

Index

Note: Page numbers followed by *f* and *t* refer to figures and tables, respectively

- A**
Acetabularia acetabulum, 103
Acetyl coenzyme A (ACoA)
 alternate potential fuel products of, 420
 insulin regulated by, 444
 synthesis inside plasmid, 205–206, 206*f*
Acid sphingomyelinase (ASM), 222–223
Adenosine triphosphate (ATP), 4
Adhesion and omega-3 fatty acids role in, 164–165
Adhesion molecules, expression of, 309
Adipose tissue
 accretion, linoleic acid's role in, 434–436, 435*f*, 436*f*
 composition of plasma nutrients by, 445
 half-life of, 444–445
 LA rich diets effect on, 431–433, 431*f*, 432*f*
Age-related macular degeneration (AMD), 251–254
 current research in, 253
 dry, 253
 observational studies in, 253–254, 254*f*
 para-inflammation in, 252
 pathogenesis of, 251–252
 treatment options for, 252–253
 wet, 254
Aging
 antioxidants role in, 507
 disorders, fish oil fatty acids for, 585–594
Agrotis ipsilon Hfn., 37
Ahiflower oil, 87
Albumin, as transport mechanism, 390
Alcohol concentration, effect on emulsion formation, 133
Algal oil, 85, 86
Allostasis–homeostasis–stress integration, 7–8
Alpha-linolenic acid (ALA), 12, 13–14, 45, 46, 80, 321, 351
 absorption of, 387–388, 388*f*
 and cancer, 373–374, 374*f*
 chemical structure of, 174*f*, 514*f*
 delivery of, 387
 phosphatidylcholine for, 388–389, 388*f*
 desaturase function, 354–355
 dietary
 absence of, 440, 440*f*
 balance of, 421–423
 effect on brain function, 410
 digestion of, 387
 as essential nutrients, 351
 evolutionary importance of
 anoxic environment, 327–331, 328*f*
 conditions of existence, 322
 light and energy, 324–326, 325*f*, 326*f*
 light-protective evolutionary niches, 326–327
 organised structure, 331–332
 womb and cradle of life, 322–324
 feed efficiency in livestock, 440
 in human fat tissue, 439
 in humans, 344, 351–352
 limited capacity of antioxidants, 356–357, 357–359*f*
 linseed, 24
 in mammals, 344
 marine algae, 113*t*
 mechanisms of action, 178–179
 metabolism, 440
 in monogastrics, 439
 and non-alcoholic fatty liver disease, 440
 omega-3-eggs, 54–59, 56*t*
 omega-6 oxylipins, negative effects of, 356–357, 357–359*f*
 oxidative overload, 355–356
 oxidised products, physiological relevance of, 358–362
 COX and LOX 12/15 enzymes, 360–362
 CTP450 enzymes, 362
 multiple pathways, 358–359
 9 and 13HODE, 359–360
 oxylipins, 360
 photo-oxidation products, 360
 sensitivity, 358
 peroxisomal beta-oxidation of, 439–440, 451–461
 peroxisomes, 451–461
 pharmacology and therapeutic benefits of, 174–178
 physiological consequences of, 352–354, 353*f*
 in plants
 cardiolipin, 342–343
 chiral lipid forms, 344
 COX, 341
 energy production and storage, 341
 eukaryotes, conservation of gene pathways in, 339–340
 galactolipids and phosphatidylcholine, 340
 immune system and predator defence, 342
 light sensing, 343–344
 LOX, 341
 oxidised derivatives and signaling systems, 342
 peroxisomes, 340–341
 photosynthesis and UV protection, 340
 reproduction and fast storage, 342
 in structural brain lipids, 414
 thermogenesis, 440
 uptake and usage by brain, 414–415
 uptake pathways of, 387

- and vascular disease, 406
 - vesicles, 332–339, 335–338f
 - Alternaria* blight
 - disease development, 39
 - management, 39
 - Alzheimer's disease (AD), 235–236
 - lipid composition imbalance and, 423
 - omega-3 fatty acids role in, 236–237
 - β -Amyloid protein, 236
 - Anagallis arvensis*, 36
 - Angiogenesis, omega-3 fatty acids role in, 164–165
 - Animal feed, omega-3 fatty acids, 85
 - Animal studies. *See also* Rabbits; Rodents
 - obesity, 178
 - omega-3 fatty acids role in cancer, 167
 - Anther culture, 27, 30
 - Antigen-presenting cells (APCs), 309
 - Antihypertensive drugs, drug interaction, 575
 - Anti-inflammatory effect, of dietary omega-3, 308–309
 - Antioxidants
 - natural, 502
 - role in human health, 501–508, 508f
 - aging, 507
 - cancer, 505–506
 - cardiovascular diseases, 502–504, 503f, 505f
 - chronic kidney disease, 504–505, 505f
 - diabetes mellitus, 504, 505f
 - neurodegenerative diseases, 506–507
 - obesity, 507
 - sources of, 502
 - Antiplatelet agents, drug interaction, 573–574
 - Apolipoprotein E polymorphisms, 73–74
 - Apoptosis, omega-3 fatty acids role in, 164
 - APP^{swe} (Tg2576) transgenic mouse model, 236
 - Aquaculture, 480–481
 - Arabinoxylans, structure of, 182f
 - Arachidonic acid (ARA), 47, 48, 85
 - derived lipid mediators
 - in brain, chemical structures of, 241f
 - enzymatic and non-enzymatic, 242–243
 - marine algae, 113t
 - Archean, 324–327, 330
 - Ardeola grayii*, 37
 - Arrhythmias
 - fish oil fatty acids for, 589–590
 - omega-3 fatty acids effect on, 519
 - Arrhythmogenic right ventricular dysplasia (ARVD), 394
 - Asthma, 147, 150r, 312
 - Astrocytes, 415–416, 417
 - Autophagy, 7
- B**
- Baby food, 95
 - Bakery, 94
 - B-cell inhibitors, for rheumatoid arthritis, 145, 147
 - Beta oxidation, 341. *See also* Peroxisomal beta-oxidation
 - mobilisation of fats out of adipose tissue and, 434
 - of n-3 PUFA, 566
 - peroxisomal DHA, 455
 - preferred substrates for, 454
 - protection of long-chain fats in brain, 417
 - regulation of insulin, and, 444
 - to support mitochondrial ATP production, 458–459
 - use of, 439–440
 - Beverages, 95
 - Biological evolution, 3–4
 - Birds, 16, 456
 - omega-3 enrichment to, benefits of, 18, 58–59
 - Bleeding complications, omega-3 fatty acids and, 569–571
 - Blood pressure, in metabolic syndrome, 198
 - Bone density, 288
 - Bone health, fish oil fatty acids for, 590–591, 592–693r
 - Bone remodeling
 - inflammation and, 286–287
 - omega-3 fatty acids, negative effect of, 289
 - oxidative stress and, 286–287
 - Bone resorption, 285–289
 - Bone turnover, 285–289
 - breast cancer and, 288–289
 - Bornetia secundiflora*, 114
 - Brain
 - mitochondria, 416
 - omega-3 fatty acids role in, 235
 - sensitivity to oxidative stress, 421
 - Breads, 94
 - Breast-feeding, 572–573
 - Breast milk, polyunsaturated percentage content of, 407
 - Bud fly (*Dasyneura lini* Barnes), 36
- C**
- Cadra cautella* Walk, 36
 - Cancer, 372–374
 - alpha-linolenic acid, 373–374, 374f
 - antioxidants role in, 505–506
 - breast, and bone turnover, 288–289
 - epithelial tissues, role of, 372
 - linoleic acid and, 373–374, 374f
 - omega-3 fatty acids role in, 157–168
 - adhesion and angiogenesis, 164–165
 - animal studies, 167
 - apoptosis, 164
 - combination with chemotherapeutic agents and drug resistance, 165–167
 - immunomodulation, 165, 166f
 - inflammation, 161–163, 162f
 - limitless cell proliferation, 164
 - lipid peroxidation, 159–160, 161f
 - lipid rafts and signal transduction, physicochemical properties of, 163, 164f
 - metastasis, 165
 - OLR1 and, 372
 - relationship with LA oxidised products, 372
 - Canola, omega-3 enrichment, 57
 - Carbohydrate metabolism, in metabolic syndrome, 193–197, 194–197r
 - Carcinogenesis, omega-3 fatty acids and, 571
 - Cardiac arrhythmias, 302
 - Cardiolipin, 342–343, 366–368
 - damage, 400–401, 401f
 - mitochondrial function of, 421–422
 - Cardiovascular diseases (CVD)
 - antioxidants role in, 502–504, 503f, 505f
 - mitochondrial dysfunction and, 231
 - monosaturated fat and, 404–406
 - omega-3 fatty acids role in, 513–524, 516f, 520–521r
 - adverse effects of, 523–524
 - dosage recommendations, 523r
 - pharmacological preparations and dosages, 523
 - supplementation, 312–313
 - saturated fat and, 403–404, 404f, 405f
 - Cardiovascular protection, omega-3 PUFA in, 301–302

