

CONTENTS

PART I. BASES OF THE BIOCHEMISTRY OF METABOLISM	1
1. A SYNOPTIC REGARDING THE BIOCHEMISTRY OF METABOLISM	3
1.1. General considerations.....	3
1.2. Bioconstituents and nutrients.....	6
1.2.1. Synoptic view.....	6
1.2.2. Bioconstituents.....	6
1.2.2.1. General data.....	6
1.2.2.2. Bioelements.....	7
1.2.2.3. Biomolecules – structure and classification.....	8
1.2.2.3.1. Organic biomolecules.....	8
1.2.2.3.2. Inorganic biomolecules.....	11
1.2.2.3.3. Biochemical effectors.....	11
1.2.3. Nutrients.....	12
1.2.3.1. General data.....	12
1.2.3.2. Trophic requirement.....	12
1.2.3.3. Energetic requirement.....	14
1.2.3.3.1. Basic energetic requirement.....	15
1.2.3.3.2. Relation energetic requirement.....	15
1.2.3.4. Comparisons regarding composition of bioconstituents and nutrients....	16
1.3. Enteral and parenteral nutrition.....	17
1.3.1. General view.....	17
1.3.2. Enteral nutrition.....	19
1.3.3. Parenteral nutrition.....	20
1.4. Specificity of trophicity.....	24
1.4.1. General view.....	25
1.4.2. Trophicity in the living world.....	25
1.4.3. Trophicity and dynamic equilibrium.....	27
1.5. Metabolism: conceptual and applicative aspects.....	29
1.5.1. General view.....	29
1.5.2. Metabolic phases and pathways.....	30
1.5.2.1. Metabolic phases.....	30
1.5.2.2. Metabolic pathways.....	32
1.5.3. Metabolic turnover.....	34

1.6. The interrelationship metabolism - dinamic characteristics in biological systems..	35
1.6.1. Synoptic view.....	35
1.6.2. Interrelationship metabolism - chronobiochemistry	36
1.6.2.1. Periodicity of biorhythms	39
1.6.2.2. Conditioning of biorhythms	40
1.6.2.3. Representative parameters.....	41
1.6.2.4. Autonomy and synchronization of biorhythms	42
1.6.3. Interrelationship metabolism - homeostasis.....	43
1.6.3.1. Regulation and balance in homeostasis.....	44
1.6.3.2. Homeostasis in the living world	44
1.6.3.3. Heterostasis.....	46
1.6.4. Interrelationship metabolism - homeoresis	46
1.6.4.1. Distable balance.....	46
1.6.4.2. Morphophysiological implications	47
1.7. The concept of biotransformation in connection with xenobiotics.....	47
1.7.1. Synoptic view.....	47
1.7.2. Metabolisation and biotransformation: similitudes and discrepancies	48
1.7.3. Biologically-active specificity	49
References (selective)	51

2. MORPHOPHYSIOLOGICAL ASPECTS AND THE BIOCHEMICAL SPECIFICITY IN THE METABOLISM - NUTRITION RELATIONSHIP.....	53
2.1. General considerations	53
2.2. Apparata and systems	54
2.3. Digestive apparatus - morphological aspects.....	56
2.3.1. Segments of the digestive tract	57
2.3.1.1. Oral cavity	57
2.3.1.1.1. Delimitations, relationships.....	57
2.3.1.1.2. Tongue.....	58
2.3.1.1.3. Annexes of the oral cavity.....	59
2.3.1.2. Pharynx.....	61
2.3.1.3. Esophagus.....	62
2.3.1.4. Stomach	62
2.3.1.5. Small intestine	63
2.3.1.5.1. Duodenum	63
2.3.1.5.2. Jejunum	64
2.3.1.5.3. Ileum.....	64
2.3.1.6. Large intestine	64
2.3.1.6.1. Caecum.....	65
2.3.1.6.2. Colon	65
2.3.1.6.3. Rectum	66
2.3.2. Annex glands of the digestive tract.....	66
2.3.2.1. Pancreas	66
2.3.2.2. Liver	68
2.4. Digestion and absorption - biochemical and physiological aspects.....	69
2.4.1. Digestion	69
2.4.1.1. Oro-pharyngo-esophagian phase	70
2.4.1.1.1. Insalivation	70

