INDEX

Accessory food factors, in nutrition, 23 Aconitase, in Lentinus edodes, 48 AC-PS polysaccharide, immunomodulatory effects of, 168 Acquired immunodeficiency syndrome (AIDS), mushrooms and, 21-22 Active ingredients, WHO guidelines and, 202 Adenocarcinoma, antimetastatic effects on, 171 Adenosine diphosphate (ADP), in Lentinus edodes, 45 Adenosine triphosphate (ATP), in Lentinus edodes genetics, 53 AER bill, 208 Aerobic pathways, in Lentinus edodes, 48 Africa, mushroom production in, 73 Agaricaceae, classification of, 80 Agaricales, 35 classification of, 80 Agaricus cultivation of. 14 in developing countries, 22 US regulation of dietary supplements from, 204Agaricus bisporus antioxidants in, 92 antitumor polysaccharides from, 156 ash and mineral content of, 76 classification of, 80 cultivation of, 14, 18 dietary fiber in, 77 edibility of, 4 energy content of, 78 hypocholesterolemic effects of, 97 hypolipidemic effects of, 95 moisture content of, 73 in mushroom industry, 26 mushroom-related hypoglycemia and, 98-99 protein quality of, 88 US regulation of HMBD from, 204

vitamin content of, 76-77 world production of, 73 Agaricus bitorquis, cultivation of, 14 Agaricus blazei, 18, 85, See also Agaricus brasiliensis antimetastatic effects of, 172 antitumor polysaccharide-protein complexes from, 158, 160, 164 antitumor polysaccharides from, 154, 155, 156 chemical composition of, 82 classification of, 80 FWE water extract from, 158, 172 polysaccharide-protein complex from, 167 polysaccharides isolated from, 148, 150-151 world production of, 72, 73 Agaricus blazei Murill (ABM), immunomodulatory effects of, 164. See also Agaricus murrill Agaricus brasiliensis. See also Agaricus blazei antitumor polysaccharides from, 154 bed preparation for, 18-19 biology and genetics of, 18 cultivation of, 18-19 polysaccharides isolated from, 151 Agaricus campestris anatomy of, 3 mushroom-related hypoglycemia and, 98-99 Agaricus macrosporus, protein quality of, 88 Agaricus murrill, antiangiogenesis and, 173. See also Agaricus blazei Murill (ABM) Agaritine, US regulation of, 204 Agriculture applied mushroom biology and, 9 biomass waste from, 10-11 mushroom cultivation as, 11-12 Agrocybe aegerita, 58, 84 chemical composition of, 82 classification of, 80 hypocholesterolemic effects of, 97 world production of, 72, 73

Mushrooms as Functional Foods. Edited by Peter C. K. Cheung Copyright © 2008 John Wiley & Sons, Inc. Agrocybe chaxinggu, 85 chemical composition of, 82 classification of, 80 Agrocybe cylindracea antioxidants in, 90 antitumor polysaccharides from, 154 chemical improvement of antitumor polysaccharides from, 176 mushroom-related hypoglycemia and, 98 protein and amino acid content of, 74-75 Air filters, in Wolfiporia cocos cultivation, 121 Akavia, Eden, xxi, 199 Alanine, in conventional edible mushrooms, 74, 75 Alkaloids, in mushrooms, 88 α -glucans in chemical improvement of antitumor activity, 176-177 from mushrooms, 157 α -tocopherol, in mushroom antioxidant assays, 90.92 Alternative herbal substances, European Union regulation of, 209 Amanita, toxicity of, 6 Amanita muscaria anatomy of, 3 antitumor polysaccharides from, 154 chemical improvement of antitumor polysaccharides from, 176 Amanita phalloides, as poisonous, 4 Amatoxin, 6 American Diabetic Association (ADA), on sclerotial dietary fiber, 124 American Herbal Products Association (AHPA), 205Amimethylation, in chemical improvement of antitumor activity, 176 Amino acids in conventional edible mushrooms, 74-75 in cultivated mushroom dietary fiber, 77 in dietary supplements, 200 during early sclerotial ontogeny, 115 in mushrooms, 88-89 Amplified fragment length polymorphisms (AFLPs), in generating Lentinus edodes molecular markers, 48, 49, 50 Anaerobic pathways, in Lentinus edodes, 48 Anaerobic saccharolytic microflora, colonic fermentation and, 129, 130 Androgen receptor (AR), 157 Angiogenesis, 172 Antiangiogenesis, 179 as antitumor mechanism, 172-173 Antiatherosclerotic effects, of mushrooms, 96

Anticancer preparations, regulation of mushroom, 199-200 Anticonvulsant medications, folic acid and, 217 Antidiabetic drugs, mushroom-related hypoglycemia and, 99 Antigenotoxicity, 179 Antigen-presenting cells (APCs), dendritic cells as. 168 Antimetastasis, 179 as antitumor mechanism, 171-172 Antioxidants, in mushrooms, 89-94 Antiproliferation of cancer cells, as antitumor mechanism, 153-161 Antisclerotic effects, of mushrooms, 94 Antitumor effects of mushroom polysaccharides, 147-198 of sclerotia, 132-134 of Wolfiporia cocos, 120 Antitumor polysaccharide-protein complexes, from mushrooms, 158-159 Antitumor polysaccharides, from mushrooms, 154 - 157Antrodia camphorata, polysaccharide from, 168 Antrodia cinnamomea, antiangiogenesis and, 173 Antrodia malicola, antiangiogenesis and, 173 Antrodia xantha, antiangiogenesis and, 173 Antrodiella liebmannii, antiangiogenesis and, 173 Aphyllophorales, 119 classification of, 80 Apoptosis, 157, 159, 160, 168, 179 antimetastatic effects on, 171 as antitumor mechanism, 153-161 polysaccharides and, 148, 150, 152 Applied mushroom biology, 6, 7-11, 28-29 impact of, 9-11 Arabinogalactan, from mushrooms, 156 Arabinoglucan, from mushrooms, 155 Arabitol, in cultivated mushrooms, 78 Arbitrary primer polymeric chain reactions (AP-PCRs), in generating Lentinus edodes molecular markers, 48, 49, 50, 51, 61 Arginine, in conventional edible mushrooms, 74 Armillariella mellea, hypolipidemic effects of, 95 Armillariella tubescens antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154 Aromatic compounds biosynthesis of, 93 in conventional edible mushrooms, 75 Artificial cultivation, of Ganoderma lucidum, 19

Ascomycetes, 3, 149 Ascomycota, classification of, 80 Ascomycotina, sclerotia of, 112 Ash. See also Minerals in conventional edible mushrooms, 75-76 in nonconventional edible mushrooms, 79, 81 in sclerotia, 123-124 Asia Lentinus edodes from, 35 medicinal mushroom uses in, 25 medicinal uses of mushroom polysaccharides in. 147, 150 mushroom production in, 22, 23, 73 Asiaticusins A/B, as mushroom antioxidants, 91, 92 Aspartic acid, in conventional edible mushrooms, 74 Aspergillus candidus, biosynthesis of phenolic compounds by, 93-94 Aspergillus oryzae, 56, 57 Aspergillus terreus, hypolipidemic effects of, 95 Atherosclerosis, hypercholesterolemia and, 94 Atkins, F. C., 26 ATOM polysaccharide-protein complex, 160, 167 Auricularia, world production of, 72, 73 Auricularia auricula antitumor polysaccharides from, 154 dietary fiber in, 77 hypolipidemic effects of, 95 Auricularia auricula-judae branching configurations of polysaccharides from, 175 hypocholesterolemic effects of, 97 mushroom-related hypoglycemia and, 98 Auricularia fuscosuccinea, world production of, 73 Auricularia polytricha, hypolipidemic effects of, 95 Australia, 220 introducing medicinal-mushroom dietary supplements in, 211-212 Australia New Zealand Food Authority (ANZFA), 201, 211-212 Australia New Zealand Food Standards Council. 211-212 Australian Parliament, 211 Authorized health claims, 206 Autotrophic agents, sclerotial ontogeny and, 113 Bacillus subtilis, 56, 57

Bakery products, sclerotial dietary fiber for, 128
 Barley dietary fiber, sclerotial dietary fiber versus, 126–127

Barrier, rind as, 116 Basic fibroblast growth factor (bFGF), antiangiogenesis and, 172 Basidiomycetes, 3, 149 biosynthesis of phenolic compounds by, 93 cell walls of, 121-122 dietary fiber in, 77 life cycles of, 37 proximate composition of, 124 Basidiomycota, 35 classification of, 80 Basidiomycotina, 119 sclerotia of, 112, 118 Basidiospore formation, in Lentinus edodes, 44 - 47Basidiospores, of Lentinus edodes, 14, 37, 38 B cells, dendritic cells and, 168 Beds, in Agaricus brasiliensis cultivation, 18-19 Befungin, regulation of, 200 Benzoic acid, biosynthesis of, 93 β -carotene bleaching, in mushroom antioxidant assays, 90 β -glucans, 179 antitumor and immunomodulatory effects of sclerotial, 132-134 branching configurations of, 174-175 in chemical improvement of antitumor activity, 176-177 colonic fermentation and, 130 conformations of, 175-176 in cultivated mushroom dietary fiber. 78 D-fraction, 167-168 effects on hematopoietic stem cells, 170-171 grifolan and, 165-166 in immune response, 162 in vivo Ca/Mg absorption and, 132 mushroom-related hypoglycemia and, 98 from mushrooms, 150, 151, 152, 153, 154-155, 157 schizophyllan and, 165 in sclerotial dietary fiber, 125 β -glucopyranosides, from mushrooms, 150 β -glucosidases, in mushrooms, 10 β oxidation, in biosynthesis of phenolic compounds, 93 Biochemistry, of sclerotia, 121-123 Biochemopreventives, regulation of, 200 Bioconversion efficiency, of mushrooms, 22 Bioconversion processes, mushrooms in, 11 Bioconversion technology, mushrooms in. 9 Biological efficiency, of mushrooms, 22 Biological response modifiers (BRMs) mushroom products as, 201 polysaccharides and, 148, 161-162, 178

Biology of mushrooms, 6-11, 28-29 specialization in, 7 Biomacromolecules, polysaccharides as, 148 Biomass by-products, reuse of, 28 Biomass wastes, applied mushroom biology and, 9,10-11,28 Biopharmacology mushroom polysaccharides in, 147-148 of sclerotia, 128-134 Bioprocessing, mushrooms and, 8, 23, 28 Bioremediation, mushroom, 7, 8, 9, 11, 28 **Biosynthesis** by mushrooms, 10-11, 28of phenolic compounds from fungi, 93-94 Biotechnology, mushroom, 7-8, 9, 23-25 Bitter components, in conventional edible mushrooms, 75 Black truffle, 72 BLASTX, in Lentinus edodes genetics, 54 Blood vessels, in angiogenesis, 172 Bolbitiaceae antioxidants in, 90 classification of, 80 Boletes, 72 Boletinus asiaticus, antioxidants in, 92 Boletus, 72 ash and mineral content of, 76 energy content of, 78 Bone marrow cells (BMCs), 170 Botanical products/botanicals in dietary supplements, 200 regulation of, 218 safety of, 215 Botryotinia, sclerotia of, 112 Botrytis, lipid bodies in, 123 Botrytis cinerea, lipid bodies in, 123 Botrytis fabae, lipid bodies in, 123 Bottles, in Ganoderma lucidum cultivation, 20 Bowel function, in colonic fiber fermentation, 129 Bran, sclerotial dietary fiber versus, 127 Branching configuration, of antitumor polysaccharides, 174-175 Brazil, Agaricus brasiliensis cultivation in, 18 Breast cancer/carcinoma chemical improvement of antitumor activity versus, 176 GLP effects on, 163 mushroom polysaccharides versus, 151, 159 Brown rot fungus, Wolfiporia cocos as, 120-121 Burkitt lymphoma, mushroom polysaccharideprotein complexes versus, 160

CAAT box, in Lentinus edodes transcriptional regulation, 55-56 Cadmium, in cultivated mushrooms, 76 Caffeic acid biosynthesis of, 93 as mushroom antioxidant, 92 Calcium in cultivated mushrooms, 76 in vitro sclerotial binding of, 128-129 in mushrooms, 24 in nonconventional edible mushrooms, 79 in sclerotial dietary fiber, 125 Calcium absorption, by sclerotia, 131-132 Calories, in mushrooms, 23-24 Canada, 220 food safety systems in, 219-220 introducing medicinal-mushroom dietary supplements in, 210-211 mushroom nutriceutical regulation in, 201 Cancer cell antiproliferation, as antitumor mechanism, 153-161 Cancer therapy, mushrooms and, 25 Cantharellus cibarius, 72 ecological classification of, 5 Cap, in mushroom identification, 5 Carbohydrate biosynthesis, in Lentinus edodes, 45 Carbohydrates in conventional edible mushrooms, 78 in mushrooms, 24 in nutrition, 23 in sclerotia, 123 during sclerotial development, 114, 115 sclerotial extracellular matrix and, 122 Carbon dioxide, in Agaricus cultivation, 14 Carboxymethylated β -glucan (CMPTR), from mushrooms, 152-153, 159 Carboxymethylation (CM), in chemical improvement of antitumor activity, 176 Carcinogenesis, effects of lentinan on, 165 Carcinoma, polysaccharide-protein complexes versus, 160, 167 Cardiotonic agent, Wolfiporia cocos as, 120 Cardiovascular disease edible mushrooms and, 71 hypercholesterolemia and, 94 Carmustine (BCNU), mushroom polysaccharides and, 150, 157 β -Carotene bleaching, in mushroom antioxidant assays, 90 Casein, protein quality of, 88 Cbx^{R} marker, in Lentinus edodes transformation, 58

