Contents

Preface ix

1 An Overview of Dietary Supplements and Functional Foods 1
   The evolving rationale for supplement use 1
   Adequacy and the prevention of deficiency diseases 1
   Diet as a means to prevent chronic, age and wealth-related diseases 3
   Supplements versus dietary change for the prevention of chronic disease 5
   Dietary supplements and natural remedies as a safer alternative to modern medicine? 7
   Defining dietary supplements 8
   Legal regulation of dietary supplements (the UK and EU perspective) 9
      Medicines 9
      Non-medicinal supplements 11
      Borderline products 11
      Health claims 12
      Vitamin and mineral supplements 15
   Regulation in the USA 18
   Supplement quality 19
   The market for supplements 20
   Reasons for taking supplements 22
      To compensate for a perceived or potential inadequacy in the diet 22
      To compensate for some perceived increase in need or defective handling of a nutrient 24
      To treat or prevent non-deficiency diseases 25
      To improve athletic performance 26
   Do supplements and functional foods work? Testing their effectiveness and safety 27
      Measures of outcome 27
   The two main investigative approaches 28
      The observational approach 28
      The experimental approach 34
   Testing: A summing up 49

2 An Overview of Micronutrient Adequacy 53
   Introduction and scope of the chapter 53
   Judging the adequacy of micronutrient intakes 53
### Contents

- A note about American standards 56
- Recommended daily allowances on food labels 57
- Measuring an individual's micronutrient status using clinical or biochemical observations 58
- Micronutrient adequacy of the UK population 60
  - Young and middle-aged adults 62
  - Children 69
  - Pregnant women 72
  - Lactating women 75
  - The elderly 76
  - Athletes in training 79
- Summing up 81

#### 3 The Individual Vitamins 83
- The fat-soluble vitamins 83
  - Vitamin A (retinol) 83
  - Vitamin D (cholecalciferol) 89
  - Vitamin E (α-tocopherol) 96
  - Vitamin K (phyloquinone) 97
- The water-soluble vitamins 99
  - Vitamin B<sub>1</sub> (thiamin) 99
  - Vitamin B<sub>2</sub> (riboflavin) 101
  - Vitamin B<sub>3</sub> (niacin) 102
  - Vitamin B<sub>6</sub> (pyridoxine) 103
  - Vitamin B<sub>12</sub> (cobalamins) 106
  - Folic acid (folate, folacin) 108
  - Biotin 113
  - Pantothenic acid 114
  - Vitamin C (ascorbic acid) 115

#### 4 The Minerals 119
- Calcium 122
- Chromium 126
- Copper 127
- Fluoride 128
- Iodine 130
- Iron 132
- Magnesium 136
- Manganese 138
- Molybdenum 139
- Potassium 140
- Selenium 141
- Zinc 142

#### 5 Free Radicals and Antioxidants 145
- Introduction 145
- The free radical or oxidant theory of disease 146
- Mechanisms for limiting free radical damage 149
- Diets with plentiful supplies of (antioxidant-rich) fruits and vegetables are associated with a reduced risk of chronic diseases 152
What evidence is there that antioxidant supplements are beneficial or at least harmless? 153
Antioxidants and pre-eclampsia in pregnancy 159
Vitamin E and dementia 159
Summing up the case for antioxidant supplements 159

6 Natural Fats and Oils 161
The nature of fats, oils and other lipids 161
Why are we preoccupied with the balance of our dietary fats? 163
Why are some fatty acids called 'essential'? 165
Essential fatty acids and eicosanoid production 169
Fish oil supplements 171
What are the suggested benefits of taking fish (liver) oil supplements? 172
Fish oil supplements and heart disease: Evidence of effectiveness 174
Evidence relating fish oils to inflammatory conditions such as arthritis 176
Fish oils, brain and behaviour 177
Evening primrose oil and other sources of GLA 178
Flaxseed oil 180
Conjugated linoleic acid (CLA) 181
β-sitosterol and the phytosterols 185

