A	В
Acetic acid, 326–330	Beet sugar syrup desalting, 325
AFM, see Atomic force microscopy	Bile acids and cholesterol
ALA, see α-Linolenic acid	movement of, between liver and small
Alzheimer's disease, see	intestine, 167
Neurodegenerative diseases	Biliary cholesterol, 167–168
Amino acids, 329, 340-341	Biopolar membranes, 286–289
profiles of	Blood pressure, tomato extract effect on, 141
flaxseed, 8–9	Bone cells, lycopene in, 135-137
flaxseed protein fractions, 9, 11	Brackish and seawater desalination
Amyotrophic lateral sclerosis, see	electrodialysis application in, 305-309
Neurodegenerative diseases	performance of pilot unit installed in Vouillé
Animal feed	(France), 308
flaxseed as, 70, 76	plant, 305, 306
for beef cattle, 72	process and capacity, 306
for dairy cattle, 73–74	Brain, vulnerability to free radical
in poultry, 70–72	damage, 145
for swine, 74–75	Breast cancer, 32–37
Anisotropy	flaxseed role in prevention of, 32-41
degree of, 244-254	studies involving α-linolenic acid, 37
mean intercept length vectors, 245	studies involving lignans, 35-37
morphological indices and measure	studies using flaxseed, 32-35
of, 253–254	Bright field microscopy, 214–215
structural anisotropy, 244-245	
tensor eigenanalysis, 245-250	C
Antifungal properties, of flaxseed, 69-70	Cancer
Antioxidants and oxidative stress	breast cancer, 32-37, 39-40
osteoblasts, associating with, 134	clinical evaluation of, 117
osteoclasts, associating with,	colon cancer, 24, 38
134–135	epidemiological evidence, 116-117
osteoporosis, associating with,	flaxseed role in prevention of, 32-41
133–134	breast cancer, 32-37, 39-40
Atherosclerosis, flaxseed affect	colon cancer, 38
on, 27–29	prostate cancer, 37-38, 40-41
Atomic force microscopy, for	skin cancer, 38
image acquisition,	lycopene role in prevention of, 117-128, 149
209, 224–226	molecular markers of, 117-120

Cancer (cont.)	Chronic diseases, see also Lycopene, prevention
cyclin D1 and cyclin E, 118	of chronic diseases
estrogen and progesterone receptors, 119	causes of morbidity and mortality, 100
Her2/neu, 119	role of lycopene in the prevention of, 114,
Ki-67, 117	115–146, 149
osteopontin, 119	Citric acid, 328, 330-332
p53 protein, 101	production from glucose syrups, 333
prostate-specific antigen	Clinical cancer proteomics, 120
expression, 118–119	CLSM, see Confocal laser scanning microscopy
prostate-specific membrane antigen, 119	Colon cancer, flaxseed role in prevention of, 38
prostate stem cell antigen, 119	Common plant foods
survivin, 117	fibre content of, 177
tumor lymph node metastases staging	plant sterols content of, 171, 172
system, 117	saponins content of, 182
vascular endothelial growth factor	Computerized simulation of X-ray imaging
expression, 118	techniques, 233–234, 236
prostate cancer, 120–126, 149	Concentration polarization, phenomenon of, 290
skin cancer, 38	Confocal laser scanning microscopy, for image
Cardiovascular diseases	acquisition, 208–209, 216
flaxseed role in prevention, 24–32	Connectivity index, 254–256
affect of α -linolenic acid and flaxseed oil	Coronary heart disease and low density
on lipid status, 24–26	lipoprotein oxidation, 129
affect on biological lipid status, 24–27	Cow milk, composition of, 309–310
affect on inflammatory markers and	CP, see Concentration polarization
atherosclerosis, 27–29	CT number, 231
clinical and epidemiological	food quality and, 237–238
studies, 29–32	food safety and, 238
low density lipoprotein oxidation and, 129	Cyanogenic glycosides
lycopene role in prevention of,	components of flaxseed, 10, 12–14
128–133, 149	linamarin, 10, 12, 13
Carotenoids, see Lycopene CHOL, see Cholesterol	linustatin, 10, 12, 13 lotasutralin, 10, 12, 13
Cholesterol	methods used to reduce contents in
	seeds, 13–14
homeostasis, 165, 168 movement of between liver and small	
intestine, 167	neolinustatin, 10, 12, 13
structure of, 171	D
transport of, 169	DAG, see Diacylglycerol
Cholesterol absorption	Dairy industry, electrodialysis application in,
efficiency of, 166	309–316
food components impact on, 170–192	Dark field microscopy, 215
fiber, 176–181	Data-processing techniques
food and nutraceutical industries	computerized simulation of X-ray imaging,
interest in, 173, 193	211, 233–234, 236
phospholipids, 186–189	CT number and food quality, 237–238
plant sterols and stanols, 170–176	CT number and food safety, 238
saponins, 181–184	internal features and mechanical properties,
soy protein, 184–186	238–256
stearic acid, 189–192	microstructure studies, 210–211
mechanisms of, 166–170	Diabetes prevention, flaxseed role in, 41–42
mediamonis 01, 100-170	Diabetes prevention, naisseed fole in, 41–42