2.4.1.1.2. Mastication	73
2.4.1.1.3. Deglutition.....	73
2.4.1.1.3.1. The oral phase	73
2.4.1.1.3.2. The pharyngeal phase.....	73
2.4.1.1.3.3. The oesophageal phase.....	74
2.4.1.2. Gastric stage	74
2.4.1.2.1. The action of the gastric secretion.....	74
2.4.1.2.2. The effect of gastric motricity	75
2.4.1.3. The intestinal stage	76
2.4.1.3.1. The action of the pancreatic secretion.....	76
2.4.1.3.2. The action of the bile secretion	78
2.4.1.3.3. The action of the intestinal secretion.....	78
2.4.2. Absorption	79
2.5. Acces of nutrients in the organism.....	83
2.5.1. Basic concepts.....	83
2.5.2. Digestive pathway.....	83
2.5.2.1. General data	83
2.5.2.2. Peculiarities of the transit	84
2.5.3. Pulmonary pathway	85
2.5.3.1. General data.....	85
2.5.3.2. Peculiarities of the transit	85
2.5.4. Cutaneous pathway	86
2.5.4.1. General data.....	86
2.5.4.2. Peculiarities of the transit	87
References (selective)	88
3. NATURAL BIOCHEMICAL BARRIERS OF METABOLIC INTEREST	91
3.1. General considerations.....	91
3.2. Tissular barriers of the organism	93
3.2.1. Digestive barrier.....	93
3.2.2. Pulmonary barrier	94
3.2.3. Olfactory barrier.....	95
3.2.4. Skin barrier.....	95
3.2.5. Haemato-tissular barriers	96
3.2.5.1. Haemato-encephalic barrier.....	96
3.2.5.1.1. The blood-brain barrier	97
3.2.5.1.2. The blood-cerebrospinal fluid barrier	97
3.2.5.2. The blood-placental barrier	98
3.2.5.3. The capillary hematologic barrier	101
3.3. Membranar barriers of cells	101
3.3.1. Membrane transport systems	102
3.3.2. Barriers of the microtransport systems	102
3.3.2.1. Passive transmembrane transport	103
3.3.2.1.1. Transport by diffusion.....	103
3.3.2.1.2. Transport by osmosis	105
3.3.2.1.3. The transport conditioned by the Donnan's equilibrium	107
3.3.2.2. Active transmembrane transport.....	107
3.3.3. Barriers of the macrotransport systems.....	109

3.3.3.1. Endocytosis.....	109
3.3.3.2. Exocytosis.....	110
3.3.3.3. Specificity of macrotransport systems.....	110
References (selective)	111

4. CHEMICAL REACTIONS CHARACTERISTIC FOR METABOLISMS - CONCEPTUAL DELIMITATIONS	113
4.1. General considerations	113
4.2. Metabolism specific enzymes	
4.3. Chemical reactions characteristic for catabolism	114
4.3.1. Oxidation reduction reactions	114
4.3.1.1. Synoptic view	114
4.3.1.2. Enzymatic specificity	115
4.3.1.3. Representative examples	116
4.3.2. Hydrolysis reactions.....	118
4.3.2.1. Synoptic view	118
4.3.2.2. Enzymatic specificity	118
4.3.2.3. Representative examples	118
4.4. Chemical reactions characteristic for anabolism	120
4.4.1. Conjugation reactions	120
4.4.1.1. Synoptic view	120
4.4.1.2. Enzymatic specificity	120
4.4.1.3. Representative examples	121
4.4.2. Adduct forming reactions	124
4.4.2.1. Synoptic view	124
4.4.2.2. Enzymatic specificity	125
4.4.2.3. Representative examples	125
References (selective)	127

PART II. METABOLISATION OF NUTRIENTS 129

5. METABOLISM OF CARBOHYDRATES	131
5.1. General considerations	131
5.2. Chemical composition and structure of carbohydrates	132
5.3. Classification of carbohydrates	134
5.4. Catabolism of carbohydrates.....	135
5.4.1. Biodegradation of glycogen.....	136
5.4.2. Biodegradation of glucose	136
5.4.2.1. Anaerobic way of biodegradation.....	138
5.4.2.2. Aerobic way of biodegradation	142
5.4.2.3. Biodegradation on the pentoso-phosphates pathway	143
5.4.2.4. Biodegradation on the uronic acid pathway	147
5.4.3. Biodegradation of other hexoses.....	149
5.4.3.1. Biodegradation of fructose	150
5.4.3.2. Biodegradation of galactose	150
5.5. Anabolism of carbohydrates	151
5.5.1. Biosynthesis of glycogen	151
5.5.2. Biosynthesis of glucose.....	152