- Catalase (CAT), 371, 501
Cathartolinum, 22
Caulerpa, 106
Caulerpa racemosa, 114
Caulerpa veravalnensis, 114
 CD36, 395–396
 Census of Marine Life, 103
Chaetomorpha sp., 114
 Chemical evolution, 3–4
Chenopodium album, 36
 Chewable softgels, 83–84
 Chia seeds, 80
Chiococca, 22
 Chiral lipid forms, 344
 Chiral oxylipin products, 365
Chlamydomonas, 106
Chlamydomonas reinhardtii, 117–119
Chlorella, 106
Chlorella minutissima, 120
Chlorella pyrenoidosa, 119
 Chocolates, 96–97
 Cholesterol lowering eggs, 62
Chondrus, 105
 Chronic degenerative disease, 1
 Chronic kidney disease (CKD)
 antioxidants role in, 504–505, 505*f*
 omega-3 fatty acids effect on, 521–522, 522*f*
 Chylomicrons, lipid delivery to fat cells by, 433
Cladophora albida, 114
 Clinical nutrition, omega-3 fatty acids, 85–86
 Coacervation, 132–133
Coccinella septempunctata Linn, 37
 Coconut fat, 403
 Codex alimentarius, and human nutrition, 108–109
Codium fragile, 115
 Cone dystrophies, 256
 Confectionary, 96–97
 Conjugated linoleic acid (CLA)-enriched eggs, 61–62
Corallina pilulifera, 115
Coralline, 105
Corcyra cephalonica, 36
 Coronary heart disease (CHD), 53, 302
 CPT1 enzymes, 416, 417–418
Crassostrea gigas, 111
Cryptocodinium cohnii, 111
 CTP450 enzymes, 362
 Cultivars, linseed, 24, 31
Cuscuta sp., 32, 36, 38, 40
Cyanidioschyzon merolae, 116
 Cyclooxygenases (COX), 161–163
 alpha-linolenic acid, 341
 linoleic acid, 341
 12/15 enzymes, 360–362
 role in oxidative stress reduction, 397
Cystoseira hakodatensis, 115
Cystoseira indica, 114
 Cytochrome p450 (CYP450), 161
 Cytokine inhibitors, for rheumatoid arthritis, 145
 Cytokines, pro-inflammatory, 309
 Cytoplasmic fatty acid pool, 209
- D**
 Dairy products, 94–95
Dasylinum, 22
 Deoxyribonucleic acid (DNA), 3–4, 6
 Desaturation, in fatty acid biosynthesis, 208
 Designer eggs, 61–62
 Diabetes mellitus (DM)
 antioxidants role in, 504, 505*f*
 gestational, 492
 omega-3 fatty acids effect on, 313–314, 516–517, 517*t*
 Diabetic cardiomyopathy, 223–224
 Diabetic mitochondria, 231–232
 Diabetic nephropathy, 222
 Diabetic neuropathy, 225
 Diabetic retinopathy, 222–223
 Diacylglycerol (DAG)
 de novo synthesis of, 209
 PC-derived, synthesis of, 209
 TAG synthesis from, 209–210
Dicrurus adsimilis, 37
 Diet and Reinfarction Trial (DART), 468
 Diet–heart hypothesis, 406
 Dietary absence of alpha-linolenic acid, 440, 440*f*
 Dietary fibre, linseed, 24
 Dietary supplement, omega-3 fatty acids, 83–84
 Diets
 ALA deficiency in, 366
 fat content in, 554–555
 high-fat preindustrialised, 407
 low-fat, 406
 and nutrition, 229
 ω -6 and ω -3 fatty acids in, 204–205
 alternative origins for, 475–483
 phosphatidylcholine composition, 388
 supplementation
 in old population, 311
 on pregnancy and lactation in relation to infant allergies, 311
 and Western disease, 374
 Digestion absorption, 5–6
 Dilution test, 134
 Disease of civilisation, 1. *See also individual diseases*
 Docosahexaenoic acid (DHA), 12, 45–47, 80–81
 biotransformation pathways of, 567*f*
 in brain, 422–423
 interaction with iron during gestation, 296
 marine algae, 109–113, 113*t*
 metabolism, enzymatic and non-enzymatic mediators of, 244–246, 244–246*f*
 omega-3-eggs, 54–59, 56*r*, 61, 62
 prevention of neuroinflammation by, 246–247
 for psoriasis
 resolvins and protectins, 534, 534*t*
 role of, 533*t*
 -rich algae oil, 263–266
 in pregnancy and development, 264–265
 supplementation, 264
 role in human brain evolution, 9
 vesicle membrane, 334, 336*f*
 Drug interactions, of omega-3 fatty acids, 573–576
- E**
 Ectopic gene expression, promoters of, 214, 215*t*
 Eggs
 compared with omega-3-eggs, 53*t*
 global production, 52–54
 health benefits of, 52
 nutritional content, 52
 Eicosanoid metabolism, iron and, 296–297, 297*f*
 Eicosapentaenoic acid (EPA), 12, 14, 15, 45, 80–81

