Bilayers at the ILL

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Influence of galactoglycerolipids on the chloroplast envelope outer membrane architecture and its adaptation to phosphate deprivation in plants

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Plant cell membranes glycerolipids can be classified in two groups: phospholipids containing phosphate, mainly synthesized in the endoplasmic reticulum (ER), and glycolipids – galactolipids and sulfolipids - without phosphate, synthesized in chloroplasts, and being the major constituents of photosynthetic membranes. When plants are deprived of phosphate, a frequent natural situation that limits plant growth, they adapt to the environment by increasing their phosphate absorption, decreasing their phosphate consumption and mobilizing phosphate cell reserves. Phospholipids contain up to one third of intracellular phosphate [1] and for that reason represent a non-negligible phosphate source. In phosphate deprived plants, phospholipid amount, mainly phosphatidylcholine (PC), decreases and is replaced by digalactosyldiacylglycerol (DGDG) in extraplastidial membrane. Because we demonstrated that PC bilayers do not share the properties of DGDG bilayers [2,3], we are now investigating what the consequences of a PC-DGDG replacement are. During phosphate starvation, to support lipid trafficking, the number of contact sites between chloroplasts and mitochondria is increased by a factor of three and the chloroplast envelope forms extensions called stromules (Stroma filled tubules). We suppose that under phosphate starvation the chloroplast outer membrane is enriched in DGDG and deprived of PC. Our objective is to understand if this change of composition can be partly responsible for the observed change in the chloroplast envelope architecture. To answer these questions, we developed the complete procedure to purify natural plant lipids and we propose to investigate a series of samples as a function of hydration under controlled humidity by neutron diffraction on the D16 instrument at ILL. The measurement of the spacing of the bilayers and the bending rigidity of the different samples indicate that the membranes enriched in DGDG are favoring membrane stacking and are less rigid. These results support the role of DGDG for stromule formation and membrane contact site during phosphate starvation.

Références.
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