cDNA clones, in Lentinus edodes genetics, 54. See also Complementary DNA (cDNA) cDNA microarray, in Lentinus edodes genetics, 36, 51, 53-54 cDNA representational difference analysis (cDNA-RDA), of Lentinus edodes, 51, 52, 61. See also Representational difference analysis (cDNA-RDA) cDNA sequencing, in Lentinus edodes sequencing by synthesis, 55 Cel genes, in Lentinus edodes, 60 Cell cycle control genes, of Lentinus edodes, 40 endo-Cellobiohydrolase, Lentinus edodes and, 36 exo-Cellobiohydrolase, Lentinus edodes and, 36 Cellobiohydrolases, in mushrooms, 10 Cellulase Lentinus edodes and, 36-57 in mushrooms, 10 Cellulase genes, in Lentinus edodes, 46 Cellulose in biomass waste, 10 Lentinus edodes degradation of, 36, 60 from mushrooms, 149 in Wolfiporia cocos cultivation, 121 Cellulose control, in vivo Ca/Mg absorption and, 131 Cell walls in mushroom sclerotia, 121-122 as source of antitumor polysaccharides, 149 Center for Food Safety and Applied Nutrition (CFSAN), 203 Office of Nutritional Products, Labeling, and Dietary Supplements, 205-206 Cerebrospinal fluid (CSF), effects of lentinan on, 165 Chang, Shu-Ting, xxi, 1, 27 Chanterelles, 72 Characteristics, for mushroom identification, 5 Cheese, protein quality of, 88 Chemical improvement, of antitumor polysaccharides, 176-177 Chemical tests, in mushroom identification, 5 Chemistry, in mushroom cultivation, 20 Chemotaxis, GLP effects on, 164 Chemotherapy, mushrooms and, 25 Cheung, Peter C. K., xxi, xvii, 71, 111 China Agaricus brasiliensis cultivation in, 18 food safety in, 215 Ganoderma lucidum cultivation in, 19 Lentinus edodes from, 35 mushroom production in, 21 mushroom sclerotia production in, 117

mushroom species in, 1-2 Pleurotus tuber-regium consumption in, 118 Polyporus rhinocerus consumption in, 119 total mushroom production in, 72-73 Volvariella cultivation in, 17-18 wild and cultivated edible mushrooms from. 72.73 Wolfiporia cocos consumption in, 120-121 Chinese medicine mushroom uses in, 25, 147 shiitake mushroom in, 215 Chitin in cultivated mushroom dietary fiber, 77, 78 dietary fiber and, 124, 125 from mushrooms, 149 in sclerotia, 124 in sclerotial cell walls, 122 Chitinase, Lentinus edodes and, 36 Chitosan from mushrooms, 149 in sclerotia, 124 Chlorflavonin, biosynthesis of, 93-94 Chlorophyll, as lacking in mushrooms, 10 Cholesterol biosynthesis, mushrooms as reducing, 96--97 Chromosomal DNA, in Lentinus edodes transformation, 57-58. See also Deoxyribonucleic acid (DNA) Chum, Winnie W. Y., xxi, 35 Cinnamic acid, biosynthesis of, 93 trans-Cinnamic acid, as mushroom antioxidant, 92 Citrate cycle, in Lentinus edodes, 48 Citrate synthase, in Lentinus edodes, 48 Citrinin, in mushrooms, 91-92 Classical Chinese medicine, shiitake mushroom in. 215 Classification, of edible mushrooms, 80 Claviceps purpurea, sclerotia of, 112 Clones, in Lentinus edodes genetics, 52 CMHAE carboxylated β -glucans, in chemical improvement of antitumor activity, 177 Codex Alimentarius, on introducing medicinal-mushroom dietary supplements, 202 - 203Codex Alimentarius Commission, 202-203 in nutritional evaluation, 87 Codex Committee on Vegetable Proteins (CCVP), in nutritional evaluation, 87 Cold shock, in Lentinus edodes primordium formation. 38 Collybia confluens, antitumor polysaccharide-protein complexes from, 158

Collybia dryophila, antitumor polysaccharides from, 154 Collybia dryophila polysaccharide (CDP), 164 Collybia maculata, antitumor polysaccharides from, 156 Colonic fermentation, of dietary fiber, 129-131 Colonic pH, in colonic fiber fermentation, 129-130 Colony formation unit of granulocyte macrophages (CSU-GM), MBG treatment and, 170 Color. See also Pigmentation; Pigments in mushroom identification, 5 of Polyporus rhinocerus, 119 of sclerotial dietary fiber, 126 of Wolfiporia cocos, 120 Color change of cortex, 116 of rind, 116 Column packing, in Pleurotus cultivation, 17 Comfrey, safety of, 216 Commercial-scale cultivation, of Lentinus edodes, 16 Competitive microorganisms, in mushroom cultivation, 13 Complementary DNA (cDNA), in Lentinus edodes genetics, 36, 43, 44. See also cDNA entries Complement receptor 3 (CR3), in immune response, 162 Compost for Pleurotus tuber-regium, 118-119 for Polyporus rhinocerus, 119-120 for Wolfiporia cocos, 121 Compost preparation phase for Agaricus mushrooms, 14 in mushroom cultivation, 12, 13 Compost technology, mushrooms and, 8 Conducting hyphae, during sclerotial development, 114 Conformation, of antitumor polysaccharides, 175 - 176Congress, DSHEA and, 204 Conservation, in mushroom cultivation, 21 Copper in cultivated mushrooms, 76 in vitro sclerotial binding of, 128-129 in sclerotial dietary fiber, 125 Coprinaceae, classification of, 80 Coprinopsis cinerea, 44, 56. See also Coprinus cinereus Coprinus cinereus, 57, 59. See also Coprinopsis cinerea Coprinus comatus, 85

chemical composition of, 82 classification of, 80 world production of, 73 Cord blood (CB) cells, 170 Cordyceps, xvii Cordyceps ophioglossoides, antitumor polysaccharide-protein complexes from, 158 Cordyceps sinensis antiangiogenesis and, 172 antimetastatic effects of, 172 antitumor polysaccharides from, 154 FWE water extract from, 158, 171 hypolipidemic effects of, 95 Cordyglucan, from mushrooms, 154 Coriolus (Trametes) versicolor. See also Trametes versicolor antiangiogenesis and, 172 antimetastatic effects of, 171, 172 antitumor polysaccharide-protein complexes from, 158, 159-160 FWE water extract from, 158, 171 medicines from, 25 polysaccharides isolated from, 148, 150 PSK polysaccharide from, 166-167, 169-170 Coriolus hirsutus, 57, 59 Cortex, structure of, 115, 116-117 Cottage-scale cultivation, of Lentinus edodes, 16 Council for Responsible Nutrition (CRN), 204 Cristulariella, during early sclerotial ontogeny, 115 Crop frequency, in Agaricus cultivation, 14 Cross breeding, of Lentinus edodes, 56, 57 Crude protein in conventional edible mushrooms, 74 in nonconventional edible mushrooms, 79 in sclerotia, 123-124 CT-rich sequence element, in Lentinus edodes transcriptional regulation, 55-56 Culinary-medicinal products, types of, 201 Cultivated edible mushrooms, 72, 73. See also Edible mushrooms; Newly developed cultivated mushrooms in mushroom industry, 2 species of, 71 world production of, 72-73 Cultivation. See also Mushroom cultivation of Pleurotus tuber-regium, 118-119 of Polyporus rhinocerus, 119-120 of sclerotia, 117-121 of Wolfiporia cocos, 121 Cultivation substrate. See also Substrate entries in Agaricus brasiliensis cultivation, 18-19

in Ganoderma lucidum cultivation, 19-20 in Pleurotus cultivation, 17 Culture filtrates, of mushrooms, 149 Culture media, in Lentinus edodes cultivation, 15 Culturing, submerged, 219 Curvulic acid, in mushrooms, 91, 92 Cyclic adenosine monophosphate (cAMP), in Lentinus edodes primordium formation, 38 Cyclin B, in Lentinus edodes genetics, 52 Cyclins, from mushrooms, 159, 161 Cyclophosphamide (CP), 170-171 immunomodulatory effects of, 164 Cystathionine, mushroom-related hypocholesterolemia and, 94 Cysteine in conventional edible mushrooms, 74, 75 in mushroom protein, 88, 89 Cytarabine, 160 Cytochrome P450, Lentinus edodes and, 44 Cytokine expression, mushroom polysaccharides and, 151 Cytokine production, antitumor and immunomodulatory effects and, 132, 133 Cytokines, 178 AC-PS effects on, 168 in angiogenesis, 172 antimetastatic effects on, 171 dendritic cells and, 168-169 effects of lentinan on, 165 effects of PG101 and, 165 effects of PSK and, 167 GLP effects on, 163 in immune response, 162 mushroom polysaccharide effects on, 167 - 168polysaccharides and, 148 Cytoplasm glycogen in hyphal, 122 in rind cells, 116 Cytoplasmic reserves, of sclerotia, 122-123 Cytotoxicity, 178, 179 as antitumor mechanism, 153, 159 of polysaccharide-protein complexes, 160-161 Cytotoxic lymphocytes, in immune response, 161 - 162Cytotoxic properties, of Wolfiporia cocos, 120 Cytotoxic responses, polysaccharides and, 148, 150

Dampness, mushrooms and, 2-3
Daniella oliveri, as Pleurotus tuber-regium compost, 119
Databases, in mushroom cultivation, 21

Death, food safety and, 215-216. See also Apoptosis Debydropachymic acid, in Wolfiporia cocos cultivation, 121 Dectin-1 in immune response, 162 in sclerotial antitumor and immunomodulatory studies, 133 Dehydrogenases, in Lentinus edodes, 48, 53 Dendritic cells (DCs) in immune response, 161-162 mushroom polysaccharides and, 150, 163, 168 - 170in sclerotial antitumor and immunomodulatory studies, 133 Denmark, food safety systems in, 219-220 Deoxyribonucleic acid (DNA). See also Complementary DNA (cDNA); DNA entries; Mitochondrial DNA (mtDNA) RFLPs; Recombinant DNA (rDNA) in Lentinus edodes particle bombardment transformation, 57-58 in mushroom cultivation, 20 Department of Food and Dietary Services (Israel), 214 Department of Health and Human Services (DHHS), 208 Descriptions, in mushroom identification, 6 Desert truffle, 2 Designer foods, regulation of, 200 Deuteromycotina, sclerotia of, 112 Developing countries mushroom harvests in, 22 mushrooms in, 72 Developmental structural proteins, in Lentinus edodes, 48 Development stage, of sclerotial ontogeny, 113-114, 114-115 D-fraction grifolan and, 165, 166 immunomodulatory effects of, 167-168 regulation of, 200 Diabetes, 207 edible mushrooms and, 71 mushrooms in treatment of, 97-99 Dictyophora indusiata antioxidants in, 90 antitumor polysaccharides from, 154, 156 carbohydrate content of, 78 dietary fiber in, 77 fat content of, 75 moisture content of, 74 Dietary enrichment, via mushroom cultivation, 21, 22, 23

Dietary fiber (DF). See Fiber Dietary food supplements mushroom polysaccharides as, 147-148 mushrooms as, 23, 24-25 Dietary protein shortages, mushrooms as alleviating, 80 Dictary Supplement and Nonprescription Drug Consumer Protection Act of 2006, 208 Dietary Supplement Guide, 205-206 Dietary supplement pyramid, 200 Dietary supplements (DSs) in Australia and New Zealand, 211-212 in Canada, 210-211 in European Union, 208-210 in Israel, 214-215 in Japan, 212-214 regulation of, 200-201 safety and diversity of, 215-218 US regulation of, 204-208 Dietary Supplements Health and Education Act (DSHEA), 200, 204, 205 Differential display, in Lentinus edodes genetics, 51 - 52Differential gene expression, in Lentinus edodes, 38 Dihydrochalcone, biosynthesis of, 93-94 Dikaryotic mycelia, of Lentinus edodes, 37, 38 - 44Dimethyl suulfoxide (DMSO), 175 Direct cytotoxicity, 179. See also Direct toxicity as antitumor mechanism, 153 Directives, on European dietary supplements, 209.210 Direct toxicity, of nutrients, 216-217. See also Direct cytotoxicity Disease, defined, 205 Ditags, in Lentinus edodes genetics, 52 Diversity, 220 of dietary supplement types, 215-218 of polysaccharides, 148 DNA fingerprints, for Lentinus edodes, 49-50. See also Deoxyribonucleic acid (DNA) DNA fragments, in Lentinus edodes sequencing by synthesis, 54-55 DNA helicases, in Lentinus edodes, 46 DNA microarray analysis, in Lentinus edodes genetics, 36, 51, 53-54, 61 DNA synthesis, in Lentinus edodes, 45 Dolichos lablab, protein quality of, 88 Dormancy, in sclerotial ontogeny, 114 Dosages, WHO guidelines and, 202 Dot-blot hybridization, in Lentinus edodes genetics, 54 Doxorubicin (DOX), 157, 170

DPPH radical scavenging, in mushroom antioxidant assays, 90 Drug abuse, US regulations and, 208 Drug approval, 218 Drugs, safety of, 215 Drug withdrawal, US regulations and, 208 Dry matter (DM), in sclerotia, 123-124 Dry mushrooms, moisture content of, 74 Ecological classification, of mushrooms, 4, 5 Ecology, mushrooms in, 9 Economic importance, of mushrooms, 72, 73 Edible mushrooms, 3, 4, See also Cultivated edible mushrooms; Wild edible entries classification of, 80 distinguishing from poisonous, 6 health benefits of, 71, 89-99 international movement for, 26, 27 in mushroom industry, 26 nutritional composition of, 73-79, 81-87 wild and cultivated, 72, 73 Edible mycorrhizal mushrooms, international movement for, 27 Egusi, Pleurotus tuber-regium in, 118 Ehrlich carcinoma, mushroom polysaccharide-protein complexes versus, 160 Elaeis guineensis, as Pleurotus tuber-regium compost, 119 Electroporation, for Lentinus edodes transformation, 58 ELN3 protein, Lentinus edodes and, 44 Emulsification, of sclerotial dietary fiber, 126 Emulsifying activities (EA), of sclerotial dietary fiber, 126, 127-128 Emulsion stability (ES), of sclerotial dietary fiber, 126, 128 endo-cellobiohydrolase, Lentinus edodes and, 3 Endocytosis genes of Lentinus edodes, 42 in Lentinus edodes yeast two-hybrid analysis 54 Endogenous factors, during sclerotial ontogeny, 113 Endoglucanases, in mushrooms, 10 Endoplasmic reticulum (ER), in rind cells, 116 Energy from conventional edible mushrooms, 78 from nonconventional edible mushrooms, 79 Energy demand, in Lentinus edodes, 44 Energy production, in *Lentinus edodes*, 47-48 Energy production genes, of Lentinus edodes, 4 Energy sources, in nutrition, 23

