Contents

Preface to the Third Edition xxiii
Preface to the Second Edition xxv
Preface to the First Edition xxvii
Acknowledgments xxix

PART I Biology and Biochemistry

Chapter 1 Introduction: Fundamentals of Nutrition 3

1.1 Terminology 3
1.1.1 Metabolism 4
1.1.2 Homeostasis 4
1.2 Nutritional Labeling 5
1.3 The Need for a Variety of Foods 5
1.3.1 Fruits and Vegetables—More Matters 6
1.3.2 Red and Processed Meat—Less Is Better 6
1.4 The Need for Energy 7
1.5 The Need for Digestion, Absorption, and Utilization of Nutrients 7
1.6 Enteral and Parenteral Nutrition 8
1.6.1 Enteral Feeding 8
1.6.2 Parenteral Feeding 8
1.7 Adaptation 9
1.8 Water as a Nutrient 10
1.8.1 Requirement for Athletes 11
1.9 Food Allergy 12
1.9.1 Allergies—Read It and Eat 14
1.9.2 Cell Phone Allergy 14
1.10 Guidelines for Americans 15
1.11 Exercise for Health 16
1.12 Healthy Advice 20
References 21
Case Bibliography 22

Chapter 2 Digestion of Carbohydrates, Lipids, and Proteins 23

2.1 Introduction 23
2.2 Carbohydrates 26
2.2.1 Digestion and Absorption 26
2.2.2 Carbohydrate Intolerance 27
2.3 Lipids 29
2.3.1 Digestion and Absorption 29
2.3.2 Lipid Malabsorption 31
2.4 Proteins 32
2.4.1 Digestion and Absorption 32
2.4.2 Defects in Protein Digestion and Absorption 33

2.5 Malabsorption Syndromes....34
2.5.1 Celiac Disease....34
2.5.2 Cystic Fibrosis....36
2.5.3 Tropical Sprue....37
2.5.4 Inflammatory Bowel Diseases....37
2.5.5 Short Bowel Syndrome....38
2.6 Microorganisms....38
References....40
Case Bibliography....40

Chapter 3 Requirements for Energy: Carbohydrates, Fats, and Proteins....41

3.1 Energy....41
3.1.1 Calories....41
3.1.2 Basal Metabolism....42
3.1.3 Resting Energy Expenditure....43
3.1.4 Thermic Effect of Food....43
3.1.5 Caloric Density....43
3.1.6 Caloric Requirement....44
3.1.7 Calorie Intake and Body Weight....45
3.2 Respiratory Quotient....46
3.3 Carbohydrates....47
3.3.1 Glycemic Index and Glycemic Load....49
3.3.2 Carbohydrates and Health....49
3.4 Fat....51
3.4.1 Need for Fat in the Diet....53
3.4.2 Dietary Fat and Health....54
3.5 Proteins....54
3.5.1 Amino Acid Catabolism....56
3.5.2 Anabolism or Catabolism....57
3.5.3 Protein Reserves....58
3.5.4 Nitrogen Balance....59
3.5.5 Nutritional Quality of Proteins....59
3.5.6 Protein Needs in Disease....60
3.5.7 Protein-Energy Malnutrition....62
3.6 Use of Body Energy Sources during Hypometabolism and Hypermetabolism....64
3.6.1 Starvation—Hypometabolism....64
3.6.2 Stress—Hypermetabolism....65
References....66
Case Bibliography....67

Chapter 4 Role of Essential Fatty Acids....69

4.1 Fatty Acids....69
4.2 Neutral Fat....70
4.3 Properties of Fat....70
4.3.1 Iodine Number....70
4.3.2 Rancidity....70
4.3.3 Hydrogenation....71
4.3.4 *Trans* Fatty Acids....71
4.3.5 Conjugated Linoleic Acid....71

4.4 Dietary Sources and Health Effects of *Trans* Fatty Acids 71
4.5 Saturated Fatty Acids 73
4.6 Monounsaturated Fatty Acids 73
4.7 Essential Fatty Acids 74
4.7.1 Functions 76
4.7.2 Deficiency of Essential Fatty Acids 77
4.7.3 Requirements 79
4.7.4 Effect of Excess Essential Fatty Acids 80
4.7.5 Food Sources 80
4.7.6 Dietary ω_3 Fatty Acids and Health 81
References 84
Case Bibliography 85

