

DGS1, a membrane-tethered transcriptional regulator of chloroplast lipid biosynthesis in Arabidopsis

Changcheng Xu, Jilian Fan, and Christoph Benning

Michigan State University, Dept. of Biochemistry and Molecular Biology, East Lansing, MI, 48824, USA

The lipid composition of different subcellular membranes in plants is highly diverse and tightly controlled. Under optimal growth conditions, galactoglycerolipids, the major constituents of the photosynthetic membranes, are nearly absent from extraplastidic membranes. However, following phosphate deprivation chloroplast-derived galactoglycerolipids replace in part the phospholipids in the plasma membrane or in mitochondria. An alternative pathway of galactoglycerolipid biosynthesis is induced under these conditions. This induction is accompanied by an increased expression of genes encoding the alternative lipid galactosyltransferases MGD2 and MGD3 associated with the outer chloroplast envelope. A suppressor mutant (*dgd1 suppressor1*, *dgs1*) of Arabidopsis was isolated in which the galactoglycerolipid deficiency caused by the *dgd1* mutation is alleviated. The gene encodes a protein with two membrane-spanning domains and a possible DNA-binding domain. The full-length protein is associated with the mitochondrion while a truncated version containing the putative DNA-binding domain localizes to the nucleus. The expression of the *MGD2/3* genes in the *dgs1* mutant is elevated. It is hypothesized that DGS1 is a membrane-tethered transcriptional repressor that becomes activated by proteolytic release from the mitochondrial outer membrane. It is involved in regulation of the conditional synthesis and transfer of galactoglycerolipids from the chloroplast to the mitochondrion. This work is supported in part by a grant from the US Department of Energy (DE-FG02-98ER20305).