Enokitake mushroom, hypocholesterolemic effects of, 97 Environment applied mushroom biology and, 9, 11 in mushroom identification, 5 population growth and, 10, 28 Environmental decontamination, via mushroom cultivation, 21 Environmental shocks, in mushroom cultivation. 12 Environmental technology, mushrooms and, 8 Enzymatic pH-stat assays, in nutritional evaluation, 87 Enzymes during early sclerotial ontogeny, 115 of Lentinus edodes, 36-37 in Lentinus edodes energy production, 48 in Lentinus edodes screening, 52 in Lentinus edodes SAGE and LongSAGE, 52 - 53in Lentinus edodes transformation, 57-58 in Lentinus edodes wood degradation, 60 in lignin degradation, 60 in mushrooms, 10-11 in sclerotial cell walls, 122 in sclerotial dietary fiber preparation, 126 Epigallocatechin 3-gallate, as mushroom antioxidant, 92 EPSF (exopolysaccharide fraction) antiangiogenesis and, 172 antimetastatic effects of, 172 Equipment, in Lentinus edodes cultivation, 16 Ergocalciferol, in cultivated mushrooms, 77 Eritadenine hypocholesterolemic effects of, 94 molecular structure of, 96 Erythrocyte hemolysis, in mushroom antioxidant assays, 90 Erythroleukemia, mushroom polysaccharides versus, 153 Escherichia coli, 57, 58 Essence of Mushrooms capsules, FDA detention of. 206 Essential amino acids, in conventional edible mushrooms, 74 Essential nutrients, in mushroom cultivation, 13 Eumycota, 119 Europe. See also European Union introducing medicinal-mushroom dietary supplements in, 203 mushroom nutriceutical regulation in, 201 wild and cultivated edible mushrooms from. 72,73

European Commission (EC), quality standards of, 209 European Community, 220 European Court of Justice, on dietary supplements, 210 European Food Supplements Directive, 203 European Union, introducing medicinal-mushroom dietary supplements in. 208-210 Eurotium chevalieri, antioxidants in, 91, 92 exg1 gene, in Lentinus edodes, 46 exg genes, in Lentinus edodes, 59 exo-cellobiohydrolase, Lentinus edodes and, 36 Exogenous factors, during sclerotial ontogeny, 113 Exopolymers, in mushroom-related hypoglycemia, 98, 99 Exopolysaccharide (EPS), 151 Experts, in mushroom identification, 6 Expressed sequence tags (ESTs), in Lentinus edodes genetics, 36, 50, 51, 53, 54 Ex situ conservation, in mushroom cultivation, 21 Extracellular enzymes, of Lentinus edodes, 36 - 37Extracellular matrix interhyphal space and, 115 of sclerotia, 122 Extract of Ganoderma lucidum polysaccharide (EORP), AC-PS effects on, 168 Exudation, during early sclerotial ontogeny, 115 Fat(s) in conventional edible mushrooms, 75, 81 in mushrooms, 23 in nutrition, 23 Fatty acid desaturases, in Lentinus edodes, 45 Fatty acids in conventional edible mushrooms, 75, 80 during early sclerotial ontogeny, 115 in mushrooms, 24 Federal Food, Drug, and Cosmetic Act, 204, 206.208 Federal Trade Commission (FTC), 203 Fermentability, of sclerotia, 129-131 Fermentation in Agaricus cultivation, 14 in mushroom cultivation, 10-11 Fermentation products, regulation of, 218 Fermentation technology, mushrooms and, 8, 23 Fiber in conventional edible mushrooms, 77-78 hypocholesterolemic effects of, 96, 97 of sclerotia, 124-126

Fiber-optic slides, in Lentinus edodes sequencing by synthesis, 55 Fiber supplements, sclerotia and, 124, 125 FIBRAPLAN dietary fiber supplement, sclerotia and, 125 FIBREX dietary fiber supplement, 127-128 Fibrosarcoma mushroom polysaccharides versus, 153 polysaccharide-protein complexes versus, 160, 167 Filamentous fungi medicinal value of, 149 structure of, 111-112 Fingerprinting, of Lentinus edodes, 50 First International Conference on Mushroom Science 26 Flammulina, world production of, 72, 73 Flammulina velutipes, 58, 85 antioxidants in, 90 antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154, 155, 156 chemical composition of, 82 classification of, 80 hypocholesterolemic effects of, 97 hypolipidemic effects of, 95 moisture content of, 73 polysaccharides isolated from, 153 Flavoglaucin, as mushroom antioxidant, 91, 92 Flavonoids biosynthesis of, 93 in cultivated mushrooms, 78 Flavor 5'-nucleotides, in cultivated mushrooms, 78 - 79Flavorful production genes, of Lentinus edodes, 42 Flow cytometric analysis, in sclerotial antitumor and immunomodulatory studies, 132 Folates, in cultivated mushrooms, 76 Folic acid, adverse effects of, 217 Fomes fomentarius, antitumor polysaccharide-protein complexes from, 158 Fomitella fraxinea antitumor polysaccharide-protein complexes from. 158 antitumor polysaccharides from, 155, 156 Food. See also Designer foods; Functional foods; Medical foods; Novel foods applied mushroom biology and, 8-9 mushrooms as, xvii, 1-34, 72 natural and organic in US, 203 population growth and, 10, 28 sclerotia as, 111-146

Food Act of 1981 (New Zealand), 201 Food Additive Amendments (1958), 204 Food additives, US regulation of, 204 Food and Agricultural Organization (FAO), 202-204.214-215 on mushroom protein and amino acid content, 74 75 Food and Drug Administration (FDA) European Union and, 209 food regulation by, 203-204, 204-208, 218 medical food regulation by, 200 Food fortification policy, in Canada, 210-211 Food industry, mushrooms in, 10-11 Food processing industry, biomass waste from, 10 - 11Food products, desirability of, 24 Food safety systems, 219-220 Foods for Particular Nutritional Uses (PARNUTS), 208 Foods for Special Dietary Uses (FOSDU), in Japan, 214 Foods for specified health uses (FOSHU), in Japan, 212-214 Food supplements European Union regulation of, 209 mushrooms as, 23, 24-25 Foods with nutrient function claims (FNFC), in Japan, 213 Food with health claims (FHC), in Japan, 212 Forestry biomass waste from, 10-11 Ganoderma lucidum cultivation and, 19-20 Forests, applied mushroom biology and, 9 Formylmethylation, in chemical improvement of antitumor activity, 176 Free amino acids, in conventional edible mushrooms, 74-75 Free radicals lignin degradation by, 60 mushrooms and, 24 mushroom scavenging of, 89-90 Fruiting bodies, 178, 219 antitumor polysaccharides from, 152, 153 in human diet, 72 of Lentinus edodes, 36, 38-44, 44-47 medicinal value of, 149 mushroom nutriceuticals from, 24-25 in mushroom-related hypoglycemia, 98, 99 of Pleurotus tuber-regium, 118 SAGE profiles of Lentinus edodes, 53 of Wolfiporia cocos, 120 Fruiting body morphogenesis, in Lentinus edodes, 46 Fruiting body senescence, in Lentinus edodes, 59 Fruiting culture of Lentinus edodes, 14, 15, 16 in mushroom cultivation, 13 preparation of, 13-14 Fruiting cycle, of Lentinus edodes, 37-38 Fruiting growth phase, in mushroom cultivation, 11 - 12Fruiting management phase, in mushroom cultivation, 12, 13 Fucogalactan antitumor effects of, 166 from mushrooms, 156, 157 Fucoglucomannan, from mushrooms, 156 Fu ling mushroom, 120 Functional foods in Canada, 210 FDA on. 208 mushrooms as, xvii, 1-34 regulation of, 200 Functional genomics studies, transformation in, 56.57 Fungal histidine kinase, in Lentinus edodes, 47 Fungal hyphae, 80 Fungal protein, from mushrooms, 11 Fungi. See also Wood rot fungus biology of, 6-7 biosynthesis of phenolic compounds by, 93-94 cell walls of, 121-122 identification of, 4-5 Israeli regulation of, 214-215 molecular chaperones in, 59-60 mushrooms as, 2-3, 3-4, 10-11, 149 phenolic antioxidants in, 91-93 structure of filamentous, 111-112 Fungisterol, as mushroom antioxidant, 92 FWE water extract AC-PS effects on, 168 antimetastatic effects of, 172 FYBOGEL dietary fiber supplement, sclerotia and. 125 Galactan, in sclerotial dietary fiber, 125 Galactoglucomannan, from mushrooms, 157 Galactomannan antitumor effects of, 166 from mushrooms, 156 Galactomannan-protein complexes, 149 Galactomannoglucan, from mushrooms, 155, 156 Galactose in cultivated mushroom dietary fiber, 78 in sclerotial dietary fiber, 125 Galactoxyloglucan, from mushrooms, 155

Gallic acid, biosynthesis of, 93 γ -amino butyric acid (GABA), in conventional edible mushrooms, 74 Ganoderan, from mushrooms, 154 Ganoderma, xvii ecological classification of, 5 polysaccharides isolated from, 151-152 as saprophytes, 4 Ganoderma applanatum, polysaccharides isolated from, 151, 152 Ganoderma capense, polysaccharides isolated from. 151 Ganoderma lucidum antiangiogenesis and, 172-173 antimetastatic effects of, 172 antitumor polysaccharide-protein complexes from, 158, 162-163 antitumor polysaccharides from, 154, 155 cultivation of, 19-19 ecological classification of, 5 FWE water extract from, 158, 172 ganopoly from, 168 hypolipidemic effects of, 95 medicinal applications of, 4 medicinal effects of, 24 medicines from, 25 polysaccharides isolated from, 151, 152, 169 as saprophyte, 4 Ganoderma lucidum polysaccharide (GLP), 163 - 163in immune response, 162-163 Ganoderma tsugae antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154, 155, 156 molecular mass of polysaccharides from, 174 polysaccharides isolated from, 151, 152 Ganopoly, 151 immunomodulatory effects of, 168 Garden of Life RM-10, FDA detention of, 207 - 208Garnishes, mushrooms as, 72 Gas chromatography-mass spectrometry (GC-MS), in antioxidant assays, 92 Gaseous exchange, in mushroom cultivation, 13 Gastrointestinal tract, in vitro sclerotial binding of minerals in, 128-129 GC box, in Lentinus edodes transcriptional regulation, 55-56 Gelling, of sclerotial dietary fiber, 126 Gene combinations, in mushroom cultivation, 20 Gene expression, 178 Gene expression analysis, of Lentinus edodes, 50-55

General Accounting Office (GAO), on food safety systems, 219-220 "Generally recognized as safe" (GRAS) criteria, 204, 207 Genes of Lentinus edodes, 36-48 in Lentinus edodes development, 48 in Lentinus edodes energy production, 47-48 for Lentinus edodes mature fruiting body formation, 44-47 in Lentinus edodes signal transduction, 47, 61 in Lentinus edodes sequencing by synthesis, 55 in Lentinus edodes transformation, 58-59 Genetic mapping, of Lentinus edodes, 50 Genome Sequencer 20 system, in Lentinus edodes sequencing by synthesis, 55 Genome sequencing, in Lentinus edodes sequencing by synthesis, 55 Germany food safety systems in, 219-220 regulation of dietary supplements in, 210 Germination, in sclerotial ontogeny, 114 Germplasm, in mushroom cultivation, 20-21 Germplasm databases, in mushroom cultivation, 21 GFPS1b polysaccharide, isolation of, 150 Gill development, in Lentinus edodes, 44-47 Gills of Lentinus edodes, 38 in mushroom identification, 5 GK16 mushroom, 85 chemical composition of, 82 GI-PP (Ganoderma lucidum polysaccharide peptide), in angiogenesis, 172-173 Glucanase activity, in Lentinus edodes, 59 Glucanase-encoding gene, in Lentinus edodes. 46 Glucan-protein complexes from mushrooms, 158, 159 structure and antitumor activity of, 173-174 Glucans. See also α -glucans; β -glucans antitumor mechanisms of, 153-157 branching configurations of, 175 from mushrooms, 149 sclerotial extracellular matrix and, 122 Glucoamylase, Lentinus edodes and, 36-57 Glucogalactan-protein complex, from mushrooms, 158 Glucogalactans, from mushrooms, 152, 156 Glucokinase, mushroom-related hypoglycemia and, 98-99 Glucomannan, from mushrooms, 156 Glucopyranan, from mushrooms, 157

Glucopyranosyl residue, mushroom-related hypoglycemia and, 98 Glucosamine, in sclerotial dietary fiber, 125 Glucose colonic fermentation and, 130 in cultivated mushrooms, 78 in cultivated mushroom dietary fiber, 77-78 during early sclerotial ontogeny, 115 mushroom-related hypoglycemia and, 98 Glucose-6-phosphate dehydrogenase, mushroom-related hypoglycemia and, 98 - 99Glucose-based oligosaccharides (GOSs), in vivo Ca/Mg absorption and, 132 Glucose-based polysaccharides, dietary fiber and, 124 Glucose residues, in sclerotial dietary fiber, 125 Glucosidases, Lentinus edodes and, 36 β -Glucosidases, in mushrooms, 10 Glucoxylan, from mushrooms, 152, 156 Glucuromannan-protein complexes, 149 Glucuronic acids, in sclerotial dietary fiber, 125 Glucuronoglycan, 151 Glucuronoxylomannan in cultivated mushroom dietary fiber, 78 from mushrooms, 157 Glucuropyranosyluronic residues, mushroom-related hypoglycemia and, 98 Glutamic acid, in conventional edible mushrooms, 74 Glyceraldehyde-3-phosphate dehydrogenase (GPD), in PEG-mediated Lentinus edodes 58. See also GPD entries Glycine, in conventional edible mushrooms, 75 Glycogen in cultivated mushrooms, 78 in sclerotial cytoplasmic reserves, 122 during sclerotial development, 114 Glycolysis, in Lentinus edodes, 48 Glycosidic linkages, in polysaccharides, 148 GM-CSF (granulocyte macrophage colony-stimulating factor), 164, 178. See also Granulocyte colony-stimulating factor (G-CSF); Macrophage colony-stimulating factor (M-CSF) effects of PG101 and, 165 Good agriculture practice (GAP), 217 Good clinical practice (GCP), 218 Good laboratory practice (GLP), 217 Good manufacturing practice (GMP), 217 WHO guidelines and, 202 Good production practice (GPP), 218

GPD gene, in Lentinus edodes transformation, 58. See also Glyceraldehyde-3-phosphate dehydrogenase (GPD) GPD promoter and terminator, in Lentinus edodes transformation, 57, 58 Granular glycogen deposits, in sclerotial cytoplasmic reserves, 122 Granulocyte colony-stimulating factor (G-CSF), 170. See also GM-CSF (granulocyte macrophage colony-stimulating factor) Granulocytes PG101 treatment and, 170 SCG and, 170-171 Greenhouse gases, population growth and, 10 Grey oyster mushroom, 17. See also Pleurotus sajor-caju Grifola frondosa, 85. See also Maitake mushroom antioxidants in. 90 antitumor glucans from, 157, 165-166 antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154, 155, 156 carbohydrate content of, 78 chemical composition of, 82 chemical improvement of antitumor polysaccharides from, 176 classification of, 80 D-fraction from, 167-168 fat content of, 75 heteroglycan-protein complex from, 167 hypocholesterolemic effects of, 97 hypolipidemic effects of, 95 Japanese production of, 72-73 MBG from, 170 moisture content of, 73 molecular mass of polysaccharides from, 174 mushroom-related hypoglycemia and, 98 polysaccharides isolated from, 148, 150 regulation of polysaccharides from, 199-200 Grifolan, antitumor effects of, 165-166 Grifola umbellata antitumor polysaccharides from, 154 cultivation of sclerotia of, 117 Growth genes, of Lentinus edodes, 36-37, 39 - 42Guanidine, mushroom-related hypoglycemia and, 99 Guanidinoacetic acid, mushroom-related hypocholesterolemia and, 94 Guanosine monophosphate (GMP), in cultivated mushrooms, 78 Guidance for Industry: Botanical Drug Products (FDA), 218