Chapter 5 Eicosanoids 87

5.1 Prostaglandins 87
5.1.1 Chemistry and Nomenclature 87
5.1.2 Biosynthesis 88
5.1.3 Catabolism 89
5.1.4 Physiological Actions 89
5.2 Thromboxanes 90
5.3 Prostacyclins 91
5.4 Leukotrienes 91
5.4.1 Metabolism of Leukotrienes 91
5.4.2 Physiological Actions 91
5.5 Lipoxins 92
5.6 Cytochrome P450–Derived Products 92
5.7 Inhibitors of Eicosanoid Biosynthesis 93
5.7.1 Cyclooxygenase 2: A Target for Treatment of Diseases 95
5.7.2 Cyclooxygenase 3 96
5.8 Eicosanoids and Chronic Diseases 97
5.9 Effects of Diet on Eicosanoids 97
5.9.1 Factors Affecting the Formation of 20-Carbon PUFAs 97
5.9.2 Factors Affecting Eicosanoid Synthesis 98
5.10 Alternative Medicine for Pain 98
5.10.1 Turmeric 99
5.10.2 Avocado Soy Unsaponifiable 100
5.10.3 Glucosamine and Chondroitin 100
References 101
Case Bibliography 102

Chapter 6 Inorganic Elements (Minerals) 103

6.1 Essential Macrominerals 103
6.1.1 Calcium 103
6.1.2 Phosphorus 108
6.1.3 Magnesium 109
6.1.4 Potassium 110
6.1.5 Sodium 112
6.1.6 Chloride 113

6.1.7 Sulfur ... 114
6.1.8 Role of Macrominerals and Other Factors in Hypertension ... 114
6.2 Essential Trace Elements ... 120
6.2.1 Iron ... 120
6.2.2 Copper ... 124
6.2.3 Zinc ... 127
6.2.4 Cobalt ... 130
6.2.5 Molybdenum ... 131
6.2.6 Selenium ... 133
6.2.7 Manganese ... 136
6.2.8 Iodine ... 138
6.2.9 Chromium ... 141
6.2.10 Fluoride ... 143
6.3 Ultratrace Minerals ... 149
6.3.1 Silicon ... 149
6.3.2 Nickel ... 149
6.3.3 Boron ... 150
6.3.4 Arsenic ... 151
6.3.5 Tin ... 151
6.3.6 Vanadium ... 152
References ... 152
Case Bibliography ... 156

Chapter 7 Vitamins—An Overview ... 157

7.1 Historical Perspective ... 157
7.2 Definition ... 157
7.3 Names ... 157
7.4 Classification ... 158
7.5 Functions ... 158
7.6 Deficiency ... 159
7.7 Need for Supplements ... 160
7.8 Hypervitaminosis ... 161
7.9 Antivitamins ... 162
7.10 Enrichment of Foods ... 162
References ... 164
Case Bibliography ... 164

Chapter 8 Fat-Soluble Vitamins ... 165

8.1 Vitamin A ... 165
8.1.1 Chemistry ... 165
8.1.2 Food Sources ... 165
8.1.3 Absorption ... 166
8.1.4 Transport ... 167
8.1.5 Biochemical Role ... 167
8.1.6 Deficiency ... 171
8.1.7 Units ... 174
8.1.8 Recommended Dietary Allowance ... 174
8.1.9 Assessment of Vitamin A Status ... 174
8.1.10 Toxicity ... 174

8.2 Vitamin D ... 175
8.2.1 Chemistry ... 175
8.2.2 Food Sources ... 177
8.2.3 Absorption ... 177
8.2.4 Metabolism ... 178
8.2.5 Functions ... 179
8.2.6 Deficiency ... 182
8.2.7 Units ... 185
8.2.8 Assessment of Vitamin D Status ... 185
8.2.9 Toxicity ... 185
8.3 Vitamin E ... 186
8.3.1 Chemistry ... 186
8.3.2 Food Sources ... 187
8.3.3 Absorption and Transport ... 187
8.3.4 Functions ... 187
8.3.5 Deficiency ... 189
8.3.6 Units ... 190
8.3.7 Assessment of Vitamin E Status ... 190
8.3.8 Toxicity ... 190
8.4 Vitamin K ... 190
8.4.1 Chemistry ... 191
8.4.2 Food Sources ... 192
8.4.3 Absorption ... 192
8.4.4 Functions ... 192
8.4.5 Deficiency ... 194
8.4.6 Requirements ... 195
8.4.7 Assessment of Vitamin K Status ... 195
8.4.8 Toxicity ... 195
References ... 196
Case Bibliography ... 199

