

COMPREHENSIVE BIOCHEMISTRY

EDITED BY A. NEUBERGER

VOLUME 19^A

**AMINO ACID
METABOLISM
AND
SULPHUR METABOLISM**

ELSEVIER

CONTENTS

VOLUME 19A

AMINO ACID METABOLISM AND SULPHUR METABOLISM

General Preface	ix
Preface to Volume 19A	x

Chapter 1. Regulation of Amino Acid Metabolism
by H.E. UMBARGER

1. Introduction	1
2. Patterns of regulation of amino acid biosynthesis	2
2.1. Regulation of enzyme activity	3
2.1.1. Endproduct inhibition	4
2.1.2. Compensatory modulation of enzyme activity by ligand binding	14
2.1.3. Modification of enzymes as a control mechanism ...	17
2.1.4. Regulation of metabolite flow by protein—protein interactions	21
2.1.5. General metabolic regulation of enzyme activity ...	23
2.2. Regulation of enzyme amount	24
2.2.1. Regulation of enzyme synthesis	24
3. Patterns of regulation of amino acid breakdown	33
3.1. Factors affecting carbon flow in amino acid catabolic path- ways	34
3.2. Regulation of enzyme amount in amino acid catabolic path- ways	35
References	43

Chapter 2. Special Problems of Nitrogen Metabolism in Plants
by H. REINBOTHE, J. MIERSCH and K. MOTHES

1. Preface	51
1.1. Biological nitrogen fixation	52
1.2. Nitrate and nitrite assimilation	56

of Preve

L
Profe
LaboA
Al

This volume
cerned with
metabolism
prehensive
areas under
The many
biochemical
lism with c
in plants;
with glycine
The book
appeal to the
and biochem
development
important a

2. Ammonia and cyanide assimilation	58
2.1. Glutamine and glutamate synthesis	58
2.2. Carbamoylphosphate synthesis	61
2.3. Nitrogen assimilation in nitrogen-fixing angiosperms	63
2.4. Cyanide assimilation	69
3. Nitrogen transfer reactions in plants	73
3.1. Aminotransferases in amino acid biosynthesis	73
3.2. Amidotransferases and the central role of L-glutamine in nitrogen metabolism	75
3.3. Amidinotransferase and the major role of L-arginine in the biosynthesis of guanidino compounds	76
3.4. Biosynthesis of diamines and polyamines	78
3.4.1. Biosynthesis of putrescine and closely related simple compounds	78
3.4.2. The biosynthesis of spermidine and spermine	79
3.5. Biosynthesis of γ -glutamyl compounds in plants	86
4. Biosynthesis of "uncommon" amino acids in plants	93
4.1. N-Heterocyclic β -substituted alanines	95
4.2. Sulfate assimilation and the formation of sulfur amino acids	99
4.2.1. Assimilatory sulfate reduction by autotrophic plants and algae	100
4.2.2. Formation of sulfur-containing amino acids other than L-cysteine	104
4.3. Compounds with N—N bonds in plants and fungi	107
4.4. Isoxazolinone derivatives and other compounds with C—O—N bonds	110
5. Metabolism of guanidines in plants	112
5.1. Arginine catabolism in fungi	125
5.2. Urea assimilation in green algae and in yeasts	127
6. The physiological importance and pharmacological activity of "un- common" amino acids from plants	135
7. Possible ecological significance of "uncommon" amino acids	140
References	143

Chapter 3. Metabolism of Simple Sulphur Compounds
by P.A. TRUDINGER and R.E. LOUGHLIN

1. Introduction	165
2. Uptake of sulphate	170
3. Activation of sulphate	173
4. Assimilatory sulphate reduction	177
4.1. PAPS-sulphotransferase	178
4.2. APS-sulphotransferase	180
4.3. Thiosulphonate reductase	181
4.4. Reduction of sulphite	183
5. Formation of carbon-bonded sulphur	187

6. Genetics of cysteine biosynthesis	192
7. Dissimilatory reduction of inorganic sulphur compounds	199
7.1. Sulphate reduction	200
7.1.1. Assimilation of sulphur by dissimilatory sulphate-reducing bacteria	205
7.2. Miscellaneous dissimilatory reductions of inorganic sulphur compounds	207
8. Degradation of organic sulphur	209
8.1. Cysteine	209
8.1.1. Sulphite oxidation	212
8.2. Methionine	215
9. Lithotrophic oxidation of inorganic sulphur compounds	216
9.1. Sulphide oxidation	217
9.2. Oxidation of elemental sulphur	220
9.3. Oxidation of sulphite	223
9.4. Oxidation of thiosulphate	227
9.5. Metabolism of polythionates	230
10. Assimilation of sulphur by lithotrophic sulphur bacteria	231
11. Concluding remarks	234
12. Acknowledgements	235
References	236

Chapter 4. The Metabolism of Glycine and Serine by A. NEUBERGER

1. Glycine in proteins	258
2. Glycine in the mammalian organism	259
3. Overall metabolism of glycine in animals	260
4. Biosynthesis of glycine	261
4.1. Glycine formation associated with photosynthesis	261
4.2. Glycine formation through the operation of the glyoxylate cycle	264
4.3. Glycine and serine formation from 3-phosphoglycerate or glycerate	264
4.4. The conversion of L-serine to glycine	265
4.5. Glycine formation from L-threonine	268
4.6. The formation of glycine by the bacterial fermentation of purines	269
5. The glycine cleavage complex	270
6. The metabolism of glycine and serine in animals	273
7. Catabolism of serine and glycine in green plants	275
8. (a) Special features of glycine and serine metabolism in bacteria	277
(b) Glycine and serine in the microbial biochemistry of methane	277
9. Glycine and serine as precursors of "one-carbon" compounds	279
10. Biological carriers of "one-carbon" compounds	283
11. Purine formation	285