Guidelines for the Assessment of Herbal Medicine (WHO), 202 Guidelines for the Safety Assessment of Novel Foods Derived from Plants and Microorganisms, 211 Haploid monokaryotic mycelia, of Lentinus edodes, 38 Harvesting phase, in mushroom cultivation, 12, 13 HDL cholesterol levels, 97 Health, applied mushroom biology and, 8-9 Health benefits of edible mushrooms, 89-99 of mushrooms, 71-109 Health Canada, 210-211 Health claims, 206 in Japan, 214 Health Food Emporium, FDA detention of, 207 - 208Health Promotion Law, in Japan, 214 Heat shock proteins (HSPs), as molecular chaperones, 59 Heavy metals in cultivated mushrooms, 76 in nonconventional edible mushrooms, 79 Hebeloma crustuliniforme, antitumor polysaccharide-protein complexes from, 158 Helicases, in Lentinus edodes, 46 Helper T cells, effects of lentinan on, 165 Hematopoietic stem cells, mushroom polysaccharide effects on, 170-171 Hemicelluloses in biomass waste, 10 in cultivated mushroom dietary fiber, 78 Lentinus edodes degradation of, 36 in Wolfiporia cocos cultivation, 121 Hepatic cholesterol, mushroom effects on, 97 Hepatic glucose, colonic fermentation and, 130 Hepatic HMG-CoA reductase, 97 Herbal medicines, WHO guidelines and, 202 Herbal substances, European Union regulation of. 209 Herbs, in dietary supplements, 200 Hericium erinaceus, 86 antioxidants in, 90 antitumor polysaccharides from, 154, 155, 156 ash and mineral content of, 76 chemical composition of, 82 classification of, 80 mushroom-related hypoglycemia and, 98 world production of, 73

Hericium ramosum, 86 chemical composition of, 82 classification of, 80 Heterogalactan, from mushrooms, 156, 157 Heteroglucans, from mushrooms, 155-156 Heteroglycan-protein complexes immunomodulatory effects of, 167 from mushrooms, 158, 159 structure and antitumor activity of, 173-174 Heteroglycans, from mushrooms, 149, 156-157 Heteropolysaccharide-protein complexes, from mushrooms, 160-161 Heteropoysaccharides, from mushrooms, 152 Hexokinase, mushroom-related hypoglycemia and, 98-99 High density lipoprotein (HDL), 97 High-throughput sequencing technologies, in Lentinus edodes sequencing by synthesis, 54 - 55Histidine in conventional edible mushrooms, 75 in mushroom protein, 89 Histidine kinase, in Lentinus edodes, 47 Hoelen mushroom, 120 Hohenbuehelia serotina, antitumor polysaccharides from, 156 Homeostasis, polysaccharides and, 148 Homobasidiomycetes, 35 Homocysteine, mushroom-related hypocholesterolemia and, 94 Homoglucans, from mushrooms, 154-155 Hong Kong, 206 mushroom conference in, 27 Host-specific factors, in colonic fiber fermentation, 129 hph gene, in PEG-mediated Lentinus edodes transformation, 56 HRA cell proliferation, mushroom polysaccharides versus, 151 HSP70 protein, as molecular chaperone, 59 HUMAMIL dietary fiber supplement, sclerotia and, 125 Human fecal microflora, colonic fermentation and, 130 Human immunodeficiency virus (HIV), mushrooms and, 21-22 Human peripheral blood mononuclear cells (hPBMCs), effects of PG101 and, 165 Humans applied mushroom biology and, 8-9 benefits of mushrooms for, 71 feeding, 23 health benefits of mushrooms to, 89-99 mushrooms in diet of, 72

Human tumor xenografts, in sclerotial antitumor and immunomodulatory studies, 133-134 Human umbilical vein endothelial cells (HUVECs), antiangiogenesis and, 172-173 Human welfare, mushrooms and, 28-29 Hungary, mushroom production in, 21 Hurulingzhi mushroom, 119 HWE heteropolysaccharide-protein complex, 157-159, 161 Hybridization, in Lentinus edodes genetics, 54 Hybridization analysis, Lentinus edodes meiosis and, 61 Hydnaceae, classification of, 80 Hydration properties, of sclerotial dietary fiber, 127 Hydrogen peroxide, lignin degradation by, 60 Hydrophobins, of Lentinus edodes, 44, 48, 53 Hydroxybenzoic acid, as mushroom antioxidant, 92 p-Hydroxybenzoic acid, biosynthesis of, 93 Hydroxylation, in chemical improvement of antitumor activity, 176 Hydroxyl free radicals, mushroom scavenging of, 89-90 4-Hydroxymethylbenzenediazonium (HMBD), US regulation of, 204 Hygromycin B phosphotransferase gene, in Lentinus edodes transformation, 58 Hygromycin B resistance, Lentinus edodes transformation and, 58 Hymenium, in Lentinus edodes, 45 Hymenomycetes, 119 classification of, 80 Hymenophore, Lentinus edodes meiosis and, 60 - 61Hypercholesterolemia, mushrooms versus, 94 Hyperglycemia, mushrooms in treatment of, 97-99 Hyperhomocysteinic effects, mushroom-related hypocholesterolemia and, 94 Hyphae cell walls of, 121-122 of cortex, 117 of filamentous fungi, 111-112 of medulla, 117 polyphosphate granules in, 123 of rind, 116 during sclerotial ontogeny, 113-114 structure of, 115 Hyphal cells, of rind, 116 Hyphal tips during early sclerotial ontogeny, 115 rind and, 115-116 structure of, 115

Hypocholesterolemia colonic fermentation and, 130 from mushrooms, 94-97 Hypoglycemia, from mushrooms, 97-99 Hypolipidemia, from mushrooms, 94, 95, 96 Hypsizygus marmoreus, 86 antioxidants in, 90 antitumor polysaccharides from, 154, 156 chemical composition of, 82 classification of, 80 Japanese production of, 72-73 Identification, of mushrooms, 4-6 IL-12 interleukin, 162, See also Interleukins (ILs) IL-12p35 interleukin, 163 IL-12p70 interleukin, 151 Immune response, cancer and, 161-162 Immunomodulation, as antitumor mechanism, 153.161-171 Immunomodulators, 161 Immunomodulatory effects of mushroom polysaccharides, 147-198 of sclerotia, 132-134 of Wolfiporia cocos, 120 Immunomodulatory proteins, in mushrooms, 25 Immunopotentiators, mushroom products as, 200 - 201Incubation in Lentinus edodes cultivation, 16 in Pleurotus cultivation, 17 India mushroom nutriceutical regulation in, 201 mushroom production in, 21 Indoor fermentation, in Agaricus cultivation, 14 Inducible nitric oxide synthase (iNOS) protein, 164Information, in mushroom cultivation, 20, 21 Infrared (IR) spectrometry, in antioxidant assays, 92 Ingredients labeling of, 204-205 WHO guidelines and, 202 Inhibitor of kappa B (I- κ B) kinase, dendritic cells and, 169 Initials, in sclerotial ontogeny, 113-114 Initiation stage, of sclerotial ontogeny, 113 Innate immunity, cancer and, 161-162 Innovation, in mushroom industry, 22 Inonotus obliguus antitumor polysaccharides from, 156 endopolysaccharide from, 166 regulation of polysaccharides from, 199-200 Inorganic compounds, in nutrition, 23

Inosine monophosphate (IMP), in cultivated mushrooms, 78 Inositol in cultivated mushrooms, 78 during early sclerotial ontogeny, 115 Insects, inside mushrooms, 2 In situ conservation, in mushroom cultivation, 21 Insoluble dietary fiber (IDF) in cultivated mushrooms, 77, 81 of sclerotia, 124, 125 Insulin-dependent diabetes mellitus (IDDM), mushroom-related hypoglycemia and, 98 - 99Insulin release, mushroom-related hypoglycemia and, 99 Intercellular adhesion molecule-1 (ICAM-1), in immune response, 162, 179 Interferon gamma (IFN-y), 151, 162, 163, 164, 178 effects of lentinan on, 165 Interhyphal materials, in sclerotial ontogeny, 114 Interhyphal space of medulla, 117 sclerotial extracellular matrix and, 122 structure of, 115 Interleukins (ILs). See also IL-12 entries effects of lentinan on, 165 effects of PG101 and, 165 effects of PSK and, 167 GLP effects on, 164 grifolan and, 165 Internal morphogenetic factors, during sclerotial ontogeny, 113 International Commission on Mushroom Science, formation of, 26 International Conference on Mycorrhizas, 27 International Conference for Mushroom Biology and Mushroom Products (ICMBMP), 27 International Journal of Medicinal Mushrooms (IJMM), 27 International Medicinal Mushroom Conference (IMMC), 27 International Society of Mushroom Science (ISMS), 21 formation of, 26 International Workshop on Edible Mycorrhizal Mushrooms (IW-EMM), 21, 27 InterBsimple sequence repeat markers (ISSRs), for Lentinus edodes, 48, 49-50 Inulin, in vivo Ca/Mg absorption and, 131 Investigational new drug (IND), 218 In vitro fermentability, of sclerotia, 129-131 In vitro methods, in nutritional evaluation, 87

In vitro mineral binding capacity, of sclerotia, 128 - 129In vitro protein digestibility (IVPD), in nutritional evaluation, 87, 88 In vivo calcium absorption, by sclerotia, 131 - 132In vivo magnesium absorption, by sclerotia, 131 - 132Ireland, food safety systems in, 219-220 Iron in cultivated mushrooms, 76 in vitro sclerotial binding of, 128-129 in mushrooms, 23 in sclerotial dietary fiber, 125 Iron sulfur protein (Ip) subunit gene, in Lentinus edodes transformation, 58 Isoleucine in conventional edible mushrooms, 74, 75 in mushroom protein, 89 Israel, 220 introducing medicinal-mushroom dietary supplements in, 214-215 Japan, 207, 220 Agaricus brasiliensis cultivation in, 18 introducing medicinal-mushroom dietary supplements in, 212-214 Lentinus edodes from, 35 medicinal mushroom uses in, 25 medicinal uses of mushroom polysaccharides in. 147 mushroom antioxidant studies in, 89 mushroom nutriceutical regulation in, 201 mushroom-related hypocholesterolemia studies in, 94 wild and cultivated edible mushrooms from, 72.73 Jaundice, Wolfiporia cocos in, 120 Jew's ear mushroom, hypocholesterolemic effects of, 97. See also Auricularia auricula-judae Karyogamy, of Lentinus edodes, 38 Kava for mushroom identification, 5, 6 warnings against, 209 Korea, medicinal uses of mushroom polysaccharides in, 147 Krestin. See also PSK polysaccharide-protein complex from mushrooms, 25, 150 regulation of, 200 Kugitake mushrooms, antioxidants in, 89

Kwan, Hoi-Shan, xxi, 35

Labeling of Canadian dietary supplements, 210 false or misleading, 206-208 US regulation of, 203-204, 204-205 Laccase, in mushrooms, 10 Laccase genes, in Lentinus edodes, 46 lac genes, in Lentinus edodes, 46, 60 Lactobacillus, in colonic fiber fermentation, 130 Laetiporus sulphureus, antitumor polysaccharide-protein complexes from, 158 Laminarinase, Lentinus edodes and, 36 Lampteromycer japonicus, antitumor polysaccharides from, 156 Lateral development, of sclerotia, 113 Latin America, mushroom production in, 22, 23, 73 LDL cholesterol levels, mushrooms reducing, 97. See also Low density lipoprotein (LDL) oxidation Lead, in cultivated mushrooms, 76 Le-cdc5 gene, in Lentinus edodes transcriptional regulation, 55 Le.CDC5 protein, of Lentinus edodes, 43 LeClb gene, of Lentinus edodes, 43 Lectins, mushroom-related hypoglycemia and, 99 Le.cyp genes, of Lentinus edodes, 44 Le.DRMIP gene in Lentinus edodes, 43, 47 in Lentinus edodes yeast two-hybrid analysis, 54 Le.egl1 gene, in Lentinus edodes, 60 Le.-FAD genes, of Lentinus edodes, 44, 45 Le.-FDA1 gene, of Lentinus edodes, 44 Le.Ga gene, in Lentinus edodes, 47 Legal issues, in introducing medicinal-mushroom dietary supplements, 202 - 215Legumes, protein quality of, 88 Le.hyd genes, in Lentinus edodes, 48 Le.MAPK gene in Lentinus edodes, 43, 44, 47 in Lentinus edodes yeast two-hybrid analysis, 54 Le.mfbC gene, in Lentinus edodes, 47 LeMPP gene, in Lentinus edodes, 48 Le.nik1 gene in Lentinus edodes, 47 in Lentinus edodes yeast two-hybrid analysis, 54 LeNot1 gene, of Lentinus edodes, 43 Lentinacin (lentysine), hypocholesterolemic effects of. 94