Chapter 9 Water-Soluble Vitamins I ... 201

9.1 Thiamin—B_1 ... 201
9.1.1 Food Sources ... 201
9.1.2 Chemistry ... 201
9.1.3 Absorption and Transport ... 201
9.1.4 Functions ... 202
9.1.5 Deficiency ... 203
9.1.6 Requirements ... 205
9.1.7 Assessment of Thiamin Status ... 206
9.1.8 Antithiamin Substances ... 206
9.1.9 Toxicity ... 206
9.2 Riboflavin—B_2 ... 206
9.2.1 Chemistry ... 207
9.2.2 Food Sources ... 207
9.2.3 Absorption and Transport ... 207
9.2.4 Biochemical Role ... 208
9.2.5 Deficiency ... 208
9.2.6 Requirements ... 210
9.2.7 Assessment of Nutritional Status ... 210

9.2.8 Antagonists 210
9.2.9 Toxicity 210
9.3 Niacin 210
9.3.1 Food Sources 211
9.3.2 Tryptophan–Niacin Relationship 211
9.3.3 Bound Forms of Niacin 212
9.3.4 Chemistry 212
9.3.5 Absorption and Transport 213
9.3.6 Functions 213
9.3.7 Deficiency 214
9.3.8 Requirements 215
9.3.9 Evaluation of Niacin Status 216
9.3.10 Toxicity 216
9.4 Pantothenic Acid 216
9.4.1 Food Sources 216
9.4.2 Chemistry 217
9.4.3 Absorption and Transport 217
9.4.4 Functions 217
9.4.5 Deficiency 218
9.4.6 Requirements 219
9.4.7 Assessment of Pantothenic Acid Status 219
9.4.8 Effect of Excess Pantothenic Acid 219
9.5 Biotin 220
9.5.1 Food Sources 220
9.5.2 Chemistry 220
9.5.3 Absorption and Transport 221
9.5.4 Functions 221
9.5.5 Deficiency 222
9.5.6 Assessment of Biotin Status 224
9.5.7 Requirements 224
9.5.8 Effect of Pharmacological Doses 224
References 226
Case Bibliography 227

Chapter 10 Water-Soluble Vitamins II 229

10.1 Folic Acid 229
10.1.1 Food Sources 229
10.1.2 Chemistry 229
10.1.3 Absorption 230
10.1.4 Functions 231
10.1.5 Deficiency 231
10.1.6 Antagonists 234
10.1.7 Assessment of Folic Acid Status 234
10.1.8 Requirements 234
10.1.9 Excess Folate 235
10.2 Vitamin B_{12} 235
10.2.1 Food Sources 236
10.2.2 Chemistry 236
10.2.3 Absorption and Transport 237
10.2.4 Biochemical Functions 238

10.2.5 Deficiency 241
10.2.6 Requirements 243
10.2.7 Assessment of B_{12} Status 243
10.2.8 Toxicity 243
10.3 Pyridoxine 244
10.3.1 Chemistry 244
10.3.2 Food Sources 244
10.3.3 Absorption and Transport 245
10.3.4 Functions 245
10.3.5 Deficiency 246
10.3.6 Effect of Drugs 246
10.3.7 Genetic Defects 247
10.3.8 Requirements 247
10.3.9 Assessment of Vitamin B_6 Status 248
10.3.10 Effect of Pharmacological Doses 248
10.4 Vitamin C—Ascorbic Acid 249
10.4.1 Food Sources 250
10.4.2 Chemistry 250
10.4.3 Absorption and Metabolism 251
10.4.4 Biochemical Functions 251
10.4.5 Deficiency 252
10.4.6 Requirements 255
10.4.7 Assessment of Vitamin C Status 255
10.4.8 Effects of High Doses of Vitamin C 256
10.5 Anemias 258
References 258
Case Bibliography 260

