ENZYMES DEPENDENT ON NON-BILAYER LIPIDS

K. STRZAŁKA

Jagiellonian University, Kraków, Poland

The xanthophyll cycles are a light-dependent interconversions between various xanthophylls and they function as a photoprotective mechanisms widespread in plant kingdom. Conversion of violaxanthin to zeaxanthin in the violaxanthin cycle is carried out in strong light by a lumenal enzyme, violaxanthin de-epoxidase (VDE). De-epoxidation reaction in the diadinoxanthin cycle is carried out by diadinoxanthin de-epoxidase (DDE) resulting in diatoxanthin formation. Both de-epoxidases are lumenal enzymes requiring for their activity low pH, ascorbate and monogalactosyldiacylglycerol (MGDG).

We found that replacement of MGDG with digalactosyldiacylglycerol (DGDG) or phosphatidylcholine (PC) resulted in strong inhibition of violaxanthin and diadinoxanthin de-epoxidation. On the other hand, replacement of MGDG with phosphatidylethanolamine (PE) sustained a high VDE and DDE activity in spite of very different chemical character of these two lipids. The obtained results clearly indicate that only inverted hexagonal phase (H_{II}) forming lipids (MGDG and PE) may effectively support the violaxanthin and diadinoxanthin de-epoxidation, whereas bilayer forming lipids (DGDG and PC) are not effective in this process. Hence, a conclusion is drown that the activity of VDE and DDE depends not on the chemical character of lipids but on the kind of structure they form in water environment. Using phosphorus NMR measurements we detected the existence of H_{II} phase in a binary (MGDG/PC) lipid mixture as well as in thylakoid membranes. We propose a molecular model of violaxanthin and diadinoxanthin de-epoxidation in which a crucial role play H_{II} phase forming lipids.

This work was financed as the ordered research project No PBZ-KBN-110/P04/19.