- biotransformation pathways of, 567f
 - marine algae, 109–113, 113r
 - metabolism, enzymatic and non-enzymatic mediators of, 243–244
 - omega-3-eggs, 54–59, 56r
 - prevention of neuroinflammation by, 246–247
 - for psoriasis
 - resolvins, 534, 534r
 - role of, 533r
 - Elasmus* sp., 37
 - Embryo rescue technique, 31
 - Emulsifiers
 - high-molecular weight, 130–131
 - low molecular weight, 130
 - Emulsion
 - bioavailability of, 135
 - characterisation of
 - dilution test, 134
 - limpidity test, 134
 - long-term stability, 134
 - microscopic examination, 134
 - peroxides and degradation product detection, 134
 - repeated freezing and thawing, 134
 - rheological properties, 134
 - size determination, 133
 - stability assessment test, 134
 - staining test, 134
 - stress testing using centrifugation, 134
 - thermal stability, determination of, 134
 - visual inspection, physical appearance by, 133
 - definition of, 128
 - formation, factors affecting
 - alcohol concentration, 133
 - hydrophobic chain length of surfactant, 133
 - ionic strength, 133
 - oil properties, 133
 - pH, 133
 - salt concentration, 133
 - microencapsulation of, 131
 - coacervation, 132–133
 - extrusion, 133
 - fluidised bed drying, 132
 - freeze-drying (lyophilisation), 132
 - spray drying, 131–132
 - preparation methods, 129–130
 - Endothelial health, in metabolic syndrome, 198
 - Endothelial progenitor cells (EPCs), 222
 - Enterocyte, Fe absorption pathways in, 294f
 - Entropy, 2–3, 3f
 - Epithelial tissues, role in cancer, 372
 - Escherichia coli*, 571
 - acetyl-CoA synthetase (ACS), 119
 - TE gene tesA, 120
 - E-selectin, 141
 - Essential amino acids (EAA), 40, 52
 - Essential fatty acids (EFAs), 11, 47, 94, 141, 487
 - alpha-linolenic acid (ALA), 80
 - breast milk, 45
 - and diabetic neuropathy, 225
 - EPA and DHA, 80–81
 - in human nutrition (*see also* Long-chain polyunsaturated fatty acids (LCPUFAs)), 46
 - linseed, 24
 - Eukaryotes, conservation of gene pathways in, 339–340
 - Eurytoma* sp., 37
 - Extrusion, 133
 - Eye health, omega-3 fatty acids role in, 251–258
 - age-related macular degeneration, 251–254, 254f
 - cone dystrophies, 256
 - macular dystrophies, 256, 256f
 - polyunsaturated fatty acids, 241
 - retinitis pigmentosa, 254–255
 - severe dry eyes, 256–258, 257f, 258f
 - Stargardt disease, 255–256
- F**
- Farnesol X receptor (FXR), 69–70
 - Fat deposition, fructose synergy with, 442–444
 - FAT1. *See* CD36
 - Fat-1 transgenic mouse model, 167
 - Fatty acids
 - classification of, 514f
 - essential (*see* Essential fatty acids (EFAs))
 - non-esterified free, 69
 - omega-3 (*see* Omega-3 fatty acids)
 - omega-6 (*see* Omega-6 fatty acids)
 - terrestrial plants, 106–108, 107f
 - between tissues, trafficking of, 70
 - Fatty acyl chain elongation, termination of, 208
 - Fish
 - feeds, 480–481
 - omega-3 enrichment, 57
 - Fish oil fatty acids
 - for aging disorders, 585–594
 - bone health, 590–591, 592–693r
 - clinical evidence, 587–589, 588–589r
 - mechanism of action, 586–587
 - pain, 591, 594–595
 - and cardiovascular health, 586
 - arrhythmia, 589–590
 - Fish oil versus omega-3-eggs, 55–56
 - Flax Bio-village Concept (FBC), 11–18, 17f
 - Flax lignin, pharmaceutical applications of, 17–18
 - Flaxseeds, 15–16
 - omega-3 enrichment, 57
 - Fluidised bed drying, 132
 - Formula milk, 46
 - Fortification, 46–47, 89–99
 - to combat micronutrient malnutrition, advantages of, 90–91
 - guidelines for, 91–92
 - industry-driven, 91
 - national food law and, 91
 - omega-3, 92
 - policy, 91
 - safety of, 92–93
 - Fortified products
 - baby food and pediatric juices, 95
 - beverages and juices, 95
 - breads and bakery, 94
 - confectionary and chocolates, 96–97
 - dairy products, 94–95
 - infant formula, 97–98
 - market of, 93–94
 - meats and meat products, 95–96
 - omega-3
 - beneficiaries of, 98
 - market drivers of, 98
 - market restraints for, 98
 - omega-3 eggs, 90, 95
 - prepared products, 96
 - Free radicals, 7, 239–240
 - Freeze-drying (lyophilisation), 132

Fructose synergy, with LA and fat deposition, 442–444

Fumaria parviflora, 36

Functional foods

obesity and, 173

omega-3 fatty acids, 83

and public health, 11–12

G

Galactolipids, 340, 377–378

Gamma linolenic acid (GLA), 31

diabetic nephropathy, 222

in flax seeds, 40

marine algae, 113*r*

Gelidium, 105

Gender differences, in hyperlipidemia, 74

Generally Recognized as Safe (GRAS), 129

Gestation, iron–DHA interaction during, 296

Gestational diabetes mellitus (GDM), 492

Glial death, PPAR gamma-induced, 420

Glucose, in refined food, 442–443

Glutathione, 370–371

Glutathione peroxidase (GPx), 501

Glutathione reductase (GRx), 501

Gracilaria, 105

Gracilaria debilis, 114

Gracilaria dura, 114, 115–116

Gracilaria gracilis, 115

Gracilaria tenuistipitata, 115

Gracilaria vermiculophylla, 116

Gracilaria wattii, 114

Grateloupia turuturu, 115

H

Habitat loss, 476–477

Halopteris scoparia, 114

Haploid technique, 27, 30

HDL-ch fraction, effects on metabolic syndrome, 198

Healthy donors, omega-3 fatty acid supplementation
effect on, 311

Heart failure, omega-3 fatty acids effect on, 519

Helicoverpa armigera Hubn., 37

Hepatocyte nuclear factor-4 α (HNF-4 α), 69

Herbal-enriched eggs, 62

High-density lipoprotein (HDL)

as antioxidant transport for oxidised phospholipids and cholesterol,
401–403, 402*f*

cholesterol (HDL-ch), 71

High-molecular-weight emulsifiers, 130–131

High-pressure homogeniser, 129

Himantalia elongata, 115

Homeostasis–allostasis–stress integration, 7–8

Human fat tissue, alpha-linolenic acid in, 439

Human genome project, 5

4-Hydroxynonenal (4HNE), 128342, 363–364

9-Hydroxyoctadecadienoic acid (9HODE), 359–360, 368

13-Hydroxyoctadecadienoic acid (13HODE), 340, 342–344, 359–360,
378, 434, 437, 441, 443