Lentinan antitumor mechanism of, 153-157 branching configuration of, 174-175 conformation of, 175 immunomodulatory effects of, 164-165 isolation of, 148, 150 from mushrooms, 25, 154, 161-162 regulation of, 199-200 Lentinan degradation, Lentinus edodes and, 59 Lentinan degradation genes, of Lentinus edodes, 40 Lentinula, 35 Lentinula edodes. See Lentinus edodes Lentinus hypocholesterolemic effects of, 94 world production of, 72 Lentinus edodes, 35-69, 165. See also Shiitake mushroom anatomy of, 3 antimetastatic effects of, 171, 172 antioxidants in, 90, 91, 92 antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154, 156 ash and mineral content of, 76 biology and genetics of, 14, 15 carbohydrate content of, 78 chemical improvement of antitumor polysaccharides from, 176-177 Chinese production of, 73 classification of, 80 conformation of polysaccharides from, 175 - 176cultivation of, 14-16 development of, 37-47 dietary fiber in, 77 economic value of, 35-36 fat content of, 75 FWE water extract from, 158, 171 gene expression analysis of, 50-55 genetically improving, 35-36 growth genes of, 36-37, 39-42 hypocholesterolemic effects of, 94 isolation of genes of, 36-48 life cycle of, 14-15, 37-38 lignocellulolytic enzymes of, 10 medicinal value of, 25, 35 moisture content of, 73 molecular genetics of, 36, 48-50 molecular mass of polysaccharides from, 174 physiological processes in, 47-48, 61 polysaccharides isolated from, 148, 149, 150 process analysis of, 59-61 protein and amino acid content of, 74, 75

protein quality of, 88 provenance of, 35 regulation of polysaccharides from, 199-200 taxonomy of, 35 transcriptional regulation of, 55–56 transformation of, 56-59 vitamin content of, 76-77 as wood rot fungus, 15 world production of, 72, 73 Lentinus giganteus, 86 chemical composition of, 82 classification of, 80 Lentinus lepideus biosynthesis of phenolic compounds by, 93 polysaccharide extracted from, 165, 170 Lepiota, toxicity of, 6 Lepista nuda, world production of, 73 LePriA gene, in Lentinus edodes transcriptional regulation, 55 Le.ras gene, in Lentinus edodes, 44, 47 Le.recQ gene, in Lentinus edodes, 46, 47 Le.rnr2e gene in Lentinus edodes, 45 in Lentinus edodes meiosis, 60-61 Leucine, in conventional edible mushrooms, 74, 75 Leucopaxillus giganteus, antitumor polysaccharides from, 156 Leukemic cells, mushroom polysaccharide-protein complexes versus, 159-160, 161 Lewis lung cancer, mushroom polysaccharides versus, 151-152 Life cycles of Lentinus edodes, 37-38 of mushrooms, 149 Life expectancy, food safety and, 215 Life-span increases, mushrooms and, 25 Lignin in biomass waste, 10 in cultivated mushrooms, 77, 78 Lentinus edodes degradation of, 36, 60, 61 Ligninases, in mushrooms, 10 Lignin peroxidase, from Lentinus edodes, 60 Lignocellulolytic enzymes of Lentinus edodes, 36 in mushrooms, 10 Lignocellulose degradation, by Lentinus edodes, 60 Lignocellulosic biomass waste, applied mushroom biology and, 9, 10-11, 21, 28 Lignolytic system, of Lentinus edodes, 36 Lignosus rhinoceros, 119. See also Polyporus rhinocerus

Linoleic acid in conventional edible mushrooms, 75 mushroom-related hypocholesterolemia and, 94 Linolenic acid, in conventional edible mushrooms, 75 Lipid biosynthesis, in Lentinus edodes, 45 Lipid bodies, in sclerotia, 123 Lipid metabolism, mushroom-related hypocholesterolemia and, 94 Lipid peroxidation inhibition, by mushrooms, 91 Lipids in conventional edible mushrooms, 75 in mushrooms, 24 in nonconventional edible mushrooms, 79 in sclerotia, 123 in sclerotial cytoplasmic reserves, 122, 123 Liquid chromatography-mass spectrometry (LC-MS), in antioxidant assays, 92 Liver injury, from kava, 209 Log cultivation, of Ganoderma lucidum, 19-20 LongSAGE, in Lentinus edodes genetics, 52-53. See also Serial analysis of gene expression (SAGE) Loose development, of sclerotia, 113 Lovastatin hypocholesterolemic effects of, 96 submerged culturing of, 219 Low density lipoprotein (LDL) oxidation. See also LDL cholesterol levels hypercholesterolemia and, 94 hypocholesterolemia and, 97 in mushroom antioxidant assays, 90 LPK15 mushroom, 86 chemical composition of, 82 Luciferase expression, 166 Lung cancer GLP effects on, 163 mushroom polysaccharides versus, 151-152 Lung cancer cells, antitumor polysaccharides versus, 157 Lymphocytes AC-PS effects on, 168 in immune response, 161-162 mushroom polysaccharide effects on, 163 Lymphoma, mushroom polysaccharide-protein complexes versus, 159-160 Lyophyllum decastes antitumor polysaccharides from, 154, 164 polysaccharides isolated from, 153 Lyophyllum ulmarius dietary fiber in, 77 fat content of, 75 protein and amino acid content of, 75

Lysine in conventional edible mushrooms, 74, 75 in mushroom protein, 88 LZE extract, 151 Lzps-1, 151-152 Macrofungi, mushrooms as. 2, 3, 149 Macromolecules, polysaccharides as, 148 Macrophage colony-stimulating factor (M-CSF), 151. See also GM-CSF (granulocyte macrophage colony-stimulating factor) Macrophages, 178 in chemical improvement of antitumor activity, 176 D-fraction and, 167-168 galactomannan and, 166 grifolan and, 165-166 in immune response, 161-162, 162-163 mushroom polysaccharides and, 150, 151, 159, 160, 163-167 schizophyllan and, 165 in sclerotial antitumor and immunomodulatory studies, 133 Magnesium in cultivated mushrooms, 76 in vitro sclerotial binding of, 128-129 in nonconventional edible mushrooms, 79 in sclerotial dietary fiber, 125 Magnesium absorption, by sclerotia, 131-132 Maitake D-fraction. See D-fraction Majtake mushroom, 207. See also Grifola frondosa antioxidants in, 89 antitumor glucans from, 157 antitumor polysaccharides from, 150 hypocholesterolemic effects of, 97 Manganese in cultivated mushrooms, 76 in Lentinus edodes cellulose degradation, 60 Manganese peroxidase, in mushrooms, 10 Manna, from mushrooms, 2, 156 Mannans in cultivated mushroom dietary fiber, 77 in sclerotial dietary fiber, 125 Mannitol in cultivated mushrooms, 78 during sclerotial development, 114, 115 Mannofucogalactan, from mushrooms, 156 Mannofucoxyloglucan, from mushrooms, 155 Mannogalactan, from mushrooms, 152 Mannogalactofucan, from mushrooms, 156 Mannogalactoglucan, from mushrooms, 155, 156 Mannoglucan, from mushrooms, 156

Mannoglucoxylan, from mushrooms, 156 Mannopyranose, mushroom-related hypoglycemia and, 98 Mannose in cultivated mushroom dietary fiber, 78 in sclerotial dietary fiber, 125 MAPK kinase (MEK) dendritic cells and, 169 in Lentinus edodes, 47 Marketing licenses, WHO guidelines and, 202 Mass spectrometry (MS), in antioxidant assays, 92 Mating factor gene, of Lentinus edodes, 40 Mating-type genes, of Lentinus edodes, 38 Matsutake truffle, 72 as saprophyte, 4 Maturation, of rind, 116 Maturation stage, of sclerotial ontogeny, 113, 114 Mature fruiting body formation, of Lentinus edodes, 44-47 Maturity of Lentinus edodes, 14 in mushroom cultivation, 12 MBG β -glucan, effects on hematopoietic stem cells, 170 Medical care, population growth and, 10, 28 Medical foods, regulation of, 200 Medications, European Union regulation of, 209 Medicinal mushroom products, 220. See also Mushroom medicinal products Medicinal mushrooms international movement for, 27 Lentinus edodes, 35-36 in mushroom industry, 26 Medicinal uses/value of mushroom polysaccharides, 147-198 of mushrooms, xvii, 3, 4, 21-22, 24, 28-29 of Pleurotus tuber-regium, 118 of Polyporus rhinocerus, 119 of Wolfiporia cocos, 120, 121 Medicines, European Union regulation of, 209 Medulla cortex and, 116-117 structure of, 115, 117 Meiosis, in Lentinus edodes, 60-61 MEK kinase (MEKK), in Lentinus edodes, 47 Melanins, in sclerotial cell walls, 122 Melanoma cells, 166 Melon seed ball preparations, Pleurotus tuber-regium in, 118 Memory B cells, dendritic cells and, 168 Menstruation, Wolfiporia cocos in, 120 Mercury, in cultivated mushrooms. 76

Metabolic pathways, in Lentinus edodes, 48 Metal oxalates. in sclerotial dietary fiber, 125 Metals, in cultivated mushrooms, 76. See also Heavy metals Methanol extracts in sclerotial antitumor and immunomodulatory studies, 133 in Wolfiporia cocos cultivation, 121 Methionine in conventional edible mushrooms, 74, 75 in mushroom protein, 88, 89 Mevinolin, hypocholesterolemic effects of, 96 mfbC gene, in Lentinus edodes, 46 Mgel gene, molecular chaperones and, 59-60 Mice antitumor polysaccharide-protein complex studies in, 160, 161 grifolan studies in, 166 lentinan studies in, 165 mushroom-related hypoglycemia studies in, 98, 99 polysaccharide branching configuration studies using, 175 PS-G studies in, 169 PSK studies in, 171 PSPC studies in, 167 PSP studies in, 167 SCG studies in, 164 schizophyllan studies in, 165 sclerotial antitumor and immunomodulatory studies in, 132 studies of chemical improvement of antitumor activity in, 177 Microarray hybridization, in Lentinus edodes genetics, 36, 51, 53-54 Microfungi, 2 Microorganisms in Agaricus cultivation, 14 in mushroom cultivation, 13 sclerotial cell walls and, 122 during sclerotial ontogeny, 113 Mineral binding capacity, of sclerotia, 128-129 Minerals. See also Ash in conventional edible mushrooms, 75-76, 80 in dietary supplements, 200 European Union regulation of, 209 labeling of, 204-205 in mushrooms, 88 in sclerotial dietary fiber, 125 Minimum inhibition rates (MIRs), 172 Ministry of Health (Israel), 214 Minister of Health, Labor and Welfare (MHLW), in Japan, 212, 213

Miracle Mushroom Blend, FDA detention of, 207 Mitochondria, in rind cells, 116 Mitochondrial DNA (mtDNA) RFLPs, for Lentinus edodes, 49. See also Deoxyribonucleic acid (DNA) Mitogen-activated protein kinase, in Lentinus edodes genetics, 52 Mitosis, of Lentinus edodes, 37 mnp gene, in Lentinus edodes transcriptional regulation, 56 Moisture in conventional edible mushrooms, 73-74 in nonconventional edible mushrooms, 79, 81 in sclerotia, 124 in Wolfiporia cocos, 121 Molecular chaperones, in fungi, 59-60 Molecular genetics, of Lentinus edodes, 48-50 Molecular markers, for Lentinus edodes, 48-49, 49 - 50Molecular mass, of antitumor polysaccharides, 174 Monilinia, sclerotia of, 112 Monilinia fructicola, lipid bodies in, 123 Monoclonal antibody (mAb), 164 Monocytes, 178 mushroom polysaccharides and, 159 Monokaryons, of Lentinus edodes, 37 Monokaryotic mycelia, of Lentinus edodes, 38 Monosaccharide residues, of polysaccharides, 148 Monosodium glutamate (MSG) in conventional edible mushrooms, 74-75 in cultivated mushrooms, 78-79 Morchella esculenta, galactomannan from, 166 Morphogenesis genes, of Lentinus edodes, 41 Morphology of sclerotia, 112 of sclerotia during ontogeny, 112-114 Mortality patterns, safety and, 215 Mother spawn of Lentinus edodes, 14, 15 in mushroom cultivation, 13-14 mRNA expression, 164. See also Ribonucleic acid (RNA) Mucilage matrix, sclerotial ontogeny and, 113 Multicytokine inducers, polysaccharides and, 148 Multienzymatic digestion test, in nutritional evaluation, 87 MultiExperiment Viewer (MeV), in Lentinus edodes genetics, 54 Multihyphal structures. See also Hyphae; Hyphal entries

of filamentous fungi, 111-112 sclerotial ontogeny and, 113 Multilocus enzyme electrophoresis, for Lentinus edodes, 49 Mushroom biology, 6-11, 23, 28-29 applied, 6, 7-11, 28-29 as a discipline, 7, 8-9 Mushroom bioremediation, 7, 8, 9, 11, 28 Mushroom biotechnology, 7-8, 9, 23-25 dietary supplements and, 24-25 medicinal value of mushrooms and, 23-24 nutriceuticals and, 24-25 nutritional value of mushrooms and, 23-24 Mushroom cultivation, 1-34. See also Cultivation entries Agaricus, 14 Agaricus brasiliensis, 18–19 Ganoderma lucidum, 19-20 Lentinus edodes, 14-16 mushroom germplasm in, 20-21 phases of, 12-13 Pleurotus sajor-caju, 17 stages of. 13-14 Volvariella, 17-18 Mushroom industry, 21-23 Mushroom industry movements, development of, 25-27 Mushroom medicinal products, regulation of, 200-201. See also Medicinal mushroom products Mushroom microbiology, 23 Mushroom nutriceuticals, 3, 9, 10, 11, 24-25, 28-29, 150. See also Nutriceuticals Mushroom polysaccharides antitumor mechanisms of, 153-173, 173-177 identifying antitumor, 149-153, 154-157, 158 - 158medicinal uses/value of, 147-198, 178-179 structures and antitumor activities of. 173 - 177Mushroom preparations, safety of, 216 Mushroom products, submerged culturing of, 219 Mushrooms, 3-6 anatomy/structure of, 3-4 antipollution uses of, 3 bioactive components of, 89-91 biological aspects of, xvii in biomass waste processing, 28-29 biosynthesis of phenolic compounds by, 93 - 94as botanical drugs, 218 chemical aspects of, xvii cross breeding of, 56, 57

cultivation of sclerotia of, 117-121 defined. 3-4 as dietary supplements, 3 domesticated, 2 ecological classification of, 4, 5 economic importance of, 72, 73 edible, 3, 4 fear of. 2 fossilized. 2 health benefits of, 71-109 hypocholesterolemic effects of, 94-97 identification of, 4-6 insects inside, 2 Israeli regulation of, 214-215 life cycles of, 149 lifestyles of, 2-3 literature on. xvii medicinal value of, xvii, 3, 4, 21-22, 28-29 moisture content of, 23 nutritional evaluation of, 80-89 nutritional value of, xvii, 3-4, 28-29, 71-109 plants versus, 2, 10-11 poetry about, 2 poisonous, 2 poisonous versus edible, 6 propagation of, 217 protein quality of, 87-89 recent interest in. 3 regulation of, 199-224 safety of, 215 sclerotia of, 111-148 seasonality of, 2-3 symbiotic with plants, 4 temperature stress in, 59, 60 value of, 21-22 widely cultivated, 72, 73 world production of, 21-23, 199 Mushroom science, 7, 8, 9 Mushroom spawn, in mushroom cultivation, 13. See also Spawn development phase Mushroom species, number of known, 1-2Mycelia, 3-4, 179 in Agaricus brasiliensis cultivation, 18 antitumor polysaccharides from, 152, 159, 160 - 161applied mushroom biology and, 11 in human diet, 72 of Lentinus edodes, 14, 37, 38 in Lentinus edodes cultivation, 15 medicinal value of, 149 mushroom nutriceuticals from, 24-25 in mushroom vegetative growth phase, 11, 12 of Polyporus rhinocerus, 120 SAGE profiles of Lentinus edodes, 53

during sclerotial development, 114 during sclerotial ontogeny, 113 of Wolfiporia cocos, 121 Mycelial cultures, medicinal effects of, 24 Mycelial hydrophobins, in Lentinus edodes genetics, 53 Mycelial running phase, in mushroom cultivation, 12, 13 Myceteae, 3 Mycochemicals, regulation of, 200 Mycology, 6-7 "Mycomeat," 10-11 Mycophiles, 1 Mycophobes, 1 Mycoprotein, 80 "Mycorestoration," 11 Mycorrhiza. See also Mycorrhizal mushrooms international movement for, 27 mushrooms as, 4, 5 Mycorrhizal mushrooms, harvesting of, 21-22 Myeloid progenitors, PG101 treatment and, 170 Myotoxins, 92 Naive B cells, dendritic cells and, 168 Natural foods, US regulation of, 203 Natural killer (NK) cells, 166, 178 in immune response, 161-162 mushroom polysaccharides and, 150, 163, 167-168 in sclerotial antitumor and immunomodulatory studies, 133 Natural personal care products, US regulation of, 203 Natural Products Association, 208 Netherlands, food safety systems in, 219-220 Net protein ratio (NPR), in nutritional evaluation, 87, 88 Net protein utilization (NPU), 88 Neurospora crassa, 37 Neutral sugars, in cultivated mushroom dietary fiber. 77 Neutrophils, GLP effects on, 163, 164 New drug application (NDA), 218 Newly developed cultivated mushrooms chemical composition of, 82 health and nutritional benefits of, 79-80. 81 - 87New Zealand, 220 food safety systems in, 219-220 introducing medicinal-mushroom dietary supplements in, 211-212 New Zealand Dietary Supplements Regulations

