

Contents

List of figures	xi
List of tables	xiii
Biography	xvii
Preface	xix
Acknowledgments	xxi
1. Introduction	1
1.1 Mineral composition and radioactivity	4
1.2 Basic mycological terms	5
References	7
2. Overall outline of mineral composition	9
2.1 Factors affecting mineral element levels in fruiting bodies	9
2.1.1 Overall information	9
2.1.2 Bioaccumulation of mineral elements	10
2.2 Chemistry and biochemistry of mineral elements in fruiting bodies	13
2.3 Losses of minerals during mushroom preservation and cooking	15
2.4 Consumer health implications	16
2.5 Analytical determination of mineral elements	19
References	21
3. Major essential elements	25
3.1 Calcium (Ca)	26
3.2 Chlorine (Cl)	65
3.3 Magnesium (Mg)	65
3.4 Phosphorus (P)	66
3.5 Potassium (K)	67
3.6 Sodium (Na)	68
3.7 Sulfur (S)	69
3.8 Conclusion	69
References	70

4. Trace elements	75
4.1 Essential trace elements	76
4.1.1 Boron (B)	77
4.1.2 Cobalt (Co)	77
4.1.3 Copper (Cu)	90
4.1.4 Chromium (Cr)	106
4.1.5 Fluorine	115
4.1.6 Iodine (I)	115
4.1.7 Iron (Fe)	115
4.1.8 Manganese (Mn)	130
4.1.9 Molybdenum (Mo)	141
4.1.10 Nickel (Ni)	141
4.1.11 Selenium (Se)	154
4.1.11.1 <i>Level and bioconcentration in fruiting bodies</i>	154
4.1.11.2 <i>Speciation of selenocompounds</i>	157
4.1.11.3 <i>Biofortification</i>	158
4.1.11.4 <i>Bioavailability</i>	162
4.1.12 Silicon (Si)	163
4.1.13 Zinc (Zn)	163
4.1.14 Conclusion	180
4.2 Trace elements with detrimental health effects	181
4.2.1 Arsenic (As)	181
4.2.1.1 <i>Level in fruiting bodies</i>	181
4.2.1.2 <i>Bioconcentration in fruiting bodies</i>	188
4.2.1.3 <i>Speciation of arsenic compounds</i>	189
4.2.1.4 <i>Effects of mushroom cooking</i>	191
4.2.1.5 <i>Conclusion</i>	192
4.2.2 Barium (Ba)	192
4.2.3 Beryllium (Be)	192
4.2.4 Cadmium (Cd)	198
4.2.5 Lead (Pb)	210
4.2.6 Mercury (Hg)	221
4.2.6.1 <i>Distribution within fruiting bodies</i>	229
4.2.6.2 <i>Bioconcentration in fruiting bodies</i>	229
4.2.6.3 <i>Mercury speciation</i>	231
4.2.6.4 <i>Mercury shrinkage during mushroom storage and cooking</i>	233
4.2.7 Silver (Ag)	233
4.2.8 Thallium (Tl)	239
4.2.9 Estimation of intake of the main deleterious elements	239
4.3 Nutritionally nonessential elements	241
4.3.1 Aluminum (Al)	241
4.3.2 Antimony (Sb)	248
4.3.3 Bismuth (Bi)	249
4.3.4 Bromine (Br)	249
4.3.5 Cesium (Cs)	249
4.3.6 Gallium (Ga)	252

4.3.7 Germanium (Ge)	252
4.3.8 Gold (Au)	252
4.3.9 Indium (In)	253
4.3.10 Lithium (Li)	253
4.3.11 Platinum group elements	256
4.3.12 Rare-earth elements	258
4.3.13 Rhenium (Re)	258
4.3.14 Rubidium (Rb)	261
4.3.15 Strontium	261
4.3.16 Tellurium (Te)	270
4.3.17 Thorium (Th)	270
4.3.18 Tin (Sn)	270
4.3.19 Titanium (Ti)	271
4.3.20 Uranium (U)	272
4.3.21 Vanadium (V)	272
4.3.22 Zirconium (Zr)	279
4.3.23 Elements with very limited data	279
4.3.24 Conclusion	279
References	280
Further reading	298
5. Radioactivity	299
5.1 Radioactivity units and legislation	300
5.2 Methods of radioactivity measurement	301
5.3 Radionuclide concentration in mushrooms	302
5.3.1 Naturally occurring radionuclides	302
5.3.2 Anthropogenic radionuclides other than radiocesium	308
5.3.3 Anthropogenic radiocesium until 1985	308
5.3.4 Mushroom radioactivity after the Chernobyl disaster	309
5.3.4.1 Chernobyl disaster	309
5.3.4.2 Mushroom radioactivity between 1986 and 2000	309
5.3.4.3 Mushroom radioactivity since 2001	311
5.3.5 Mushroom radioactivity after the Fukushima disaster	317
5.4 Parameters affecting radiocesium transfer from soils to mushrooms	318
5.5 Distribution of radiocesium in fruiting bodies	318
5.6 Decrease of mushroom radioactivity by culinary treatments	319
5.7 Radioactivity burden due to mushroom consumption	320
5.8 Radiocesium in meat of game feeding mushrooms	320
5.9 Conclusions	321
References	322
6. Conclusion	327
6.1 Overall outline of mineral composition	328
6.2 Major essential elements	330

x Contents

6.3 Essential trace elements	331
6.4 Detrimental trace elements	333
6.5 Nutritionally nonessential elements	336
6.6 Radioactivity	336
6.7 Prospects	338
Appendix I: List of abbreviations	341
Appendix II: Commonly used Japanese names of mushrooms	343
Appendix III: List of images	345
Index of Mushroom Species	357
Subject Index	363