Chapter 11 Vitamin-Like Substances 261

11.1 Choline 261
11.2 Carnitine 263
11.3 Bioflavonoids 266
11.4 Lipoic Acid 267
11.5 Coenzyme Q 268
11.6 Inositol 270
11.7 *p*-Aminobenzoic Acid 272
References 274
Case Bibliography 275

PART II Special Nutritional Needs

Chapter 12 Nutritional Aspects of Pregnancy and Lactation 279

12.1 Nutrition Prior to Pregnancy 279
12.2 Nutrition during Pregnancy 281
12.2.1 Length of Pregnancy and Birth Weight 281
12.2.2 Physiology 281
12.2.3 Nutrient Requirements 285
12.2.4 Other Maternal Factors 289

12.3 Fetal Origins of Adult Disease 295
12.4 Nutrition during Lactation 297
12.4.1 Energy 297
12.4.2 Protein 298
12.4.3 Essential Fatty Acids 298
12.4.4 Calcium 298
12.4.5 Water-Soluble Vitamins 298
12.4.6 Other Factors 298
12.5 Lactation Effects 298
12.5.1 Role of Prolactin Other than in Lactation 299
References 299
Case Bibliography 300

Chapter 13 Nutrition and Development 301

13.1 Fetal Development 301
13.2 Extrauterine Development 304
13.3 Nutrition and Development during Infancy 306
13.3.1 Nutritional Requirements 306
13.3.2 Requirements for Low Birth Weight Infants 308
13.3.3 Breast-Feeding 309
13.3.4 Infant Formulas 313
13.3.5 Solid Foods 314
13.3.6 Adverse Reactions to Food 315
13.3.7 Metabolic Disorders 315
13.4 Nutrition and Development during Childhood 316
13.4.1 Energy 316
13.4.2 Protein 317
13.4.3 Vitamins and Minerals 317
13.5 Nutrition and Development during Adolescence 317
13.5.1 Energy 318
13.5.2 Protein 318
13.5.3 Vitamins and Minerals 318
13.6 Overweight in Infancy, Childhood, and Adolescence 319
References 321
Case Bibliography 322

Chapter 14 Nutrition and Aging 323

14.1 Aging 323
14.1.1 Life Expectancy and Lifespan 323
14.1.2 Theories of Aging 325
14.2 Effects of Nutrition, Drugs, Supplements, and Genes 325
14.2.1 Nutrition 325
14.2.2 Drugs and Supplements 327
14.2.3 Genetic Factors 328
14.3 Role of Antioxidants 329
14.4 Factors Affecting Nutrition Status 330
14.4.1 Physiologic Changes 330
14.4.2 Malabsorption and Gastrointestinal Disorders 331
14.4.3 Metabolism 332
14.4.4 Drugs 332

14.4.5 Diseases 332
14.4.6 Other Factors 332
14.5 Nutrient Requirements 332
14.5.1 Energy 332
14.5.2 Protein 333
14.5.3 Other Macronutrients 333
14.5.4 Micronutrients 333
14.6 Lifestyle 334
References 336
Case Bibliography 337

PART III Nutrition and Specific Disorders

Chapter 15 Nutritional Assessment 341

15.1 Anthropometric Measurements 341
15.1.1 Body Weight 342
15.1.2 Length and Height 342
15.1.3 Body Mass Index 342
15.1.4 Skinfold Thickness 342
15.1.5 Head Circumference 343
15.1.6 Midarm Muscle Circumference 343
15.2 Clinical Evaluation 343
15.2.1 Medical History 343
15.2.2 Physical Examination 344
15.3 Laboratory Assessment 345
15.3.1 Assessment of Body Protein Status 346
15.3.2 Body Fat 348
15.3.3 Immune Function 348
15.3.4 Nitrogen Balance 349
15.3.5 Lipids 349
15.3.6 Other Nutrients 349
15.3.7 Nutrients Involved in Hematopoiesis 349
15.4 Dietary Assessment 350
References 350

Chapter 16 Obesity and Eating Disorders 353

16.1 Classification 353
16.2 Pattern of Fat Deposition 355
16.3 Prevalence 355
16.4 Causes of Obesity 357
16.4.1 Calories 357
16.4.2 Genetics 358
16.4.3 Brown Fat 358
16.4.4 Lipoprotein Lipase 359
16.4.5 ATPase 360
16.4.6 Set Point 360
16.4.7 Role of Hormones 360