(NZDSR), 201

New Zealand Food Safety Authority (NZFSA), 212 Niacin, in cultivated mushrooms, 76 Nicotinamide adenine dinucleotide phosphate (NADPH), in Lentinus edodes genetics, 53 Nigeria, Pleurotus tuber-regium consumption in, 118 Nitric oxide (NO), 151, 153 Nitric oxide production, in sclerotial antitumor and immunomodulatory studies, 133 Nonconventional mushrooms, health and nutritional benefits of, 79-80, 81-87 Nonfat dry milk (NFDM), protein quality of, 88 Nongreen organisms, mushrooms as, 10-11 Nongreen revolution, mushrooms in, 9-11, 28-29 Non-insulin-dependent diabetes mellitus (NIDDM), mushroom-related hypoglycemia and, 98 Nonprotein N, in sclerotia, 124 Nonstarch polysaccharides (NSPs) in cultivated mushroom dietary fiber, 77 from mushrooms, 152 North America medicinal mushroom uses in, 25 mushroom production in, 22, 23, 73 Novel foods in Australia and New Zealand, 212 in Japan, 212-214 Novel Foods Regulations (Canada), 211 Nuclear factor kappa B (NF- κ B), 151, 166 dendritic cells and, 169 effects of PG101 and, 165 Nuclear magnetic resonance (NMR), in antioxidant assays, 92 Nucleic acid biosynthesis, in Lentinus edodes, 45 Nucleic acids, in cultivated mushrooms, 78-79. See also Deoxyribonucleic acid (DNA); Ribonucleic acid (RNA) Nucleotide biosynthesis genes, of Lentinus edodes, 41 Nucleotides, in cultivated mushrooms, 78-79 Nutraceuticals. See also Nutriceuticals in Canada, 210 regulation of, 200 Nutriceuticals. See also Mushroom nutriceuticals defined, 200 regulation of, 200-201 sclerotial dietary fiber in, 126 Nutrients in conventional edible mushrooms, 73-79, 81 - 87direct toxicity of, 216-217 labeling of, 204-205

in mushroom cultivation, 13 during sclerotial development, 114-115 for sclerotial ontogeny, 113-114 Nutritional evaluation biological methods for, 80-87 of mushrooms, 80-89 of sclerotia, 123-126 Nutritional supplements, US regulation of, 203 - 208Nutritional value, of mushrooms, 24, 71-109 Nutrition Improvement Act of 1992 (Japan), 213 Nutrition industry, US regulation of, 203 Office of Nutritional Products, Labeling, and Dietary Supplements, 205-206 Office of Special Nutritionals, medical food regulation by, 200 Official Journal of the EC, 209 Oil-holding capacity (OHC), of sclerotial dietary fiber, 126, 127 Oleic acid, in conventional edible mushrooms, 75 Oligosaccharides in cultivated mushrooms, 78 in vivo Ca/Mg absorption and, 131, 132 Omphalia lapidescens antitumor polysaccharides from, 154 branching configurations of polysaccharides from, 175 cultivation of sclerotia of, 117 Ontogeny, of sclerotia, 112-115 Oogitake mushrooms, antioxidants in, 89 Ooi, Vincent E. C., xii, 147 Organic foods, US regulation of, 203 Ornatipolide, as mushroom antioxidant, 91, 92 Ornithine, in conventional edible mushrooms, 74 O-sulfonation, in chemical improvement of antitumor activity, 177 Ovarian cancer, mushroom polysaccharides versus, 151 Ovariectomized (OVX) rats, in vivo Ca/Mg absorption studies using, 131-132 Overdoses, US regulations and, 208 Over-the-counter (OTC) drugs, US regulation of, 205 Oxalates in cultivated mushrooms, 79 in sclerotial dietary fiber, 125 Oxidases, in Lentinus edodes genetics, 53 Oxidation, in biosynthesis of phenolic compounds, 93 Oyster mushrooms, 17. See also Pleurotus ostreatus hypocholesterolemic effects of, 96, 97

p38 MAPK, GLP effects on, 164 Pachyman conformation of, 176 from mushrooms, 155 Pachymaran, in chemical improvement of antitumor activity, 176 Pachymic acid, in Wolfiporia cocos cultivation, 121 Palmitic acid, in conventional edible mushrooms, 75 Parasites, mushrooms as, 4, 5 Particle bombardment, for Lentinus edodes transformation, 58 Pasteurization, in mushroom cultivation, 13 Pathogens, mushrooms as, 5 P. atroumborata, energy content of, 78 Pattern recognition receptors (PRRs), in immune response, 162, 178 Paxillus involutus polyphosphate granules in, 123 protein bodies in, 123 safety of, 216 Paxillus syndrome, 216 Pectic substances, in cultivated mushroom dietary fiber, 78 PEG-mediated transformation, for Lentinus edodes, 56 Perigold black truffle, as saprophyte, 4 Peripheral blood lymphocytes (PBLs), immunomodulatory responses of, 166-167 Peristalsis, in colonic fiber fermentation, 129 Peritoneal exudate cells (PEC) GLP effects on, 163 PSPC effects on, 167 Peritoneal macrophages (PMs), 166 Peroxide value, of Japanese mushrooms, 89 Peroxyl radical inhibition, by mushrooms, 91 PG101 polysaccharide, from Lentinus lepideus, 165, 170 Phagocytes, 178 Phagocytic responses, 162 polysaccharides and, 148 Phallus impudicus, biosynthesis of phenolic compounds by, 94 Phanerochaete chrysosporium, lignin peroxidase from, 60 Pharmaceuticals from mushrooms, 10, 11, 28 regulation of mushroom, 199-200 Pharmacodynamic agents, safety of, 215 Pharmacology, of sclerotia, 128-134 Pharmacopeia monographs, WHO guidelines and, 202 Phaseolus angularis, protein quality of, 88

Phaseolus calcaratus, protein quality of, 88 Phaseolus vulgaris, protein quality of, 88 Phellinus gilvus, antimetastatic effects of, 171 Phellinus linteus antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 154, 157 polysaccharide-protein complexes from, 160, 162, 166 polysaccharides isolated from, 148, 150, 151 proteoglycan from, 169s Phenolic acids, as mushroom antioxidants, 92 Phenolic antioxidants, in mushrooms, 91-93 Phenolic compounds in cultivated mushrooms, 78 fungal biosynthesis of, 93-94 in mushrooms, 88-89, 90-91 Phenolic pigments, in sclerotial cell walls, 122 Phenotypic variation, in mushroom cultivation, 20 Phenylacetic acid, biosynthesis of, 93 Phenylalanine biosynthesis of, 93 in conventional edible mushrooms, 75 Pholiota adiposa, 86 chemical composition of, 82 classification of, 80 Pholiota nameko, 87 chemical composition of, 82 classification of, 80 world production of, 73 Phosphatidyl biosynthesis, mushroom-related hypocholesterolemia and, 94 Phosphatidylcholine (PC), mushroom-related hypocholesterolemia and, 94 Phosphatidylethanolamine (PE), mushroom-related hypocholesterolemia and, 94 Phosphatidylinositol 1-kinase (PI3K), GLP effects on, 164 Phosphorus in cultivated mushrooms, 76 in mushrooms, 23 in sclerotial dietary fiber, 125 Photosynthesis, as lacking in mushrooms, 10, 28 pH values, of sclerotial dietary fiber, 126 Physicochemical properties, of sclerotia, 126 - 128Physiological processes, in Lentinus edodes, 47 - 48, 61Physiology, of sclerotia during ontogeny, 114 - 115Phytic acids, in cultivated mushrooms, 79 Phytochemicals, regulation of, 200

PicoTitle Plate, in Lentinus edodes sequencing by synthesis, 55 Pigmentation, of cortex, 116. See also Color entries Pigments, in sclerotial cell walls, 122 Pinto beans, protein quality of, 88 Pinus densiflora, in Wolfiporia cocos cultivation, 121 Planting spawn of Lentinus edodes, 14, 15-16 in mushroom cultivation, 13-14 Plants mushrooms versus, 2, 10-11 symbiotic with mushrooms, 4 Plasma, mushroom effects on, 97 Plasma membrane, in Lentinus edodes genetics, 51 - 52Plasmid DNA, in Lentinus edodes transformation, 57-58 Plastic bags, in Ganoderma lucidum cultivation, 20 Platelets, mushroom effects on, 97 pLC1-hph plasmid, in Lentinus edodes transformation, 57-58 Pleurotaceae, classification of, 80 Pleurotus, 83-84 biology and genetics of, 17 chemical compositions of, 81 health and nutritional benefits of, 79 hypocholesterolemic effects of, 96 protein and amino acid content of, 74 protein quality of, 88 world production of, 72, 73 Pleurotus abalones, 83 chemical composition of, 81 classification of, 80 Pleurotus citrinopileatus, 83 antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 156 chemical composition of, 81 classification of, 80 dietary fiber in, 77 protein and amino acid content of, 75 Pleurotus cornucopiae, 83 antitumor polysaccharides from, 156 chemical composition of, 81 classification of, 80 hypocholesterolemic effects of, 96 Pleurotus cystidiosus antioxidants in, 90 carbohydrate content of, 78 dietary fiber in, 77 moisture content of, 73

Pleurotus djamor, 83 chemical composition of, 81 classification of, 80 Pleurotus eryngii, 83 antitumor polysaccharides from, 155, 156 chemical composition of, 81 classification of, 80 hypocholesterolemic effects of, 96 world production of, 72, 73 Pleurotus eryngii var ferulae, 83. See also Pleurotus ferulae ash and mineral content of, 76 chemical composition of, 81 classification of, 80 moisture content of, 73 protein and amino acid content of, 74, 75 Pleurotus eryngii var nebrodensis, 84. See also Pleurotus nebrodensis chemical composition of, 81 classification of, 80 Pleurotus ferulae, chemical composition of, 81, 82. See also Pleurotus eryngii var ferulae Pleurotus florida antitumor polysaccharides from, 155 immunomodulating polysaccharide from, 166 polysaccharides isolated from, 153 Pleurotus nebrodensis, 84. See also Pleurotus ervngii var nebrodensis chemical composition of, 81 classification of, 80 Pleurotus ostreatoroseus, antitumor polysaccharides from, 155 Pleurotus ostreatus, 56, 57, 58, 59, 84 antioxidants in, 90, 92 antitumor glucans from, 157-159 antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 157 ash and mineral content of, 76 carbohydrate content of, 78 chemical composition of, 81 classification of, 80 energy content of, 78 fat content of, 75 hypocholesterolemic effects of, 96 moisture content of, 73 polysaccharides isolated from, 152 protein and amino acid content of, 74, 75 protein quality of, 88 vitamin content of, 76-77 Pleurotus pulmonarius, 84 antitumor polysaccharides from, 155, 156 chemical composition of, 81

classification of, 80 moisture content of, 73 Pleurotus sajor-caju antitumor polysaccharide-protein complexes from, 158 antitumor polysaccharides from, 157 cultivation of, 17 dietary fiber in, 77 lignocellulolytic enzymes of, 10 polysaccharides isolated from, 152 temperature stress in, 59 Pleurotus sapidus, 84 chemical composition of, 81 classification of, 80 hypocholesterolemic effects of, 96 Pleurotus tuber-regium, 121 antioxidants in, 90, 92 antitumor effects of, 132-133 antitumor polysaccharides from, 155 biopharmacological value of sclerotia from, 128 - 134chemical improvement of antitumor polysaccharides from, 177 cultivation of sclerotia of, 117 dietary fiber in, 125, 126-128 fermentation of dietary fiber from, 130 in vivo Ca/Mg absorption and, 131 Polyporus rhinocerus versus, 119 polysaccharides isolated from, 152-153 preparation of dietary fiber from, 126 proximate composition of, 123-124 sclerotia of, 118-119 Pluteaceae, classification of, 80 Poisonous mushrooms, distinguishing from edible, 6 Poland, mushroom production in, 21 Pollution applied mushroom biology and, 9, 11 mushrooms versus, 3 population growth and, 10, 28 Polyethylcne glycol (PEG), 56 Polymerase chain reaction (RAP-PCR), in Lentinus edodes genetics, 36, 50, 51-52 Polymeric chain reactions (PCRs), in generating Lentinus edodes molecular markers, 48. 49-50, 61 Polymers, polysaccharides as, 148 Polyphosphates, in sclerotial cytoplasmic reserves, 122, 123 Polyporaceae, 119 classification of, 80 Polyporus confluens antitumor polysaccharide-protein complexes from, 159

antitumor polysaccharides from, 155, 156, 157 hypolipidemic effects of, 95 Polyporus mylittae sclerotial germination of, 114 sclerotia of, 112 Polyporus rhinocerus, 121 antitumor effects of, 132-133 biopharmacological value of sclerotia from, 128 - 134classification of, 119 cultivation of sclerotia of, 117 dietary fiber in, 125, 126-128 fermentation of dietary fiber from, 130 in vivo Ca/Mg absorption and, 131 preparation of dietary fiber from, 126 proximate composition of, 123 sclerotia of, 119-120 Polyporus tumulosus, biosynthesis of phenolic compounds by, 93 Polysaccharide extracts, of mushrooms, 89-90 Polysaccharide from Ganoderma lucidum (PS-G), 163-164. See also Ganoderma lucidum polysaccharide (GLP) dendritic cells and, 169 Polysaccharide-hydrolytic enzymes, in sclerotial cell walls, 122 Polysaccharide medicines, from mushrooms, 25 Polysaccharide-protein complex (PSPC). See also PSP polysaccharide-protein complex mushrooms and, 24, 25, 160, 167 structure and antitumor activity of, 173-174 Polysaccharide-protein complexes, 148, 149-150, 152, 153, 178, 179 from mushrooms, 158-159 Polysaccharides, 178-179. See also Mushroom polysaccharides in cultivated mushroom dietary fiber, 77 dietary fiber and, 124 in vivo Ca/Mg absorption and, 131, 132 Lentinus edodes degradation of, 36-37 mushroom-related hypoglycemia and, 98 in mushrooms, 25 in sclerotial dictary fiber, 125 structural features of, 148 of Wolfiporia cocos, 120 Polysaccharopeptide (PSP), from mushrooms, 150. See also PSP polysaccharide-protein complex Polyunsaturated fatty acids, in conventional edible mushrooms, 75, 80 Polyuronides, in sclerotial dietary fiber, 125 Population growth, applied mushroom biology and, 9-10, 28