5.5.2.1. Glucogenesis.....	152
5.5.2.2. Gluconeogenesis.....	154
5.5.2.2.1. Biosynthesis from lipid metabolites.....	154
5.5.2.2.2. Biosynthesis from protein metabolites.....	154
5.6. Nutritional characteristics of carbohydrates.....	156
5.6.1. Nutrients of carbohydrate nature.....	156
5.6.2. Digestion and absorption.....	157
References (selective).....	158
6. METABOLISM OF LIPIDS.....	161
6.1. General considerations.....	161
6.2. Chemical composition and structure of lipids.....	161
6.3. Classification of lipids.....	165
6.4. Catabolism of lipids.....	166
6.4.1. Biodegradation of fundamental constituents.....	166
6.4.1.1. Biodegradation of fatty acids.....	167
6.4.1.1.1. Biodegradation by β -oxidation.....	167
6.4.1.1.2. Biodegradation by ω -oxidation.....	171
6.4.1.1.3. Biodegradation by α -oxidation.....	171
6.4.1.2. Biodegradation of fatty acids and cetogenesis.....	172
6.4.1.3. Biodegradation of hydroxylic compounds.....	175
6.4.1.3.1. Biodegradation of glycerol.....	175
6.4.1.3.2. Biodegradation of cholesterol.....	175
6.4.1.3.3. Biodegradation of other hydroxylic compounds.....	176
6.4.2. Biodegradation of simple lipids.....	176
6.4.2.1. Biodegradation of glycerides.....	178
6.4.2.2. Biodegradation of sterides.....	180
6.4.2.3. Biodegradation of cerides.....	180
6.4.3. Biodegradation of complex lipids.....	182
6.4.3.1. Biodegradation of glycerophospholipids.....	182
6.4.3.2. Biodegradation of sphingolipids.....	182
6.5. Anabolism of lipids.....	183
6.5.1. Biosynthesis of fundamental constituents.....	183
6.5.1.1. Biosynthesis of fatty acids.....	183
6.5.1.2. Biosynthesis of hydroxylic compounds.....	186
6.5.1.2.1. Biosynthesis of glycerol.....	186
6.5.1.2.2. Biosynthesis of sterols.....	186
6.5.1.2.3. Biosynthesis of aminoalcohols.....	190
6.5.2. Biosynthesis of simple lipids.....	191
6.5.2.1. Biosynthesis of glycerides.....	191
6.5.2.2. Biosynthesis of sterides.....	193
6.5.2.3. Biosynthesis of cerides.....	194
6.5.3. Biosynthesis of complex lipids.....	194
6.5.3.1. Biosynthesis of glycerophospholipids.....	195
6.5.3.2. Biosynthesis of sphingolipids.....	195
6.6. Nutritional characteristics of lipids.....	196
6.6.1. Nutrients of lipidic nature.....	196
6.6.2. Digestion and absorption of lipids.....	198

References (selective)	199
7. METABOLISM OF PROTEINS	201
7.1. General considerations	201
7.2. Chemical composition and structure of proteins	202
7.3. Classification of proteins	207
7.4. Catabolism of proteins	209
7.4.1. Biodegradation of amino acids	210
7.4.1.1. General pathways of biodegradation of amino acids.....	210
7.4.1.1.1. Deamination of amino acids.....	210
7.4.1.1.2. Transamination of amino acids	212
7.4.1.1.3. Decarboxylation of amino acids.....	214
7.4.1.2. Specific pathways of biodegradation of amino acids	218
7.4.1.2.1. Biodegradation of monoaminomonocarboxylic amino acids.....	218
7.4.1.2.2. Biodegradation of monoaminodicarboxylic amino acids.....	223
7.4.1.2.3. Biodegradation of diaminomonocarboxylic amino acids.....	224
7.4.1.2.4. Biodegradation of hydroxyamino acids	226
7.4.1.2.5. Biodegradation of thioamino acids	227
7.4.1.2.6. Biodegradation of homocyclic amino acids	231
7.4.1.2.7. Biodegradation of heterocyclic amino- and iminoamino acids	234
7.4.1.3. Metabolic integration of biodegradation products.....	239
7.4.1.3.1. Metabolisation of amoniacal residual components	239
7.4.1.3.2. Metabolisation of ketone residual components	245
7.4.2. Biodegradation of peptides	247
7.4.3. Biodegradation of protein macromolecules	248
7.4.3.1. Biodegradation of holoproteins	248
7.4.3.2. Biodegradation of heteroproteins	248
7.4.3.2.1. Biodegradation of porphyrines.....	249
7.4.3.2.2. Biodegradation of nucleic acids	252
7.5. Anabolism of proteins.....	255
7.5.1. Biosynthesis of amino acids.....	255
7.5.1.1. General pathways of biosynthesis	255
7.5.1.1.1. Biosynthesis of amino acids in microorganisms	255
7.5.1.1.2. Biosynthesis of amino acids in vegetal reign	256
7.5.1.1.3. Biosynthesis of amino acids in animal reign.....	256
7.5.1.2. Specific pathways of biosynthesis.....	257
7.5.1.2.1. Biosynthesis of monoaminomonocarboxylic amino acids.....	257
7.5.1.2.2. Biosynthesis of monoaminodicarboxylic amino acids.....	258
7.5.1.2.3. Biosynthesis of diaminomonocarboxylic amino acids.....	260
7.5.1.2.4. Biosynthesis of hydroxyamino acids.....	262
7.5.1.2.5. Biosynthesis of thioamino acids.....	263