16.5 Assessment of Obesity 363
16.5.1 Body Weight 363
16.5.2 Body Mass Index 363
16.5.3 Skinfold Thickness 364
16.5.4 Other Techniques 364
16.6 Medical Complications 365
16.6.1 Waist Circumference 366
16.7 Diet and Other Strategies for Weight Reduction 367
16.8 Fad Diets 368
16.9 Alternative Medicine for Weight Reduction 368
16.9.1 Seaweeds for Dieters 368
16.10 Pharmacotherapy 369
16.11 Eating Disorders 371
16.11.1 Anorexia Nervosa 372
16.11.2 Bulimia Nervosa 373
16.11.3 Binge Eating 374
16.11.4 Night Eating Disorders 374
16.11.5 Baryphobia 374
16.11.6 Pica 374
16.11.7 Miscellaneous Eating Disorders 375
References 376
Case Bibliography 378

Chapter 17 Cholesterol and Dyslipidemia 379

17.1 Cholesterol 379
17.1.1 Food Sources 379
17.1.2 Body Cholesterol 380
17.1.3 Functions 380
17.1.4 Synthesis 380
17.1.5 Cholesterol Degradation 381
17.2 Lipoproteins and Lipid Transport 382
17.2.1 Chylomicrons 383
17.2.2 Very Low–Density Lipoprotein 384
17.2.3 Intermediate-Density Lipoprotein 384
17.2.4 Low-Density Lipoprotein 384
17.2.5 High-Density Lipoprotein 385
17.2.6 Lipoprotein (a) 386
17.3 Plasma Cholesterol and Risk of Heart Disease 386
17.4 The National Cholesterol Education Program 387
17.5 Plasma Triglycerides and Risk of Heart Disease 388
17.6 Dietary Management 388
17.7 Drug Therapy 390
17.8 Recent Studies on HDL 391
17.9 Hypocholesterolemia 392
17.10 Effects of Low Blood Cholesterol 392
17.11 Alternative Medicine to Lower Cholesterol 392
17.11.1 Policosanol 393
17.11.2 Berberine 393
17.11.3 Phytosterols 394

17.12 Inborn Errors of Cholesterol Biosynthesis 394
17.12.1 Smith–Lemli–Opitz Syndrome 394
References 395
Case Bibliography 396

Chapter 18 Osteoporosis 397

18.1 Osteopenia and Bone Mineral Density 397
18.2 Epidemiology of Osteoporosis 397
18.3 Disease Process 398
18.4 Factors Contributing to Bone Mass 399
18.4.1 Genetic Factors, Body, and Build 399
18.4.2 Sex 400
18.4.3 Calcium Intake 400
18.4.4 Phosphorus Intake 401
18.4.5 Lactose Intake 401
18.4.6 Protein Intake 401
18.4.7 Vitamin D Intake 402
18.4.8 Vitamin C Intake 402
18.4.9 Vitamin K Intake 402
18.4.10 Magnesium Intake 403
18.4.11 Other Nutrients—Folic Acid, Vitamin B_{12}, Vitamin A, and Sodium 403
18.4.12 Fiber and Related Substances 403
18.4.13 Vegetarian Diet 403
18.4.14 Caffeine Intake 404
18.4.15 Alcohol, Cigarette Smoking, and Drugs 404
18.4.16 Trace Elements 405
18.4.17 Organ Transplant 406
18.4.18 Physical Activity 407
18.4.19 Toxic Effects of Some Minerals 407
References 408
Case Bibliography 409

Chapter 19 Nutritional Aspects of Diabetes 411

19.1 Classification 411
19.2 Epidemiology 413
19.3 Diagnosis of Diabetes 415
19.4 Role of Adiponectin, Osteocalcin, Fetuin-A, and Melatonin 415
19.4.1 Adiponectin 415
19.4.2 Osteocalcin 416
19.4.3 Fetuin-A 416
19.4.4 Melatonin 417
19.5 Mechanism of Insulin Action 417
19.6 Complications of Diabetes 418
19.7 Dietary Management 420
19.8 Dietary Factors 421
19.8.1 Energy 421
19.8.2 Carbohydrate 422
19.8.3 Fat 423