-related oxidised stress, and damage to vascular membranes,
397–398

Hyperlipidemia, 67–68

n-3 PUFA efficacy in, factors affecting

apolipoprotein E polymorphisms, 73–74

gender differences, 74

Hypocaloric diets, for metabolic syndrome, 193, 191–192*r*

I

Immune response, long-chain fatty acids and, 307–308

Immune system, 307

components, omega-3 PUFA effect on, 308–310

inflammation in, 141–142, 142*f*

Immunoglobulin-enriched eggs, 62

Immunomodulation, omega-3 fatty acids role in, 165, 166*f*

Impaired glucose metabolism (IGM), 303

Inducible nitric oxide synthase (iNOS), 352, 361, 365, 366, 371, 372

peroxisome peroxide production in conjunction with, 458

-related NO catalase inhibition, 443

Industry-driven fortification, 91

Infant formula

fortified products, 97–98

omega-3 fatty acids, 85

Inflammation

and bone remodeling, 286–287

in immune system, 141–142, 142*f*

neuroinflammation, 246–247

omega-3 fatty acids role in, 161–163, 162*f*

omega-3 PUFA effect on, 308–309

PUFA's role in, 142–143

Inflammatory bowel disease (IBD), 147, 148–149*r*, 312

Inflammatory diseases, omega-3 fatty acids in, 141–151, 144*f*, 145*r*

asthma, 147, 150*r*, 312

diabetes, 313–314

exerting effect on cell signaling pathways, 143

multiple sclerosis, 150, 314

inflammatory bowel diseases, 147, 148–149*r*, 312

lipid mediator patterns, altering, 143–145

membrane's physical properties, altering, 143

psoriasis, 312

rheumatoid arthritis, 145–147, 146*r*, 312

systemic lupus erythematosus, 314

Inflammatory markers, effects on metabolic syndrome, 198–199

Ingredients, 4*f*

Insulin

by melonyl CoA and ACoA, 444

resistance, beta-cell related, 443–444

Integrated disease management, for linseed, 38–40, 38*r*

Integrated pest management, for linseed, 36–37

Intercellular adhesion molecule-1 (ICAM-1), 141

Interspecific hybridisation, linseed, 22–23, 31

Intrauterine growth restriction (IUGR), 492

Ionic strength, effect on emulsion formation, 133

Iron

absorption pathways, in enterocyte, 294*f*

and eicosanoid metabolism, 296–297, 297*f*

interaction

with DHA during gestation, 296

with omega-3 fatty acids, 295–296

metabolism, 293–294

Irrigated ecosystem, 32–33

Ischemic heart disease (IHD), 517–518

Iso-caloric diets, for metabolic syndrome, 191–193, 191–192*r*

Isochrysis galbana, 112

Isochrysis sp., 112

Isochrysis zhangjiangensis, 112

J

Juices, 95

K

Krill, 81

- omega-3 market, 81–82
- omega-3 world market
 - for ingredients, 82–83
 - for application segment (*see* Krill, application segment)
- Krill, application segment
 - clinical nutrition, 85–86
 - infant formula, 85
 - pet and animal feed, 85
 - pharmaceuticals, 84
 - omega-3 therapeutic potential, 84–85
 - supplements and functional foods, 83
 - soft gels, 83–84
- L**
- Lactation
 - DHA and, 97–98, 268
 - omega-3 diet supplementation effect on, 311
- Laminaria*, 105
- Laminaria digitata*, 115
- Laminaria hyperborean*, 114
- Laurencia filiformis*, 114–115
- Laurencia intricata*, 114–115
- LDL-ch fraction, effects on metabolic syndrome, 198
- Lignans, 15
 - flax lignan, 17–18
 - linseed, 24
- Limitless cell proliferation, 164
- Limpidity test, 134
- Linastrum*, 22
- Linola, 24
- Linoleic acid (LA), 12, 321, 351, 385
 - absorption of, 387–388, 388f
 - age of menarche, 354
 - brain maturation, 354
 - and cancer, 373–374, 374f
 - to control reproductive capacity and function, 352
 - delivery of, 387–390
 - desaturase function, 354–355
 - dietary balance of, 421–423
 - dietary oxidised, 398–400, 399f
 - digestion of, 387
 - as enabler and controller of reproductive capacity, 351
 - as essential nutrients, 351
 - evolutionary importance of
 - anoxic environment, 327–331, 328f
 - conditions of existence, 322
 - light and energy, 324–326, 325f, 326f
 - light-protective evolutionary niches, 326–327
 - organised structure, 331–332
 - womb and cradle of life, 322–324
 - export from liver, and non-alcoholic fatty liver disease, 390–391
 - fructose synergy with, 442–444
 - in humans, 344, 351–352
 - in mammals, 344
 - marine algae, 113t
 - and non-alcoholic fatty liver disease, 440
 - oxidative overload, 355–356
 - oxidised products, physiological relevance of, 358–362
 - 9 and 13HODE, 359–360
 - COX and LOX 12/15 enzymes, 360–362
 - CTP450 enzymes, 362
 - multiple pathways, 358–359
 - oxylipins, 360
 - photo-oxidation products, 360
 - sensitivity, 358
 - peroxisomes, 451–461
 - physiological consequences of, 352–354, 353f
 - in plants
 - cardiolipin, 342–343
 - chiral lipid forms, 344
 - COX, 341
 - energy production and storage, 341
 - eukaryotes, conservation of gene pathways in, 339–340
 - galactolipids and phosphatidylcholine, 340
 - immune system and predator defence, 342
 - light sensing, 343–344
 - LOX, 341
 - oxidised derivatives and signaling systems, 342
 - peroxisomes, 340–341
 - photosynthesis and UV protection, 340
 - reproduction and fast storage, 342
 - puberty, 354
 - rich diets
 - effect on adipose tissue, 431–433, 431f, 432f
 - native versus westernised, 430–431
 - role in adipose tissue accretion, 434–436, 435f, 436f
 - in structural brain lipids, 414
 - uptake pathways of, 387
 - vesicles, 332–339, 335–338f
- Linseed, 15–16, 21–42
 - agriculture to health and wealth, convergence of, 17
 - cake, 24–25
 - centre of origin, 21
 - composition, 174
 - crop description
 - floral biology, 23
 - importance, 21–22
 - nutritional values, 23–25
 - origin, 21
 - scientific name and species relationship, 22–23
 - cultivars, 24, 31
 - cultivation
 - special initiatives, 41–42
 - zones, 25
 - comparative analysis, 25, 26–27t
 - export–import status, 25, 27t
 - varietal development, 25, 28–30t, 31t
 - yield gap, 25
 - climatic requirement, 25
 - gene pool, 23
 - genetic potentiality advancement, 25, 27, 30–32
 - seed scenario, 32
 - good crop production practices, 32–36
 - agronomical practices, 34t
 - cropping systems, 34, 35t
 - harvesting calendar, 35t
 - irrigated ecosystem, 32–33
 - rained ecosystem, 32
 - soil and moisture management, 34, 36
 - utera* system, 32
 - history of, 173
 - integrated nutrient management
 - biological control, 37
 - chemical control, 37–38
 - harvesting, drying and threshing, 36
 - integrated disease management, 38–40, 38t
 - integrated pest management, 36–37
 - IPM schedule, 37
 - linseed bud fly, 37
 - post-harvest technology, 36
 - sowing time and intercropping, 37