7.5.1.2.6. Biosynthesis of homocyclic amino acids	264
7.5.1.2.7. Biosynthesis of heterocyclic amino- and iminoamino acids.....	266
7.5.2. Biosynthesis of peptides	271
7.5.3. Biosynthesis of protein macromolecules	271
7.5.3.1. Biosynthesis of holoproteins	272
7.5.3.2. Biosynthesis of heteroproteins	272
7.5.3.2.1. Biosynthesis of porphyrines	272
7.5.3.2.2. Biosynthesis of nucleic acids	273
7.5.3.3. Biosynthesis of proteins	277
7.5.3.3.1. Overview	278
7.5.3.3.2. Process of replication	278
7.5.3.3.3. Process of transcription	281
7.5.3.3.4. Process of translation	284
7.5.3.4. Genetic code – relation with biosynthesis	286
7.5.3.4.1. Characteristics of the genetic code.....	286
7.5.3.4.2. Translation apparatus	288
7.5.3.4.3. Activation of amino acids	289
7.5.3.4.4. Stages of the biosynthesis of proteins	290
7.5.3.4.5. Energo-genesis and regulation of proteins’ biosynthesis	293
7.6. Nutritional characteristics of proteins	295
7.6.1. Protein nutrients	295
7.6.2. Digestion and absorption	297
References (selective)	298
8. METABOLISM OF HYDRO-ELECTROLYTES	301
8.1. General considerations	301
8.2. Water and biomineral compounds of living matter	302
8.3. Classification of the distribution system of water and biomineral compounds in the organism	303
8.4. Metabolic peculiarities of water – hydric balance	305
8.4.1. Repartition of water in organism	305
8.4.2. Regulation of hydric balance	307
8.5. Metabolic peculiarities of biomineral compounds.....	308
8.5.1. Biomineral compounds with cationic character.....	309
8.5.2. Biomineral compounds with anionic character.....	316
8.5.3. Peculiarities of multiple biomineral deficiency	322
8.6. Nutritional characteristics of water and biomineral compounds	325
8.6.1. Nutrients of hydric and mineral nature	325
8.6.2. Digestion and absorption of water and mineral compounds.....	326
8.6.2.1. Digestion and absorption of compounds with cationic character.....	326
8.6.2.2. Digestion and absorption of compounds with anionic character	329
References (selective)	330

PART III. MATERIAL METABOLISMS AND ENERGY METABOLISM: INTERFERENCES	333
9. INTERACTIVE BIOCHEMICAL PATHWAYS OF MATERIAL METABOLISMS	335
9.1. General considerations	335
9.2. Tricarboxylic acids cycle	337
9.2.1. Synoptic view.....	337
9.2.2. Steps of tricarboxylic acids cycle	338
9.2.3. Energetical balance of TAC	342
9.2.4. Metabolical interconversions and the tricarboxylic acids cycle.....	345
References (selective).....	347
10. METABOLIC SPECIFICITY OF THE RESPIRATORY CHAIN AND OF OXIDATIVE PHOSPHORYLATION	349
10.1. General considerations	349
10.2. Mechanism of tissular respiration	351
10.3. Redox reactions specific for the respiratory chain in the classic view	353
10.4. Peculiarities of the respiratory chain in eukaryotes and prokaryotes.....	355
10.4.1. Respiratory chain – general aspects.....	355
10.4.2. Notable differences in the respiratory chain.....	356
10.4.3. Respiratory chain in eukaryotes	357
10.4.4. Respiratory chain in prokaryotes	361
10.5. Oxidative phosphorylation	362
References (selective).....	364
11. PECULIARITIES OF METABOLISM IN PHOTOSYNTHESIS	365
11.1. General considerations	365
11.2. Stages of photosynthesis	366
11.2.1. Light stage.....	366
11.2.1.1. Photolysis of water	366
11.2.1.2. Photophosphorylation	367
11.2.2. Dark stage	367
11.2.2.1. The metabolic integration of carbon dioxide	368
11.2.2.2. The reduction of 3-phosphoglyceric acid.....	369
11.2.2.3. The regeneration of the ribuloso-1,5-diphosphate molecule.....	369
11.3. Structure-activity relationship in chlorophyll	374
11.3.1. Chemical structure	374
11.3.2. Biological activity	375
References (selective)	376
12. FROM METABOLISM TO METABOLOMICS – CONCEPTUAL AND ANALYTIC ASPECTS	
12.1. General considerations	
12.2. Evolution of concepts regarding „omics” in molecular biology	
12.3. Metabolomics – a conceptual extension imposed by the biochemical analytics	
12.4. Proceedings to extend the exploration denominations	
12.5. Metabolisation related with the applications in personalized medicine	

References (selective).....

Addenda 379