19.8.4 Protein 423
19.8.5 Alcohol 423
19.8.6 Dietary Fiber 423
19.8.7 Vitamins and Minerals 423
19.9 Physical Activity 424
19.10 Metabolic Syndrome 425
19.10.1 Definition of Metabolic Syndrome 425
19.11 Lifestyle Modification to Reduce the Risk of Type 2 Diabetes 426
19.12 Alternative Medicine for Diabetes 426
References 428
Case Bibliography 429

Chapter 20 Nutritional Aspects of Kidney Disease 431

20.1 Kidney Functions 431
20.2 Chronic Kidney Disease 432
20.2.1 Nutritional Management 433
20.2.2 Nutritional Management for Patients Treated with Dialysis 434
20.3 Acute Kidney Injury 435
20.4 Nephrotic Syndrome 436
20.5 Kidney Stone Disease 436
20.5.1 Epidemiology 437
20.5.2 Causes 437
20.5.3 Classification 438
References 440

Chapter 21 Nutritional Aspects of Genetic Diseases 441

21.1 Carbohydrate Metabolism 441
21.1.1 Sucrose and Fructose Metabolism 442
21.1.2 Lactose and Galactose Metabolism 443
21.1.3 Glucose Metabolism 444
21.1.4 Glycogen Metabolism 444
21.2 Amino Acid Metabolism 445
21.2.1 Phenylalanine 445
21.2.2 Tyrosine 446
21.2.3 Histidine 447
21.2.4 Arginine and Ornithine 447
21.2.5 Urea Cycle 447
21.2.6 Methionine 448
21.2.7 Valine, Leucine, and Isoleucine 449
21.2.8 Glutaryl Coenzyme A Accumulation 450
21.2.9 Cystinuria 450
21.2.10 Lysine 450
21.3 Disorders of Lipid Metabolism 450
21.3.1 Propionate and Methylmalonate 451
21.3.2 Carnitine 452
21.3.3 Other Abnormalities 453
21.4 Miscellaneous Genetic Diseases 454
21.5 Summary 454
References 457
Case Bibliography 458

Chapter 22 Nutritional and Metabolic Effects of Alcohol 459

22.1 Epidemiology 459
22.2 Absorption 460
23.3 Distribution 460
22.4 Nutritional Significance of Alcohol 460
22.5 Alcohol Metabolism 461
22.5.1 Cytosolic Alcohol Dehydrogenase Pathway 461
22.5.2 Microsomal Ethanol-Oxidizing System 462
22.5.3 Peroxisomal Catalase 462
22.6 Rate of Alcohol Metabolism 463
22.6.1 Gender Difference 463
22.6.2 Ethnic Difference 464
22.7 Metabolic Effects of Alcohol 465
22.8 Effect of Alcohol on the Body 466
22.8.1 Neurological Disorders 467
22.8.2 Liver 468
22.8.3 Cardiovascular System 468
22.8.4 Gastrointestinal Disorders 469
22.8.5 Immune System 469
22.8.6 Cancer 469
22.8.7 Fetus 469
22.9 Nutritional Implications 470
22.10 Health Benefits of Alcohol 471
22.11 Alcohol Dependency 472
22.12 Alternative Medicine for Alcoholism and Alcohol Hangover 473
22.12.1 Alcoholism 473
22.12.2 Alcohol Hangover 474
References 476
Case Bibliography 478

Chapter 23 Nutritional Epidemiology 479

23.1 Historical Perspective 479
23.2 Techniques/Approaches 480
23.2.1 Descriptive Studies 480
23.2.2 Correlation Studies 480
23.2.3 Observational Studies—Case–Control 481
23.2.4 Observational Studies—Cohort 483
23.2.5 Experimental Epidemiology 484
23.3 Epidemiological Measures 484
23.4 Significance of Epidemiological Studies 486
23.5 A Few Examples of Nutritional Studies 486
References 487