7 Non-Essential ‘Nutrients’ that are Used as Dietary Supplements 187
General rationale 187
Glucosamine and chondroitin sulphate 189
Nature and functions of cartilage 190
Supplement forms and origins 190
Rationale for use and evidence of effectiveness 191
s-Adenosyl-methionine (SAMe) 194
Nature and functions 194
Rationale for use and evidence of efficacy 194
Lecithin and choline 197
L-carnitine 198
Nature and synthesis of L-carnitine 198
Functions of carnitine 199
Circumstances that may increase carnitine requirements 200
Use of carnitine supplements 201
Carnitine supplements: Conclusions 202
Creatine 202
Nature and origins of body creatine 202
Functions of creatine 203
Rationale and evidence for the use of creatine supplements 203
Coenzyme Q₁₀ (ubiquinone) 204
Nature and sources of coenzyme Q₁₀ 204
Functions of coenzyme Q₁₀ 206
Rationale and evidence for the use of coenzyme Q₁₀ supplements 207
Alpha(α)-lipoic acid 209
Nature and sources of body alpha-lipoic acid 209
Functions of alpha-lipoic acid 210
Rationale and evidence for the use of alpha-lipoic acid supplements 210
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methylsulphonylmethane (MSM)</td>
<td>211</td>
</tr>
<tr>
<td>Nature and sources of MSM</td>
<td>211</td>
</tr>
<tr>
<td>MSM as a supplement</td>
<td>212</td>
</tr>
<tr>
<td><strong>8 Natural Products and Extracts</strong></td>
<td>213</td>
</tr>
<tr>
<td>Scope of the chapter</td>
<td>213</td>
</tr>
<tr>
<td>Secondary plant metabolites</td>
<td>214</td>
</tr>
<tr>
<td>Terpenoids</td>
<td>216</td>
</tr>
<tr>
<td>Phenolic compounds (phenols and polyphenols)</td>
<td>217</td>
</tr>
<tr>
<td>Nitrogen-containing alkaloids</td>
<td>219</td>
</tr>
<tr>
<td>Sulphur-containing plant secondary metabolites</td>
<td>220</td>
</tr>
<tr>
<td>How might these secondary metabolites reduce the risk of chronic disease?</td>
<td>221</td>
</tr>
<tr>
<td>Natural extracts as a source of drugs</td>
<td>223</td>
</tr>
<tr>
<td>The individual plant and animal extracts</td>
<td>224</td>
</tr>
<tr>
<td>Agnus castus</td>
<td>224</td>
</tr>
<tr>
<td>Aloe vera</td>
<td>225</td>
</tr>
<tr>
<td>Bee products</td>
<td>226</td>
</tr>
<tr>
<td>Chitosan</td>
<td>229</td>
</tr>
<tr>
<td>Echinacea</td>
<td>231</td>
</tr>
<tr>
<td>Garlic</td>
<td>232</td>
</tr>
<tr>
<td>Ginger</td>
<td>236</td>
</tr>
<tr>
<td>Ginkgo biloba</td>
<td>238</td>
</tr>
<tr>
<td>Ginseng</td>
<td>242</td>
</tr>
<tr>
<td>Guarana</td>
<td>245</td>
</tr>
<tr>
<td>Kelp</td>
<td>246</td>
</tr>
<tr>
<td>Milk thistle</td>
<td>247</td>
</tr>
<tr>
<td>Saw palmetto</td>
<td>250</td>
</tr>
<tr>
<td>Spirulina and chlorella</td>
<td>252</td>
</tr>
<tr>
<td>St John’s wort (Hypericum perforatum)</td>
<td>254</td>
</tr>
<tr>
<td>Tea extracts</td>
<td>260</td>
</tr>
<tr>
<td><strong>9 Functional Foods</strong></td>
<td>263</td>
</tr>
<tr>
<td>Introduction and scope of the chapter</td>
<td>263</td>
</tr>
<tr>
<td>A note about ‘superfoods’</td>
<td>265</td>
</tr>
<tr>
<td>Phytosterols and phytostanols</td>
<td>267</td>
</tr>
<tr>
<td>Phyto-oestrogens</td>
<td>271</td>
</tr>
<tr>
<td>Probiotics, prebiotics and synbiotics</td>
<td>277</td>
</tr>
<tr>
<td>Definitions and scale of usage</td>
<td>277</td>
</tr>
<tr>
<td>The lactic acid bacteria</td>
<td>278</td>
</tr>
<tr>
<td>Breast milk and the ‘bifidus factor’</td>
<td>279</td>
</tr>
<tr>
<td>What makes a good probiotic?</td>
<td>279</td>
</tr>
<tr>
<td>Suggested benefits of probiotics</td>
<td>280</td>
</tr>
<tr>
<td>Effect of probiotics on incidence and severity of diarrhoea</td>
<td>282</td>
</tr>
<tr>
<td>Possible effects of probiotics on the risk of developing bowel cancer</td>
<td>284</td>
</tr>
<tr>
<td>Probiotics and the prevention of childhood eczema</td>
<td>286</td>
</tr>
<tr>
<td>Prebiotics</td>
<td>287</td>
</tr>
<tr>
<td>Synbiotics</td>
<td>288</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>289</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>313</td>
</tr>
</tbody>
</table>