Lipids in Photosynthesis: Structure, Function and Genetics

Edited by

Paul-André Siegenthaler
Laboratoire de Physiologie Végétale,
Université de Neuchâtel,
Neuchâtel, Switzerland

and

Norio Murata
National Institute for Basic Biology,
Myodaiji, Okazaki, Japan

KLUWER ACADEMIC PUBLISHERS
DORDRECHT / BOSTON / LONDON
# Contents

**Preface**

1. **Lipids in Photosynthesis: An Overview**
   - Norio Murata and Paul-André Segnerthaler
   - Summary
     1. Lipids and Fatty Acids in Photosynthetic Membranes
     2. Biosynthesis of Fatty Acids and Glycerolipids in Chloroplasts and Cyanobacterial Cells
     3. Roles of Glycerolipids in Photosynthesis
   - Acknowledgment
   - References

2. **Structure, Distribution and Biosynthesis of Glycerolipids from Higher Plant Chloroplasts**
   - Jacques Joyard, Eric Maréchal, Christine Miege, Maryse A. Block, Alain-Jean Dorne and Roland Douce
   - Summary
     1. Introduction
     2. Structure and Distribution of Chloroplast Glycerolipids
     3. Photosynthesis and Lipid Biosynthesis
     4. Diversity of Diacylglycerol Molecular Species Produced in Plastid Envelope Membranes
   - References

3. **Membrane Lipids in Algae**
   - John L. Harwood
   - Summary
     1. Introduction and Remarks
     2. The Nature of Algal Lipids
     3. Lipid Composition of Algae
     4. Metabolism of Algal Lipids
   - Acknowledgments
   - References

4. **Membrane Lipids in Cyanobacteria**
   - Hajime Wada and Norio Murata
   - Summary
     1. Introduction
     2. Characteristics of Cyanobacterial Lipids
     3. Biosynthesis of Lipids
     4. Fatty Acid Desaturation
     5. Changes in Membrane Lipids in Response to Environmental Factors
   - Conclusion and Future Perspectives
   - Acknowledgment
   - References
9 Reconstitution of Photosynthetic Structures and Activities with Lipids
   Antoine Trémolières and Paul-André Siegenthaler

   Summary
   i. Introduction
   ii. In Vitro Approaches to Lipid-Protein Interactions in the Photosynthetic Membrane
   iii. In Vitro Approaches to Lipid-Protein Interactions by Targeting Lipids into Photosynthetic Membranes
   IV. Conclusions and Perspectives

   References

   10 Lipid-Protein Interactions in Chloroplast Protein Import
   Ben de Krujff, Brian Plon, Ron van 't Hof and Rudy Demel

   Summary
   i. Introduction
   ii. Structure and Function of Transit Sequences
   iii. Transit Sequences-Lipid Interactions
   IV. A Model for Import
   V. Concluding Remarks
   Acknowledgments
   References

   11 Development of Thylakoid Membranes with Respect to Lipids
   Eva Selstern

   Summary
   i. Introduction
   ii. Lipid Composition and Biosynthesis
   III. Properties of Chloroplast Lipids
   IV. Chloroplast Differentiation from Proplasts
   V. Chloroplast Differentiation from Etioplasts
   Acknowledgments
   References

   12 Triglycerides As Products of Photosynthesis. Genetic Engineering, Fatty Acid Composition and Structure of Triglycerides
   Daniel Facciotto and Vic Knauf

   Summary
   i. Introduction
   ii. Generalties
   III. The Building Blocks of Triglyceride Synthesis
   IV. Fatty Acid Synthesis and Fatty Acid Chain Length
   V. Assemblage of Triglycerides, Acyltransferases and Structured Lipids
   VI. Fatty Acid Desaturation
   VII. Present Success and Future Challenges
   Acknowledgments
   References
13 Genetic Engineering of the Unsaturation of Membrane Glycerolipid: Effects on the Ability of the Photosynthetic Machinery to Tolerate Temperature Stress
Zoltan Gombos and Norio Murata

Summary
I. Introduction
II. Genetic Dissection of Fatty-Acid Desaturation in Synechocystis
III. Genetic Enhancement of Fatty-Acid Desaturation in Synechococcus
IV. Genetic Engineering of Phosphatidylglycerol in Tobacco
V. Genetic Engineering of Phosphatidylglycerol in Arabidopsis thaliana
VI. Conclusions
Acknowledgments
References

14 A Genetic Approach to Investigating Membrane Lipid Structure and Photosynthetic Function
Perumal Vijayan, Jean-Marc Routaboul and John Browse

Summary
I. Introduction
II. Structure and Function of the Photosynthetic Apparatus
III. Chilling Sensitivity and Fatty Acid Composition
IV. Effects of High Temperature on Photosynthetic and Growth Parameters
V. Alteration of Lipid Class Composition (Head Group Mutants)
VI. Mutations in Other Lipid Components and Their Effects
Acknowledgments
References

15 Involvement of Chloroplast Lipids in the Reaction of Plants Submitted to Stress
John L. Harwood

Summary
I. What Is Stress?
II. Environmental Factors that Alter Chloroplast Lipids
III. Light
IV. Temperature Effects on Photosynthetic Lipids
V. Drought
VI. Atmospheric Constituents
VII. Salt Stress and the Effects of Minerals
VIII. Xenobiotics which Affect Chloroplast Lipids
Acknowledgments
References

Index