- weed management, 36
 - interspecific hybridisation, 22–23, 31
 - mucilage, isolation and therapeutic effects of dietary fibre from, 181–182
 - as neglected crop, 16
 - for obesity management, 170–183
 - oil, isolation of, 174
 - products, 40–41
 - vitamins and minerals in, 176*t*
 - Linseed bud fly, 37
 - Linum africanum*, 22
 - Linum angustifolium*, 21, 22
 - Linum austriacum*, 31
 - Linum bienne*, 21, 23
 - Linum corymbiferum*, 22
 - Linum decumbens*, 22
 - Linum grandiflorum*, 22
 - Linum mysorensense*, 22
 - Linum perenne*, 22, 31
 - Linum* spp., 21–23
 - Linum strictum*, 22
 - Linum usitatissimum*, 21, 22
 - Linustatin, chemical structure of, 176*f*
 - Lipid metabolism, in metabolic syndrome, 197–198
 - Lipid peroxidation
 - mitochondrial membrane, 160
 - omega-3 fatty acids role in, 159–160, 161*f*
 - Lipid rafts, physicochemical properties of, 163, 164*f*
 - Lipids
 - and cardiac function, 386
 - and cardiovascular health, 386
 - delivery of, and oxidised substrate to heart, 395–396
 - functional and behavioral imbalances of, 424–425
 - oxidised material and cellular detritus delivery to fat cells, 433–434
 - Lipoprotein lipase (LPL) activity, 69
 - Lipoxygenases (LOX), 161, 163
 - alpha-linolenic acid, 341
 - linoleic acid, 341
 - 12/15 enzymes, 360–362
 - alpha-linolenic acid as competitive marker for, 441
 - role during brain damage or injury, 422
 - role in oxidative stress reduction, 397
 - Liver X receptor-alpha (LXR α), 69
 - Liver X receptors (LXR), 268
 - Long-chain fatty acids, and immune response, 307–308
 - Long-chain polyunsaturated fatty acids (LCPUFAs), 487–488
 - biosynthesis of, 488
 - enzymes in plant seeds, heterologous expression of, 214, 215*t*
 - enzymes for, 212
 - pathway, 213, 213*f*
 - maternal, 487–494
 - fetal development, 493–494
 - fetal status, 488
 - fetus through placenta, transport of, 491, 491*f*
 - in placental growth and development, 490–491
 - inadequacy/insufficiency, consequences of, 491–493
 - initiation of labor, 489–490, 490*f*
 - intake/status, 488
 - length of gestation, 490
 - metabolism, 488
 - recommendations for, 494
 - role of, 488–491, 490*f*
 - pathway in plants, 212
 - in psoriasis, 531–537
 - challenges to delivery, 536
 - DHA-derived resolvins and protectins, 533, 534*t*
 - EPA and DHA, role of, 533*t*
 - EPA-derived resolvins, 534, 534*t*
 - immunosuppression, 534–536
 - nanomedicine, scope of, 536–537
 - pathophysiology, 532
 - pharmacotherapy, 532–533, 532*f*
 - Low-density lipoprotein (LDL)
 - Cholesterol (LDL-ch), 70–71
 - combined with n-3 PUFA, 72–73
 - concentration, 70–71
 - delivery of
 - fat-soluble antioxidant to fat tissue, 432–433
 - lipids oxidised material and cellular detritus to fat cells by, 433–434
 - as evolutionary lipid supply mechanism, 391–394, 392*f*, 393*f*
 - LA-related oxidative stress to cardiovascular disease, 396–397
 - as LA transporter to vascular epithelial cells, 391
 - liver output, 391
 - MRFA PUFA and saturate fat content of, 391
 - particle size, 71, 71*f*
 - plasma, 391
 - via receptors sweep and regulate levels of oxidised product in blood, 400
 - very low-density lipoprotein, 69
 - Low molecular weight emulsifiers, 130
 - Lutein-enriched eggs, 61
 - Lymphocytes
 - antibody production, 310
 - NK and LAK cells activity, 310
 - proliferation, 309
 - regulatory T cells, 310
 - Lymphokine-activated killer (LAK) cell activity, 310
 - Lyophilisation, 132
 - Lysophosphatidylcholine, 367
 - use in food processing, 369
- ## M
- Macrocystis*, 101
 - Macrophages, 441
 - Macular dystrophies, 256, 256*f*
 - Malonaldehyde (MDA), 128, 342, 364
 - Malonyl acyl carrier protein (ACP), 206–207, 207*f*
 - condensation with, 207–208
 - Malonyl-CoA
 - CPTIA Randle cycle-related blocking, 444
 - formation, 206–207, 207*f*
 - insulin regulated by, 444
 - Mammals, 212
 - alpha-linolenic acid, 344, 576
 - intake of LA and ALA in, 430–431
 - linoleic acid, 344
 - peroxisomes, 458
 - MAPK cascade, for psoriasis, 535–536
 - Marine algae
 - environment, 102–106
 - omega-3 enrichment, 57
 - polyunsaturated fatty acids from, 101–121
 - biotechnology, 116–120, 117*f*
 - codex alimentarius and human nutrition, 108–109
 - seaweeds, 109*t*
 - terrestrial plants, 106–108, 107*f*
 - Marker-assisted selection (MAS), 30–31
 - MCAD deficiency disorder, 419
 - Meat products, 95–96
 - Meats, 95–96

