

CONTENTS

CONTRIBUTORS TO VOLUME 59	ix
PREFACE	xi
CONTENTS OF VOLUMES 35-58	xv

Vitamin B6 in Plants: More Than Meets the Eye

TERESA B. FITZPATRICK

I. Introduction	2
II. Biological Functions and Requirements	5
III. Distribution	14
IV. Biosynthesis and Cellular Location of the Pathways	15
V. Regulation, Turnover and Catabolism	22
VI. Impact of the Vitamin on Plant Physiology and Development	25
VII. Comparison with Other Autotrophic Non-Plant Organisms	29
VIII. Engineering the Pathway for Nutritional Enhancement	30
IX. Conclusions	31
Acknowledgements	31
References	31

Biotin (Vitamin B8) Synthesis in Plants

CLAUDE ALBAN

I. Introduction	40
II. The Biosynthetic Pathway	46
III. Protein Biotinylation	54
IV. Concluding Remarks	58
Acknowledgements	61
References	61

Metabolism of Folates in Plants

STÉPHANE RAVANEL, ROLAND DOUCE
AND FABRICE RÉBEILLÉ

I. Folates Structure	69
II. Biological Functions of Folates: C1-Metabolism and Beyond	70
III. Folate Synthesis, Turnover and Homeostasis in Plants	77
IV. Folate Synthesis in Other Autotrophs	88
V. Physiology of Folate in Human Health and Disease	93
VI. Folate Biofortification in Plants	96
References	98

Vitamin C: The Metabolism and Functions of Ascorbic Acid in Plants

NICHOLAS SMIRNOFF

I. Introduction	109
II. Ascorbate Biosynthesis: The D-Mannose/L-Galactose (Man/L-Gal) Pathway ...	112
III. Are There Multiple Pathways for Ascorbate Biosynthesis?	123
IV. The Control of Ascorbate Biosynthesis and Pathway Engineering	127
V. Ascorbate Catabolism	131
VI. Ascorbate Transport and Subcellular Compartmentation	134
VII. Ascorbate Conjugates	137
VIII. The Redox Reactions of Ascorbate	137
IX. The Functions of Ascorbate	147
X. Conclusions	155
Acknowledgements	155
References	155

Vitamin E

DEAN DELLAPENNA AND LAURENT MÈNE-SAFFRANÉ

I. A Brief History of Vitamin E Research	180
II. Structure and Chemistry of Tocochromanols and Vitamin E	181
III. Tocochromanol Distribution in Plant Tissues and Foods	185
IV. Vitamin E Requirement in Humans and Biological Functions	185
V. The Tocochromanol Pathway in Photosynthetic Organisms	188

VI. Biochemical Genomics Enabled the Cloning of Tocochromanol Pathway Enzymes	190
VII. Engineering Multiple Steps of the Pathway and Application to Agricultural Crops	198
VIII. Potential for Breeding Plants with Improved Vitamin E Content	199
IX. Progress in Elucidating Tocochromanol Functions in Photosynthetic Organisms	200
References	216

Vitamin K₁ (Phylloquinone): Function, Enzymes and Genes

**CHLOË VAN OOSTENDE, JOSHUA R. WIDHALM, FABIENNE
FURT, ANNE-LISE DUCLUZEAU AND GILLES J. BASSET**

I. Introduction	230
II. Structure and Chemistry of Vitamin K	232
III. Biochemical Roles of Vitamin K	233
IV. Detection and Distribution of Phylloquinone in Plants	238
V. Phylloquinone Biosynthesis in Plants	240
VI. Evolution of Naphthoquinone Biosynthesis in Photosynthetic Eukaryotes	250
VII. Phylloquinone Turnover	253
VIII. Engineering of Phylloquinone in Plants	253
IX. Concluding Remarks	253
Acknowledgements	255
References	255
Author Index	263
Subject Index	287