Poria cocos, 120. See also Wolfiporia cocos antitumor polysaccharides from, 155, 159, 160-161 branching configurations of polysaccharides from, 174-175 in chemical improvement of antitumor activity, 177 conformation of polysacchaides from, 176 Pork sausage, Pleurotus tuber-regium in, 118 Porodisculus pendulus, antitumor polysaccharides from, 155 Postharvest studies, of Lentinus edodes, 59, 61 Potassium in cultivated mushrooms, 76 in nonconventional edible mushrooms, 79 Potato dextrose agar (PDA), in Lentinus edodes cultivation, 15 Pregnancy, Wolfiporia cocos in, 120 Preparation, of sclerotial dietary fiber, 126 PriA gene in Lentinus edodes primordium formation, 38 in Lentinus edodes transcriptional regulation, 55.56 Lentinus edodes transformation and, 58-59 PriA gene promoter, in Lentinus edodes transformation, 57, 59 PriA gene terminator, in Lentinus edodes transformation, 57, 59 PriB gene, in Lentinus edodes transcriptional regulation, 55, 56 PRIB protein, in Lentinus edodes primordium formation, 38-43 PRIB regulator, in Lentinus edodes, 46 Primordium, SAGE profiles of Lentinus edodes, 53 Primordium development genes, of Lentinus edodes, 43, 44-47 Primordium formation, in Lentinus edodes, 38 - 44Procatechoic acid, in mushrooms, 91, 92 Process analysis, of Lentinus edodes, 59-61 Prohibition of Exaggerated and Misleading Claims law, in Japan, 214 Promoter analysis, in Lentinus edodes transcriptional regulation, 55-56 Propagation, of mushrooms, 217 Propionate, colonic fermentation and, 130 Prosenchymatous tissue, in medulla, 117 Prostatic cancer antimetastatic offects on, 171 mushroom polysaccharides versus, 150, 157 Protein. See also polysaccharide-protein complexes; Proteins in conventional edible mushrooms, 74-75

from mushrooms, 10-11, 23, 72, 80 in nonconventional edible mushrooms, 79, 81 in sclerotial cytoplasmic reserves, 122, 123 Protein Advisory Group of United Nations System, 79 Protein bodies, in sclerotial cytoplasmic reserves, 123 Protein chelators, in vitro sclerotial binding of minerals and, 128-129 Protein degradation genes, of Lentinus edodes, 42 Protein digestibility, in nutritional evaluation, 87 Protein-digestibility-corrected amino acid score (PDCAAS), in nutritional evaluation, 87 Protein efficiency ratio (PER), in nutritional evaluation, 87, 88 Protein enrichment, via mushroom cultivation, 21.22 Protein kinase C (PKC), 164, 166 Protein phosphates, in Lentinus edodes, 45 Protein quality, of mushrooms, 87-89 Proteins Lentinus edodes degradation of, 36 in Lentinus edodes genetics, 53 as molecular chaperones, 59-60 in mushrooms, 25 polysaccharides and, 148 Protein tyrosine kinase (PTK), 166 Proteoglycans in immune response, 162 immunomodulatory effects of, 169 from mushrooms, 158 Protocatechuic acid biosynthesis of, 93 as mushroom antioxidant, 92 Proximate composition, of sclerotia, 123-124 PSK polysaccharide-protein complex. See also Krestin in angiogenesis, 172 antimetastatic effects of, 171 conformation of, 175 immunomodulatory effects of, 166-167, 169 - 170isolation of, 148, 150 molecular masses of fractions of, 174 from mushrooms, 158, 159-160, 161-162 structure and antitumor activity of, 173-174 PSP polysaccharide-protein complex. See also polysaccharide-protein complex (PSPC); Polysaccharopeptide (PSP) isolation of, 148, 150 from mushrooms, 158, 159-160, 167 structure and antitumor activity of, 173-174 Pyruvate decarboxylase, in Lentinus edodes, 48

Qualified FOSHU, in Japan, 213 Qualified health claims, 206 Quality control, 220 in European Union, 209 of mushroom dietary supplements, 201 Radiation treatment, mushrooms and, 25 Rain forests, mushrooms in, 2 Random-amplified polymorphic DNA (RAPD), in generating Lentinus edodes molecular markers, 48, 49, 61 Ras gene promoter, in Lentinus edodes transformation, 57, 59 Rats in vivo Ca/Mg absorption studies using, 131 - 132mushroom protein intake by, 88, 89 mushroom-related hypocholesterolemia studies in. 94 mushroom-related hypoglycemia studies in, 98.99 Reactive nitrogen intermediates (RNIs), 160 PSPC effects on, 167 Recombinant DNA (rDNA), in mushroom cultivation, 20. See also Deoxyribonucleic acid (DNA) RecQ-type DNA helicase, in Lentinus edodes, 46 Redness, of sclerotial dietary fiber, 126 Reduction of Disease Risk FOSHU, in Japan, 213-214 Reference works, in mushroom identification, 6 Regulation of mushrooms. 199-224 standardization problems with, 201 Regulatory mechanisms, polysaccharides in, 148 Reishi mushroom, 207 Representational difference analysis (cDNA-RDA), in Lentinus edodes genetics, 36. See also cDNA representational difference analysis (cDNA-RDA) Reproductive growth phase, in mushroom cultivation, 11-12 Reproductive organs, of filamentous fungi, 111-112 Restriction enzyme-linearized plasmid DNA, in Lentinus edodes transformation, 57-58 Restriction enzyme-mediated integration (REMI), for Lentinus edodes transformation, 57-58 Restriction enzymes, in Lentinus edodes transformation, 57-58 Restriction fragment length polymorphisms (RFLPs), in generating Lentinus edodes molecular markers, 48, 49

Rhamnoglucogalactan, from mushrooms, 156 Rhamnose in cultivated mushroom dietary fiber, 78 in sclerotial dietary fiber, 125 Rhizomorphs, of filamentous fungi, 111, 112 Riboflavin, in cultivated mushrooms, 76 Riboglucan, from mushrooms, 155 Ribonucleic acid (RNA), in cultivated mushrooms, 79. See also mRNA expression; RNA synthesis Ribonucleic acid fingerprinting, of Lentinus edodes, 36 Ribonucleic acid-reduced biomass, from fungal hyphae, 80 Ribonucleotide reductase (RNR) in Lentinus edodes, 45 in Lentinus edodes meiosis, 60-61 Rice straw, in Volvariella cultivation, 17-18 Rigidoporus ulmarius, antiangiogenesis and, 173 Rind cortex and, 116 of Polyporus rhinocerus, 119 in sclerotial ontogeny, 113 structure of, 115-116 of Wolfiporia cocos, 120 RNA synthesis, in Lentinus edodes, 45. See also Ribonucleic acid (RNA) Rolled oats, protein quality of, 88 Saccharomyces cerevisiae, 46, 57, 56 Safety, 220. See also Food safety systems defined, 215-216 of dietary supplement types, 215-218 of functional foods, 208 via submerged culturing, 219 WHO guidelines and, 202 Safety warnings, for US dietary supplements, 205 SAGE 2000 Software, in Lentinus edodes genetics, 52 Salmonella typhimurium, in antioxidant assays,

92 Sammin Mycological Institute, 79, 81, 82 Sanger sequencing technology, in *Lentinus edodes* sequencing by synthesis, 55 Saprophytes, mushrooms as, 4, 5 *Sarcodon aspratus* - antitumor polysaccharides from, 157 fucogalactan from, 166 Sarcoma, 175 antimetastatic effects on, 171 chemical improvement of antitumor activity versus, 177 Sarcoma, (Continued) mushroom polysaccharide-protein complexes versus, 160 mushroom polysaccharides versus, 150-151 Sawdust, in Lentinus edodes cultivation. 16 SCG (Sparassis crispa β-glucan), 151 immunomodulatory effects of, 164, 170-171 Schizophyllan antitumor effects of, 165 branching configuration of, 175 in chemical improvement of antitumor activity, 176 conformation of, 175 isolation of, 148, 150 from mushrooms, 155, 161, 165 regulation of, 200 Schizophyllan-OH, conformation of, 176 Schizophyllum commune, 38 antitumor polysaccharides from, 155 carbohydrate content of, 78 fat content of, 75 medicines from, 25 moisture content of, 74 polysaccharides isolated from, 148, 150 protein and amino acid content of, 74 protein quality of, 88 regulation of polysaccharides from, 199-200 Schizosaccharomyces pombe, 43 Science, in mushroom cultivation, 20-21 Scleroglucan, from mushrooms, 155 Sclerotia, xvii, 111-146, 178 antitumor polysaccharides from, 159 biochemical characteristics of, 121-123 biopharmacological values of, 128-134 cell walls of, 121-122 cultivation of, 117-121 cytoplasmic reserves of, 122-123 dietary fiber in, 124-126 extracellular matrix of, 122 in human diet, 72 lipid bodies in, 123 medicinal value of, 149 morphology and size of, 112 nutritional evaluation of, 123-126 ontogeny of, 112-115 physicochemical properties of, 126-128 polyphosphate granules in, 123 protein bodies in, 123 structure of, 115-117 world production of, 117 Sclerotinia cortex of, 117 sclerotial germination of, 114 sclerotia of, 112

Sclerotiniaceae, sclerotia of, 112 Sclerotinia libertiana, antitumor polysaccharides from, 155 Sclerotinia minor cortex of, 115 glycogen reserves of, 122 rind of. 116 sclerotial germination of, 114 Sclerotinia sclerotiorum, rind of, 116 Sclerotinia trifoliorum, rind of, 116 Sclerotinium sclerotiorum, sclerotial germination of. 114 Sclerotium rolfsii ontogeny of, 113 sclerotia of, 112 Sclerotium sclerotia, antitumor polysaccharides from, 155 Seasonality, of mushrooms, 2-3 Secretion phase, in mushroom cultivation, 12, 13 Selection phase, in mushroom cultivation, 12-13 Selective breeding, in mushroom cultivation, 20 Selenium, in cultivated mushrooms, 76 Selenium enrichment, of mushrooms, 24 Septa, of rind, 115 Sequence characterized amplified region (SCAR) markers, for Lentinus edodes, 48, 49, 50 Sequence tags, in Lentinus edodes genetics, 52, 53 Sequencing-by-synthesis approach (454 Life Science), in Lentinus edodes genetics, 36, 51, 54-55, 60 Serial analysis of gene expression (SAGE), in Lentinus edodes genetics, 36, 50, 51, 52-53, 61 Serine-rich proteins, in Lentinus edodes genetics, 53 Serious adverse effects, under US regulations, 208 Serum, mushroom effects on, 97 Serum total cholesterol (TC), mushrooms reducing, 97 S-GAP-P polysaccharide, in chemical improvement of antitumor activity, 176 Shiitake mushroom, xvii, 14, 35-69, 207. See also Lentinus edodes hypocholesterolemic effects of, 94 popularity of, 35 safety of, 215 Shikimic acid pathway, in phenolic compound biosynthesis, 93 Short-chain fatty acids (SCFAs), colonic fermentation and, 129-130

Short-log cultivation, of Ganoderma lucidum, 19 - 20Signal transduction, in Lentinus edodes, 47, 61 Signal transduction genes in Lentinus edodes. 44-45, 54 in Lentinus edodes primordium formation, 38, 39 - 40Single-helix conformation, 175, 176 Size, of sclerotia, 112 Sodium in cultivated mushrooms, 76 in nonconventional edible mushrooms, 79 Solid-state fermentation, in mushroom cultivation, 10-11 Soluble dietary fiber (SDF) in cultivated mushrooms, 77, 81 of sclerotia, 124, 125 Soluble sugars, in cultivated mushrooms, 78 Soup, Pleurotus tuber-regium in, 118 South Australian Working Party on Natural and Nutrition Supplements, 211 South East Asia, Volvariella cultivation in, 17 - 18Soybean waste, applied mushroom biology and, 11 Sparassis crispa, 164 antitumor polysaccharides from, 155 branched β -glucan from, 170–171 polysaccharides isolated from, 148, 150, 151 Spawn development phase, in mushroom cultivation, 12, 13 Spawn inoculation, of Wolfiporia cocos, 121 Spawn running in Agaricus cultivation, 14 of Lentinus edodes, 14 in mushroom cultivation, 13 Spawn substrates in Lentinus edodes cultivation, 15-16 in Pleurotus cultivation, 17 Specialists, in mushroom identification, 6 Specialization, in biology, 7 Spleen cells (splenocytes), mushroom polysaccharide effects on, 163-167 Spore formation genes, of Lentinus edodes, 41 Spore germination, in Lentinus edodes cultivation, 15 Spore print, in mushroom identification, 5 Spores, in mushroom identification, 5 Sporobolomyces roseus, biosynthesis of phenolic compounds by, 93 Ssb gene, molecular chaperones and, 59-60 Stabilization, of sclerotial dietary fiber, 126 Stalk, in mushroom identification, 5 Standardization

in Australia and New Zealand, 211-212 of European dietary supplements, 209 of mushroom dietary supplements, 201 Standardized FOSHU, in Japan, 213 Starch, Lentinus edodes degradation of, 36-37 Starch utilization genes, of Lentinus edodes, 40 Sterilization, in mushroom cultivation, 13 Sterols, as mushroom antioxidants, 92 Stil gene, molecular chaperones and, 59-60 Stipe elongation, in Lentinus edodes, 44 Stock culture in mushroom cultivation, 13 preparation of, 13-14 Strains, of Lentinus edodes, 50 Strands of filamentous fungi, 111 in sclerotial ontogeny, 113 Straw mushroom, 17-18. See also Volvariella hypocholesterolemic effects of, 97 Streptomyces hygroscopicus, 57 Streptozotocin (STZ), mushroom-related hypoglycemia and, 98, 99 Stress response genes, of Lentinus edodes, 42 Stress responses, of Lentinus edodes, 59-60, 61 Stromata, of filamentous fungi, 111 Strophariaceae, classification of, 80 Stropharia rugoso-annulata, 87 chemical composition of, 82 classification of, 80 Structural proteins, in Lentinus edodes, 48 Structure, of sclerotia, 115-117 Structure-function (SF) claims, US regulation of, 205-208 Submerged culturing, safety via, 219 Substrate, in sclerotial ontogeny, 113-114. See also Cultivation substrate Substrate preparation phase in Agaricus brasiliensis cultivation, 18-19 in Ganoderma lucidum cultivation, 19-20 in Lentinus edodes cultivation, 15-16 in mushroom cultivation, 12, 13, 14 in Pleurotus cultivation, 17 Substrate-specific factors, in colonic fiber fermentation, 129 Substrate-utilizing genes, of Lentinus edodes, 36 - 37Sugar residues, in sclerotial dietary fiber, 125 Sugars. See also Carbohydrates in conventional edible mushrooms, 75 in cultivated mushroom dietary fiber, 77-78 in mushrooms, 25 Suillus, peroxide value of, 89 Sulfation, in chemical improvement of antitumor activity, 176, 177