- Medium chain triglyceride (MCT), 394
Melilotus spp., 36
Menochilus sexmaculatus Fabr, 37
 Metabolic syndrome
 obesity and, 189
 omega-3 fatty acids role in, 189–200
 blood pressure and endothelial health, 198
 carbohydrate metabolism, 193–197, 194–197*t*
 future perspectives of, 199–200
 inflammatory markers, 198–199
 lipid metabolism, 197–198
 weight loss and body composition, 191–193, 191–192*t*
 Metal toxin accumulation, 477
 Metastasis, omega-3 fatty acids role in, 165
 Microemulsion system, types of, 128–129
 Microencapsulation of emulsion, 131
 coacervation, 132–133
 extrusion, 133
 fluidised bed drying, 132
 freeze-drying (lyophilisation), 132
 omega-3 fatty acids, 135
 spray drying, 131–132
 Micronutrient malnutrition (MNM), fortification as strategy to combat, 90–91
 Micronutrients, 5
 Mitochondria, 394
 brain, 416
 long-chain lipid access to, by CPT1A malonyl-CoA Randle cycle-related blocking, 444
 Mitochondrial diseases (MDs), omega-3 fatty acids and, 229–232
 cardiovascular diseases, 231
 diabetes, 231–232
 neurodegenerative diseases, 230–231
 Mitochondrial energy coupling impairment, 230
 Mitochondrial membrane lipid peroxidation, 160
 Mitochondrial phospholipids, 231
 Moisture management, for linseed, 34, 36
 Monogastrics, alpha-linolenic acid in, 439
 Monosaturated fat, and cardiovascular disease, 404–406
 Multiple sclerosis (MS), 150, 151*t*, 314
 Mutagenesis, omega-3 fatty acids and, 571
 Myocardial infarction, omega-3 fatty acids effect on, 465–472
 clinical trials, 466–467*t*
 intervention studies, 468–471
 meta-analysis, 471
- N**
 NADH⁺, 4, 229
 NADPH⁺, 4, 206, 208, 244
Nannochloropsis, 101, 118
 fatty acids, 110
Nannochloropsis limnetica, 110
Nannochloropsis oculata, 110
 Nanomedicine, for psoriasis, 536–537
 National food law, and fortification, 91
 Natural killer (NK) cell activity, 310
 Neurodegenerative diseases
 antioxidants role in, 506–507
 mitochondrial dysfunction and, 230–231
 omega-3 fatty acids role in, 235
 Neurofibrillary tangles (NFT), 236
 Neuroinflammation, 273, 275–276
 prevention by EPA and DHA, 246–247
 Nitrogen-related (nitrous) oxidation products, 365–366
Nitzschia laevis, 113
 Non-alcoholic fatty liver disease (NAFLD), 390–391, 440
 Non-esterified free fatty acids (NEFAs), 69
 Non-puerperal depression, 268–269
 Nuclear factor kappa B (NFκB), 146
 activation, for psoriasis, 536
 Nutraceuticals, 79–80, 81
 Nutrition, 2–3
- O**
 Obesity
 antioxidants role in, 507
 functional and, 173
 management, linseed for, 170–183
 and metabolic syndrome, 190
 oxidative stress and, 433, 440–442
Odontelloa aurita, 110–111
 Oil properties, effect on emulsion formation, 133
 Oilseeds, balancing omega-6:omega-3 ratios in, 203–216
 acetyl-CoA synthesis inside plasmid, 205–206, 206*f*
 biotechnological approaches, 211–216
 choice of, 214
 condensation with malonyl-ACP, 207–208
 energy requirement, 206
 future prospects of, 216
 importance of, 204–205
 malonyl acyl carrier protein, 206–207, 207*f*
 malonyl-CoA formation, 206–207, 207*f*
 oil accumulation during seed development, 210–211
 potential hurdles in, 215–216, 215*f*
 Rubisco, role of, 208–209, 209*f*
 triacylglycerol
 formation, 209–210
 synthesis, 209–211
 in vegetable oils, 204*t*
 Older population, omega-3 diet supplementation effect on, 311
 Oleate (OA), 209
 OLR1
 activated by oxidised LDL, 395–396
 and cancer, 372
 Omega-3-chicken, 11, 12, 14–17
 fortification, 95–96
 Omega-3-eggs, 11, 12, 14–17, 51–62
 advantages of, 55
 commercial aspects of, 59–61
 commercial poultry feed for, 59
 compared with regular eggs, 53*t*
 designer eggs, 61–62
 enrichment to birds, benefits of, 58–59
 feed for enrichment, 56, 56*t*
 fish oil versus, 55–56
 fortification, 95
 health benefits of, 55
 means to improve oxidative stability and quality of, 59
 quality characteristics, production parameters and, 57–58
 resources for enrichment
 fish, 57
 marine algae, 57
 plants, 56–57
 Omega-3 fatty acids, 1, 2, 5, 6
 adverse effects of, 570–573, 570*t*
 and Alzheimer's disease, 235–237
 biochemistry of, 513–516
 and bone turnover, 285–289
 and cancer, 157–168
 and cardiovascular diseases, 513–524