PART IV Special Topics

Chapter 24 Dietary Fiber 491

24.1 Fiber 491
24.1.1 Definition 491

24.1.2 Food Sources 491
24.1.3 Components of Dietary Fiber 491
24.1.4 Metabolism of Fiber 493
24.1.5 Physiological Effects 494
24.2 Fiber and Disease 494
24.2.1 Diseases of the Gastrointestinal Tract 494
24.2.2 Circulation-Related Diseases 496
24.2.3 Metabolic Diseases 497
24.2.4 Other Diseases 498
24.3 Recommendations for Fiber Intake 498
24.4 Overconsumption of Fiber 499
References 500

Chapter 25 Antioxidants and Health 503

25.1 Free Radicals 503
25.2 Formation of Free Radicals 503
25.3 Free Radicals in Biological Systems 504
25.4 Protection from Free Radicals 505
25.4.1 Antioxidant Enzymes 505
25.4.2 Antioxidant Small Molecules 506
25.5 Benefits of Free Radicals 507
25.6 Free Radicals and Diseases 508
25.6.1 Aging 509
25.6.2 Cancer 509
25.6.3 Cataracts 509
25.6.4 Cardiovascular Disease 510
25.6.5 Brain 510
25.6.6 Reperfusion Injury 511
25.6.7 Nitric Oxide and Disease 511
25.7 Large Doses of Antioxidants 512
References 513

Chapter 26 Toxicants Occurring Naturally in Foods and Additives 515

26.1 Toxicants in Food 515
26.1.1 Naturally Occurring Toxicants 515
26.1.2 Food Contaminants 516
26.1.3 Substances That Are Toxic under Special Conditions 522
26.1.4 Toxicants Produced during Cooking 523
26.1.5 Safety of Foods 524
26.2 Additives 526
26.2.1 Nitrites 528
26.2.2 Butylated Hydroxyanisole and Butylated Hydroxytoluene 528
26.2.3 Sulfites 529
26.2.4 Monosodium Glutamate 529
26.2.5 Diacetyl 530
26.2.6 Carmine and Cochineal 530
26.2.7 Intense Sweeteners 531
26.2.8 Fat Replacers 532
References 534
Case Bibliography 535

Chapter 27 Vegetarianism and Other Popular Nutritional Practices 537

27.1 Vegetarianism 537
27.1.1 Potential Risks 537
27.1.2 Potential Benefits 539
27.2 Mediterranean Diet 540
27.3 Kosher Diet 540
27.4 Zen Macrobiotic Diet 541
27.5 One-Emphasis Diets 541
27.6 Organically Grown Foods 541
27.6.1 Nutritional Superiority 542
27.6.2 Safety of the Food Supply 543
27.6.3 Taste 544
27.6.4 Cost 544
27.6.5 Standards for Organically Grown Products 544
27.7 Natural Foods 545
27.8 Health Foods 546
27.9 Megadoses of Vitamins and Nonvitamins 546
27.9.1 Megadoses of Vitamins 546
27.9.2 Nonvitamins 548
27.10 Hair Analysis 548
References 550
Case Bibliography 551

Chapter 28 Nutritional Aspects of Biotransformation 553

28.1 Detoxication Process 555
28.1.1 Phase I Reactions 555
28.1.2 Phase II Reactions 557
28.1.3 Miscellaneous Reactions 559
28.2 Factors Affecting Detoxication 560
28.2.1 Genetics 560
28.2.2 Age and Gender 561
28.2.3 Dietary Factors 563
28.2.4 Disease 564
References 565

Chapter 29 Nutraceuticals 567

29.1 Introduction 567
29.2 Interest in Nutraceuticals 568
29.3 Fruits and Vegetables with Health-Promoting Properties 570
29.3.1 Foods Rich in Fiber 571
29.3.2 Soybeans 572
29.3.3 Cruciferous Vegetables 574
29.3.4 Tomatoes, Autumn Olive Berries 575
29.3.5 Yellow and Dark Green Vegetables 575
29.3.6 Grapes 576
29.3.7 Berries 576
29.3.8 Cherries 577
29.3.9 Citrus Fruits 577
29.3.10 Evening Primrose Oil and Olive Oil 578

29.3.11 Garlic and Related Vegetables 579
29.3.12 Nuts 580
29.3.13 Tea 580
29.3.14 Chocolate 582
29.3.15 Miscellaneous Foods and Their Active Components 582
29.4 Need for Additional Research 583
29.5 Seafood 584
29.6 Use of Biotechnology in the Food Industry 584
29.6.1 Controversy Related to Genetically Modified Foods 585
29.6.2 Genetically Altered Animals Get Closer to the Table 586
29.7 Dietary Modulation of Colonic Microorganisms 587
29.7.1 Preparation of Yogurt at Home 588
References 590
Case Bibliography 591