Sulfonation, in chemical improvement of antitumor activity, 177 Sulfur-containing amino acids, in mushroom protein, 88, 89 Superoxide free radicals, mushroom scavenging of, 89-90 Supplement facts box, in labeling, 204-205 Suppression subtractive hybridization, of Lentinus edodes, 51 Sweet components, in conventional edible mushrooms, 75 Symphytum officinale, safety of, 216 Synnemata, of filamentous fungi, 111, 112 Tags, in Lentinus edodes genetics, 52, 53. See also Expressed sequence tags (ESTs) Taiwan, Wolfiporia cocos consumption in, 120 - 121Tannins, in mushrooms, 88 TATA box, in Lentinus edodes transcriptional regulation, 55-56 TCA (tricarboxylic acid; citrate) cycle, in Lentinus edodes, 48. See also Tricarboxylic acid (TCA) T cells D-fraction and, 167-168 effects of lentinan on, 165 mushroom polysaccharides and, 150 PSK response of, 166–167 TCP1 gene, molecular chaperones and, 59-60 Technological innovation, in mushroom industry, 22 Temperature in Agaricus brasiliensis cultivation, 18 in Agaricus cultivation, 14 in Lentinus edodes cultivation. 15 in Pleurotus cultivation, 17 in Volvariella cultivation, 17-18 Temperature stress, in mushrooms, 59, 60 Terfezia arnenari, 2 Terfezia claveryi, protein quality of, 88 Terminal cells, of rind, 115-116 Terminal development, of sclerotia, 113 Termitomyces eurhinus, antitumor polysaccharides from, 155 Termitomyces robustus energy content of, 78 protein quality of, 88 Texture, of sclerotial dietary fiber, 126 The Institute for Genome Research (TIGR), in Lentinus'edodes genetics, 54 Therapeutic adjuvants, mushroom polysaccharides as, 147-148 Therapeutic agents, from mushrooms, 150

Therapeutic pharmacodynamic activity, safety of, 215 Thickening, of sclerotial dietary fiber, 126 Thin-layer chromatography (TLC), in antioxidant assays, 92 Threonine in conventional edible mushrooms, 74, 75 in mushroom protein, 89 Tiger milk mushroom, 118 tlg1 gene, in Lentinus edodes, 59 TLR pathway, in immune response, 162 Toads, mushrooms and, 2 Toadstools, 2 α -Tocopherol, in mushroom antioxidant assays, 90.92 Total color difference, of sclerotial dietary fiber, 126 Total dietary fiber (TDF) in cultivated mushrooms, 77-78 in nonconventional edible mushrooms, 79, 81 in sclerotia, 125 Total productivity, of biomass materials. 28 Toxicity of mushrooms, 6 of nutrients, 216-217 Toxic substances, in mushroom cultivation, 13 Traditional mushroom products, safety of, 216 Trametes, hypolipidemic effects of, 95 Trametes gibbosa, antitumor polysaccharides from, 155 Trametes versicolor, regulation of polysaccharides from, 199-200. See also Coriolus (Trametes) versicolor Transcriptional factor binding sites (TFBSs), in Lentinus edodes transcriptional regulation, 55 Transcriptional factors (TFs), in Lentinus edodes transcriptional regulation, 55 Transcriptional regulation, of Lentinus edodes, 55 - 56Transcription regulation genes, in Lentinus edodes primordium formation, 38, 39-40 Transformation, of Lentinus edodes, 56-59 Transformation methods, for Lentinus edodes, 56 - 58Transgenic breeding, transformation in, 56, 57 Translocation, of sclerotia during ontogeny, 114 - 115Transmission electron microscopy (TEM), in sclerotial cytoplasm studies, 122 Transport genes, of Lentinus edodes, 38, 41 Trehalose in cultivated mushrooms, 78 during sclerotial development, 114

Tremella, Chinese production of, 72, 73 Tremella aurantia dietary fiber in, 125 hypolipidemic effects of, 95 mushroom-related hypoglycemia and, 98-99 Tremella cinnabarina, world production of, 73 Tremella fuciformis antitumor polysaccharide-protein complexes from, 159 antitumor polysaccharides from, 156, 157 dietary fiber in, 77, 125 hypocholesterolemic effects of, 97 hypolipidemic effects of, 95 mushroom-related hypoglycemia and, 98-99 Tremella mesenterica, antitumor polysaccharides from, 157 Triangular model, for mushroom classification, 5 Tricarboxylic acid (TCA), Lentinus edodes and, 44. See also TCA (tricarboxylic acid; citrate) cycle Tricholoma, 173 Tricholoma giganteum antioxidants in, 90 antitumor polysaccharide-protein complexes from, 159 antitumor polysaccharides from, 155, 157 carbohydrate content of, 78 dictary fiber in, 77 fat content of, 75 protein and amino acid content of, 74 world production of, 73 Tricholoma lobayense antitumor polysaccharide-protein complexes from, 159 medicines from, 25 polysaccharide-protein complexes from, 160. 167 Tricholoma matsutake, 72 antitumor polysaccharide-protein complexes from, 159 ecological classification of, 5 as saprophyte, 4 Tricholoma mongolicum, antitumor polysaccharide-protein complexes from, 159 Tricholoma portentosum dietary fiber in, 77 protein and amino acid content of, 74, 75 protein quality of, 88 Tricholomataceae, 35 antioxidants in, 90 classification of, 80 Tricholoma terreum carbohydrate content of, 78

dietary fiber in, 77 fat content of, 75 protein and amino acid content of, 74, 75 protein quality of, 88 Triggers in Lentinus edodes primordium formation, 38 in mushroom cultivation, 12 Triglycerides, mushrooms as lowering, 96-97 Triple-helix conformation, 175-176 Triterpenes in mushrooms, 25 in sclerotial antitumor and immunomodulatory studies, 133 True protein digestibility (TPD), of mushrooms, 88 Truffles desert, 2 matsutake, 4, 5 Pengold black, 4 Tryptophan biosynthesis of, 93 in conventional edible mushrooms, 74, 75 Tuber melanosporum, 72 ecological classification of, 5 as saprophyte, 4 Tumor necrosis factor alpha (TNF- α), 151, 160, 163, 164, 166, 167, 178 effects of lentinan on, 165 Tumor xenografts, in sclerotial antitumor and immunomodulatory studies, 133-134 Tuna fish, protein quality of, 88 Tylopilus felleus, antitumor polysaccharides from, 155 Type 2 diabetes, 207 Typhula, sclerotia of, 112 Typhula incarnata cortex of, 117 medulla of, 117 protein bodies in, 123 rind of, 116 Typing, of Lentinus edodes, 50 Tyrosine biosynthesis of, 93 in conventional edible mushrooms, 75 Ubiquitins, of Lentinus edodes, 43-44 Umami flavor, of edible mushrooms, 74-75. 78 - 79Umbilical cord blood (CB) cells, 170 UMP-CMP kinase, in Lentinus edodes, 45 United Kingdom food safety systems in, 219-220

mushroom nutriceutical regulation in, 201 regulation of dietary supplements in, 210 United States, 220. See also American entries; Federal entries; Food and Drug Administration (FDA) drug regulation in, 218 food safety in, 215 introducing medicinal-mushroom dietary supplements in, 203-208 medicinal mushroom use in, 25 mushroom nutriceutical regulation in, 200, 201 Unsaturated fatty acids, in conventional edible mushrooms, 75, 80 Uronic acids in cultivated mushroom dietary fiber, 77, 78 in sclerotial dietary fiber, 125 Vacuolation, of cortex, 116 Vacuoles, in rind cells, 116 Valine in conventional edible mushrooms, 74, 75 in mushroom protein, 89 Variability, of polysaccharides, 148 Vascular endothelial growth factor (VEGF), in angiogenesis, 172 Vegetables, mushrooms as, 72 Vegetative growth phase, in mushroom cultivation, 11, 12 Verticillium dahlae lipid bodies in, 123 sclerotia of, 112 Vietnam, mushroom production in, 21 Vitamin B₁, in cultivated mushrooms, 77 Vitamin B2, in cultivated mushrooms, 76 Vitamin B₁₂, in cultivated mushrooms, 77 Vitamin B12 deficiency, 217 Vitamin C in cultivated mushrooms, 77 mushroom polysaccharides and, 150 Vitamin D₂, in cultivated mushrooms, 77 Vitamins in conventional edible mushrooms, 76-77 in dietary supplements, 200 European Union regulation of, 209 labeling of, 204-205 in mushrooms, 23, 80 in nutrition, 23 Vitapurity, FDA detention of, 207 Volvariella cultivation of, 17-18 industrial-scale cultivation of, 18 world production of, 72, 73 Volvariella bombycina dietary fiber in, 77 fat content of, 75

protein and amino acid content of, 75 Volvariella volvacea, 58 anatomy of, 3 antioxidants in, 90, 91 antitumor polysaccharides from, 155 carbohydrate content of, 78 classification of, 80 hypocholesterolemic effects of, 97 hypolipidemic effects of, 95 lignocellulolytic enzymes of, 10 medicinal effects of, 24 protein and amino acid content of, 74 world production of, 73 Wasser, Solomon P., xxi, 27, 199 Wasson, R. Gordon, 1 Wastes, applied mushroom biology and, 9, 10 - 11, 28Water in nutrition, 23 during sclerotial development, 114 Water-binding capacity (WBC), of sclerotial dietary fiber, 126, 127 White jelly-leaf mushroom, hypocholesterolemic effects of, 97 Whiteness, of sclerotial dietary fiber, 126 White rot fungus Lentinus edodes as, 60 Polyporus rhinocerus as, 119 WHO Food Standards Programme, 202-203. See also World Health Organization (WHO) WHO Nutrient Risk Project, 203 Wild edible fungi, Israeli regulation of, 214-215 Wild Edible Fungi: A Global Overview of Their Use and Importance to People (FAO), 214 - 215Wild edible mushrooms, health and nutritional benefits of, 79-80, 81-87 Wild mushrooms edible, 72, 73 international movement for, 27 in mushroom industry, 26 Wolfiporia cocos. See also Poria cocos antitumor effects of, 133 biopharmacological value of sclerotia from, 128 - 134cultivation of sclerotia of, 117 dietary fiber in, 125-126, 126-128 fermentation of dietary fiber from, 130-131 hypolipidemic effects of, 95 in vivo Ca/Mg absorption and, 131-132 preparation of dietary fiber from, 126 proximate composition of, 123, 124 sclerotia of, 120-121

Wong, Ka-Hing, xxi, 111 Wood in biomass waste, 10 in Ganoderma lucidum cultivation, 19-20 in Lentinus edodes cultivation, 15, 16 in Wolfiporia cocos cultivation, 121 Wood rot fungus Lentinus edodes as, 15 Pleurotus tuber-regium as, 118 Working Party on Natural and Nutrition Supplements, 211 World Health Organization (WHO). See also WHO entries on introducing medicinal-mushroom dietary supplements, 202, 220 on mushroom protein and amino acid content, 74 World mushroom production, 21-23 World population growth, applied mushroom biology and, 9-10, 28 World production, of cultivated mushrooms, 72-73.117 World Society for Mushroom Biology and Mushroom Products (WSMBMP), 21 formation of, 27

Xanthosine monophosphate (XMP), in cultivated mushrooms, 78

Xenografts, in sclerotial antitumor and immunomodulatory studies, 133-134

- X fraction, mushroom-related hypoglycemia and, 98
- Xiang gu mushroom, 14, 35. See also Lentinus edodes

X-ray microanalysis, of polyphosphate granules, 123

X-ray microanalyzer, in sclerotial dietary fiber studies, 125

Xylan Lentinus edodes degradation of, 60 from mushrooms, 152, 156 Xylanase genes, in Lentinus edodes transcriptional regulation, 56 Xylaria nigripes, cultivation of sclerotia of, 117 Xylogalactoglucan, from mushrooms, 156 Xyloglucan, from mushrooms, 152, 155, 156 Xvloglucan-protein complex, from mushrooms, 158, 159 Xyloglucomannan, from mushrooms, 157 Xylomannan, from mushrooms, 156 Xylopyranosyl residues, mushroom-related hypoglycemia and, 98 Xylose, in cultivated mushroom dietary fiber, 78 xyn11A gene, in Lentinus edodes, 60 Yeast, in sclerotial antitumor and immunomodulatory studies, 133 Yeast two-hybrid system, in Lentinus edodes genetics, 51, 54 Yellowness, of sclerotial dietary fiber, 126 Yunnan Province, Pleurotus tuber-regium consumption in, 118

Zero emissions, 28

Zinc

- in cultivated mushrooms, 76
- in vitro sclerotial binding of, 128-129
- in *Lentinus edodes* primordium formation, 38–43
- in sclerotial dictary fiber, 125
- Zygomycota, classification of, 80
- Zymosan, in sclerotial antitumor and immunomodulatory studies, 133