlining RL sensing by the plant cells, we combined different biophysical approaches using plant plasma membrane models and in vitro and in silico tools.
In a first step, plant plasma membrane models were developed and characterized. The major lipids of plant plasma membrane, palmitoyl-linoleoyl-phosphatidylcholine, sitosterol and glucosylceramide, were used. By using Langmuir films, in silico simulations and neutron reflectometry, it was unveiled that a strong direct interaction between the glucosylceramide and sitosterol molecules exists and governs their lateral and transversal distribution within membrane leaflets1.
Afterwards, our models were used to investigate the influence of the RLs rhamnosyl moiety on their interaction with plant cells. Our results highlighted those subtle differences between MonoRL and DiRL modulate the membrane structure like dehydration and tightening effects on the lipid polar heads. A deeper insertion could be related to a better immunity triggering. Globally, our results underlie that amphiphilic glycolipids able to be intercalated into the lipid phase of the plant plasma membrane can activate plant immunity.

Reference:
1Rondelli, V., Koutsioubas, A., Pršić, J., Deboever, E., Crowet, J.M., Lins, L. and Deleu, M. Sci Rep 11, 21618 (2021). https://doi.org/10.1038/s41598-021-00696-7

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