- and diabetic complications, 221–226
 - in diet, alternative origins for, 475–483
 - drug interactions, 573–576
 - edible and anti-nutrients, 16
 - effect on health, 310–311
 - and eye health, 251–258
 - fortification, 89–99
 - health benefits of, 54
 - and inflammatory diseases, 141–151
 - linseed, 24
 - and metabolic syndrome, 189–200
 - metabolism, 294–295
 - microencapsulation of emulsion, 135
 - and mitochondrial functions, 229–232
 - mechanism of action, 514–516
 - and myocardial infarction, 465–472
 - role in public health, 12–15, 13f
 - awareness of importance of, 16–17
 - stability of, 16
 - therapeutic potential, 84–85
 - types and sources of, 80–81
 - world market of, 79–87
 - application segment, 83–86
 - clinical nutrition, 85–86
 - infant formula, 85
 - ingredients, 82–83
 - new emerging market, 86–87
 - pet and animal feed, 85
 - Omega-3 index, 6–7
 - of cardiovascular health, 522–523
 - Omega-3-milk, 11, 12, 14–17, 45–48
 - biofortification of, 46–47
 - role in human health, 47–48
 - Omega-3 polyunsaturated fatty acids (n-3 PUFA), 54, 55
 - as alternative to oily fish, 478–480
 - animal sources of, 481–482
 - beta-oxidation of, 566
 - blood lipids, 68–73
 - combination therapies, 72–73
 - combined with natural therapies, 73
 - dietary sources and metabolism, 68
 - digestion of, 544–546, 545f
 - distribution of, 558–566, 563f
 - efficacy in hyperlipidemia, factors affecting
 - apolipoprotein E polymorphisms, 73–74
 - gender differences, 74
 - excretion of, 569
 - macro and microalgae sources of, 482
 - maternal status by pregnancy and lactation, modulation of, 268
 - metabolism of, 566–569
 - oral bioavailability of, 546–558, 547–548r, 550r, 556r
 - and postpartum depression, 267–276
 - regulation of, 267–268
 - structure of, 68
 - synthesis pathways of, 542–544, 543f
 - TG-lowering effects of, 69–70, 70f
 - Omega-6 fatty acids, 5, 7, 47, 54. *See also* Gamma linoleic acid (GLA)
 - intake of vegetarians and nonvegetarians, 12, 13f
 - linseed, 24, 40
 - and omega-3 acids, biotechnological approaches, 211–212
 - osteoblastogenesis, 287–288
 - pro-inflammatory nature, 586
 - Origin of life, 3–4
 - Osteoprotegerin (OPG), 285
 - Ostreococcus tauri*, 116, 118
 - Overfishing, 476–477
 - Oxidation of foods, 368–369
 - Oxidation of PUFAs, 127–128
 - Oxidative DNA damage, 369–370
 - Oxidative stress, 7, 8
 - and bone remodeling, 286–287
 - brain sensitivity to, 421
 - and DNA damage, 371
 - management of, 3f
 - and obesity, 433, 440–442
 - by omega-3 fatty acids in brain, prevention of, 239–247
 - ARA-derived metabolism, 242–243
 - DHA metabolism, 244–246, 244–246f
 - enzymatic and non-enzymatic mediators of, 243
 - EPA metabolism, 243–244
 - factors contributing to, 240f
 - signal transduction process, 242f
 - oxylipins, 355
 - PPAR peroxisomal activation, impact of, 420
 - reduction by LOX12/15 and COX, 385
 - Oxidised linoleic acid, and cardiovascular disease, 386
 - Oxo-HODE, 436, 440, 452
 - Oxygen, for life and death, 3f
 - Oxylipins
 - chiral oxylipin products, 365
 - 4HNE, 363–364
 - linoleic acid, 360, 362–366, 363f, 397–398, 398f
 - MDA, 364
 - nitrogen-related (nitrous) oxidation products, 365–366
 - oestrogen desaturase and cardiovascular disease, 365
 - omega-3 oxylipins, 364
 - oxidative stress, implications of, 355
 - oxidised product, metabolic sensing and pathway preference for, 366
 - PPAR gamma and alpha activators, 365
 - role during brain damage or injury, 422
 - TRVP1 pain pathways, 364–365
- P**
- Pain, fish oil fatty acids for, 591, 594–595
 - Palmaria palmata*, 114, 115
 - Palmitic acid (PA), 209
 - as peroxisomal substrate, 419–420
 - uptake and usage by brain, 414–415
 - Pavlova lutheri*, 111–112
 - Pediatric juices, 95
 - Peripheral arterial disease (PAD), 302–303
 - Peroxisomal beta-oxidation
 - of alpha-linolenic acid, 439–440
 - carbon removal cycle, shortening, 454
 - combined with blood–brain barrier, 455
 - energetic advantages, 455
 - functional roles of, 454
 - mitochondrial damage during oxidative stress, 454
 - products to support mitochondrial ATP production, capacity of, 458–460
 - proliferation and/or increased size in activity, 455–456
 - restrictions on DHA beta-oxidation, 455
 - Peroxisomal dysfunction-related cardiac impairment, 394–395
 - Peroxisomal pathway substrates
 - to fuel Inuit with CPT1A variant, 417–418
 - to fuel neonate brains, 418–419
 - Peroxisome proliferator-activated receptors (PPARs), 69, 146, 268
 - alpha
 - activation, 383, 407, 421, 438–439
 - activation, by energy deficit, 456–457

- activators, 365
 - and Alzheimer's disease, 423–424
 - and beta-cell-related insulin resistance, 443–444
 - energy production, 459
 - roles of, 453
 - alpha-related peroxisomes, 421
 - delta
 - and beta-cell-related insulin resistance, 443–444
 - role in brain antioxidant protection, 421
 - gamma
 - activation of, 438–439, 456
 - activators, 365, 441, 453
 - and Alzheimer's disease, 423–424
 - and beta-cell-related insulin resistance, 443–444
 - cellular creation maintenance and repair, 458
 - induced glial death, 420
 - master adipogenic controller, 436–438, 437f, 438f
 - peroxisomal activation, impact on oxidative stress, 420
 - roles of, 420
 - Peroxisomes, 340–341, 451–461
 - antioxidant production capacity, 457
 - basic feature and role of, 452–453
 - and calories, 459–460
 - fat oxidation rates, 453–454
 - functional role of, 454
 - importance of, 394–395
 - MCT production by, 394
 - oxygen recycling by, 394
 - peroxide production in conjunction with iNOS, 458
 - role in brain function, 416
 - stored linoleic acid, impact of, 461
 - thermogenesis temperature adoption and hibernation, 460
 - Pet feed, omega-3 fatty acids, 85
 - Peyssonnelia* sp., 114
 - pH, effect on emulsion formation, 133
 - Phaeodactylum*, 101
 - Phaeodactylum tricorutum*, 110, 116–118
 - Phagocytosis, omega-3 PUFA effect on, 308–309
 - Phalaris minor*, 36
 - Pharmaceuticals market, omega-3 fatty acids, 84
 - Phase inversion method, 129
 - Phase titration method, 129
 - Phosphatidylcholine, 340, 366–368
 - for delivery of lipids and choline, 388–389, 388f
 - importance to lipoprotein membranes, 377
 - Pi bond, 325, 333, 334, 337–339
 - Plant sterols, 73
 - Plants
 - based fat-soluble antioxidants, 405
 - cardiolipin, 342–343
 - energy production and storage, 341
 - enzymes LOX and COX, 341
 - galactolipids and phosphatidylcholine, 340
 - immune system and predator defence, 342
 - light sensing, precursor to vision, 343–344
 - omega-3 enrichment, 56–57
 - oxidised derivatives and signaling systems, 342
 - peroxisomes, 340–341
 - photosynthesis and UV protection, 340
 - reproduction and fat storage, 342
 - sources of omega-3 PUFA as an alternative to oily fish, 478–479
 - arabidopsis, 479
 - Camelina sativa*, 479–480
 - echium oil, 479
 - flaxseed, 479
 - rapeseed, 480
 - soybean, 479
 - terrestrial and fatty acids, 106–108
 - Polarisation, 327
 - Pollution, 477
 - Polyunsaturated fatty acids (PUFAs), 101–121
 - marine algae from
 - biotechnology, 116–120, 117f
 - codex alimentarius and human nutrition, 108–109
 - seaweeds, 109t
 - terrestrial plants, 106–108, 107f
 - oxidation of, 127–128
 - role in
 - eye health, 251
 - inflammation, 142–143
 - Porphyra*, 105
 - Porphyridium* sp., 57
 - Postpartum depression, n-3 PUFA role in, 267–276
 - clinical trials, 269–273, 270–271t, 272t
 - neurobiology and behavior, 273–276
 - non-puerperal depression, 268–269
 - Powdery mildew
 - disease development, 39
 - management, 39–40
 - Preeclampsia, 493
 - Pregnancy
 - DHA-rich algae oil, supplementation of, 264–265
 - omega-3 diet supplementation effect on, 311
 - Prepared products, 96
 - Preterm labor, 491–492
 - Protein kinase C (PKC) activation, for psoriasis, 534, 535f
 - Protein–sugar–lipid crosslinking, 369
 - Protoplast fusion technique, 31
 - Psoriasis, LCPUFA role in, 531–537
 - challenges to delivery, 536
 - DHA-derived resolvins and protectins, 533, 534t
 - EPA
 - derived resolvins, 534, 534t
 - and DHA, role of, 533t
 - immunosuppression, 534–536
 - nanomedicine, scope of, 536–537
 - omega-3 diet supplementation effect on, 312
 - pathophysiology, 532
 - pharmacotherapy, 532–533, 532f
 - Public health, functional foods and, 11–12
 - Purslane, 80
- ## Q
- Quality characteristics, of eggs, 57–58
 - Quality of life, functional foods, 11–12
 - Quality of omega-3 eggs, 59
- ## R
- Rabbits. *See also* Animal studies
 - secoisolaricresinol diglucoside, actions of, 180–181
 - Rainfed ecosystem, 32
 - Reactive nitrogen species (RNS), 7, 8
 - Reactive oxygen species (ROS), 5, 7, 8
 - Receptor-activated nuclear kappa- β ligand (RANKL), 285–287
 - Red blood cell deformability, omega-3 fatty acids and, 225
 - Redox, 8