Chapter 30 Alternative Medicine: Dietary Supplements 593

30.1 History of Supplement Regulation in the United States 594
30.2 Safety and Efficacy of Supplements 595
30.3 German Commission E Report 598
30.4 Beneficial Effects 598
30.5 Supplements 599
30.5.1 Supplements for Weight Loss 599
30.5.2 Coenzyme Q10 599
30.5.3 Dehydroepiandrosterone 599
30.5.4 Echinacea 600
30.5.5 Ginseng 600
30.5.6 Ginkgo 600
30.5.7 Glucosamine and Chondroitin Sulfate 601
30.5.8 Kava 601
30.5.9 Ma Huang 602
30.5.10 Melatonin 602
30.5.11 SAMe 602
30.6 Adverse Effects of Dietary Supplements 603
30.6.1 Herbal Ecstasy and Parkinson's Syndrome 604
30.6.2 Asian Herbal Medicines and Adverse Effects 604
30.6.3 Valerian and Withdrawal Symptoms 605
30.6.4 St. John's Wort and Adverse Reactions 605
30.6.5 Mu Tong and Nephropathy 607
30.6.6 Saw Palmetto and Liver Disease 607
30.6.7 Dong Quai and Hypertension 607
30.6.8 Kombucha Mushroom and Coagulation Disorder 608
30.6.9 Herb–Herb and Herb–Drug Interaction 608
30.6.10 Copper and Liver Toxicity 608
30.6.11 Creatine and Renal Function 609
30.6.12 Chromium Picolinate and Renal Failure 609
30.6.13 Tryptophan, 5-Hydroxytryptophan, and Eosinophilia–Myalgia Syndrome 609
30.7 Alternative Medicine and Cancer 610
30.8 Supplements and the Elderly—Is There a Need? 610
30.9 Why People Use Alternative Therapies 611

30.10 The Role of Physicians 611
30.11 Conclusion 612
References 614
Case Bibliography 615

Chapter 31 Gene–Nutrient Interaction—Molecular Genetics, Epigenetics, and Telomeres 617

31.1 Gene–Nutrient Interaction 617
31.1.1 Molecular Genetics 617
31.1.2 DNA Structure 617
31.1.3 Chromosomes 618
31.1.4 Genetic Code 618
31.1.5 Gene Structure and Function 618
31.1.6 Genetic Variations 620
31.1.7 Mitochondrial DNA and Inheritance 621
31.2 Effects of Nutrients on Gene Expression 622
31.3 Genetic Variation and Nutrition 622
31.4 Epigenetics 623
31.4.1 Effects of Environmental Factors on Gene Expression 624
31.4.2 Effect of Supplements during Pregnancy 624
31.4.3 Effect of Malnutrition during Pregnancy 625
31.4.4 Effect of Traffic Pollutants during Pregnancy 625
31.4.5 Effect of Environmental Chemicals during Pregnancy 625
31.4.6 Exposure to Environmental Chemicals and Obesity 626
31.4.7 Effect of Father's Exposure to High-Fat Diet on Female Offspring 626
31.5 Telomere 627
31.5.1 Structure and Function 627
31.5.2 Length 627
31.5.3 Telomere Length and Health 627
31.5.4 Factors That Accelerate Telomere Attrition 629
31.5.5 Factors That Slow Telomere Attrition 629
31.6 Longevity Based on Walking Speed 633
Definitions 634
References 634

Chapter 32 Personalized Nutrition and Personalized Medicine 637

32.1 Personalized Nutrition 637
32.1.1 Single Nucleotide Polymorphism 638
32.1.2 Nutrigenetics and Nutrigenomics 638
32.1.3 Personalized Dietary Recommendations 644
32.2 Pharmacogenetics 645
32.2.1 Warfarin 647
32.2.2 Codeine 649
32.2.3 Herceptin 649
32.3 Personalized Medicine 649
32.4 Genetic Testing Benefits and Concerns 650
References 652

Index 655