- Regulatory T cells, 310
 Reproduction studies, 572
 Retinitis pigmentosa (RP), 254–255
 current research in, 255
 Retinoid X receptor-alpha (RXR α), 69
 Retinoid X receptors (RXR), 268
 Rheumatoid arthritis, 145–147, 146*r*, 312
 RNA, 4
 Rodents. *See also* Animal studies
 secoisolaricresinol diglucoside, actions of, 180–181
 Rubisco, role in fatty acid biosynthesis, 208–209, 209*f*
 Rust
 disease development, 40
 management, 40
- S**
Saccharina latissima, 115
 Salt concentration, effect on emulsion formation, 133
Sargassum horneri, 115
Sargassum vulgare, 114
 Saturated fat
 as beta-oxidation fuel substrate, protecting, 417
 and cardiovascular disease, 403–404, 404*f*, 405*f*
Schizochytrium, 101, 112, 113, 119, 263
Schizochytrium limacinum, 112
 Seaweeds, marine algae, 109*r*, 114–116, 116*r*
 Secoisolaricresinol diglucoside (SDG), 24
 actions in rodents and rabbits, 180–181
 isolation from linseed, 179–180
 pharmacology of, 179–180
 structure of, 175*f*
 therapeutic benefits in humans, 177
 Severe dry eyes, 256–258, 257*f*, 258*f*
 Short-term fasting, benefits of, 395
 Signal transduction, physicochemical properties of, 163, 164*f*
 Softgels, 83
 chewable, 83–84
 Soil management, for linseed, 34, 36
 Sonication method, 130
 Spray drying, 131–132
 Squid, 87
 Staining test, 134
 Stargardt disease, 255
 current research in, 255–256
 Statins, drug interaction, 575
 Stearate (SA), 209
 Stearidonic acid (SDA), 87
 marine algae, 113*r*
 Stearoyl-CoA desaturase 1 (SCD1), and Alzheimer's disease, 423
 Sterol regulatory element-binding proteins (SREBP), 69
 Sulphur metabolism, 330
 Superoxide dismutase (SOD), 501
 Surfactant's hydrophobic chain length, effect on emulsion formation, 133
 Survival of the sickest, 6
Syllinum, 22
Synechococcus elongates, 118–119
Synechocystis sp., 118–119, 120
 Systemic lupus erythematosus (SLE), omega-3 diet supplementation
 effect on, 314
Systemis dasyneurae Mani, 37
- T**
Taonia atomaria, 114
 Tau protein, 236
 T-cell inhibitors, for rheumatoid arthritis, 145, 147
 Telomeres, and life span, 8
 Terrestrial plants, 106–108, 107*f*
Tetrastichus sp., 37
Thalassiosira pseudonana, 116, 117, 119
Thraustochytrium, 101, 112–113
 TNF- α inhibitors, for rheumatoid arthritis, 145
 Total cholesterol, 70
Trachydiscus minutes, 111
 Triacylglycerol (TAG)
 formation of, 209
 synthesis, 209–210, 210*f*
 metabolic flux of, 210
 during seed development, 210–211
 synthesis from DAG, 209–210
 Triglycerides (TG), 68
 clearance, 69
 effects on metabolic syndrome, 197–198
 rich lipoproteins, effects on metabolic syndrome, 197–198
- U**
Ulva, 104, 106, 114
Ulva lacuta, 115
Ulva linza, 114
Umbellularia californica (*U. californica*), 118
Undaria, 105
Undaria pinnatifida (*U. pinnatifida*), 114, 115
 Unrefined cold pressed oils, cardiac protective
 effects of, 405
Utera system, 32
- V**
 Vascular cell adhesion molecule-1 (VCAM-1), 141
 Vascular disease, alpha-linolenic acid and, 406
 Vascular plaque, omega-3 fats and, 400
 Vegans, 477–478
 Vegetarianism, 4–5
 Vegetarians, 477–478
 Very low-density lipoproteins (VLDL), 69
 Vesicles, 332–339, 335–338*f*
Vicia hirsute, 36
 Vitamins
 B group, 507
 D, 52, 522
 E, 59, 370
 K, 6
 and minerals in linseed, 176*r*
 Volcanic, 322–332
- W**
 Warburg effect, 8
 Weed management, for linseed, 36
 Wilt
 disease development, 38
 management, 38–39

X

Xenograft models, [160](#), [162](#), [164–165](#)
effects of dietary PUFA, [167](#)

Y

Yarrowia lipolytica, [120](#)

Yeast, LPCAT gene, [215–216](#)

Z

Zinc, [33](#), [53t](#), [252](#), [503](#)

Zinc sulphate (ZnSO₄), [33](#), [330](#)

Zinc sulphide, [326](#)