Diacylglycerol, in flaxseed, 3	basic unit of, 281
DIC, see Differential interference	exploded view of, 281
contrast microscopy	limiting current density, 293
Dietary fiber components, of flaxseed, 15–17	mass transfer coefficient, 293, 294
Dietary intake levels, lycopene of, 146–148	mass transfer in, 290–295
Dietary reference intakes for fiber, 176	overall potential drop across, 295–298
Differential interference contrast	sheet flow, 283–284
microscopy, 215	simplified concentration profiles in, 291
DRI, see Dietary reference intake	tortuous path of, 283–284
T.	Electrolytic cell, 270
E ED Electro dichoic	Electromembranes
ED, see Electrodialysis	biopolar membranes, 286–289
Edible fats and oils, fatty acid composition, 189, 190	for electrodialysis, 275–290
,	fouling and scaling of, 300–304 monopolar membranes, 275–286
Electrodialysis	Electron microscopy
application in the food industry, 269–342 brackish and seawater desalination,	for image acquisition, 216–218
305–309	- · · · · · · · · · · · · · · · · · · ·
dairy industry, 309–316	scanning electron microscopy, 208, 218 transmission electron microscopy,
fermentation industry, 326–341	208, 218
fruit juice industry, 321–323	Epilepsy, see Neurodegenerative diseases
sugar industry, 323–325	Equivalent conductance, 272, 297, 345
table salt production, 309	Equivalent conductance, 272, 297, 343 Equivalent conductivity, 272, 273
wine industry, 316–321	Equivalent conductivity, 272, 273
application to recover metabolites from	F
fermentation media, 328–329	Fatty acid profile, of ice cream and frozen dessert
basic concepts and definitions, 270–275	containing flaxseed oil, 68–69
device, mathematical modeling of, 342–347	Fermentation industry
electromembranes, 275–289	acetic acid, 326–330
exploded view of electrodialysis stack, 281	amino acids, 329, 340–341
history of development of, 269–270	citric acid, 328, 330–333
main industrial applications, 304	electrodialysis application in, 326–341
mathematical modeling of device, 342–347	electrodialysis application to recover
membrane-fouling index, 303	metabolites from fermentation
operating principles of, 282	media, 328–329
performance indicators, 298–300	itaconic acid, 328, 333
principles, 270–304	lactic acid, 328, 329, 333-336
electromembranes, 275–289	lysine, 329, 340–341
mass transfer in electrodialysis stack,	malic acid, 329, 337-338
290–295	propionic acid, 328, 329, 337-339
overall potential drop across	pyruvic acid, 329, 340
electrodialysis stack, 295–298	succinic acid, 329, 340
performance indicators, 298-300	Fiber
problems and future perspectives, 347-351	content of common plant foods, 177
Electrodialysis stack	dietary fiber, 177
arrangement, 284–289	dietary reference intakes for, 176
batch desalination process, 284, 285	dictary reference intakes for, 176
	functional fiber, 177, 179
continuous single-passage process,	
•	functional fiber, 177, 179

Flaxseed	phenolic acid contents of whole and dehulled
affect on biological lipid status, 24–27	flaxseed, 48
affect on inflammatory markers and	processing, 48–52
atherosclerosis, 27–29	milling and fractionation, 48–49
amino acid profiles of, 8	storage stability of, 49–52
as an animal feed, 70–75	production of, 2–3
antifungal properties of, 69–70	quality and end use functionality, 47-75
baking applications of, 62–65	roasted, 58–62
physical properties of wheat flour	concentration of secoisolariciresinol
with added	diglucoside of, 61, 62
ground flaxseed, 62, 64	fatty acid compositions of, 60-61
cancer prevention, role in, 32-41	flavor compounds in, 59
breast cancer, 32-37	peroxide values of, 61-62, 63
colon cancer, 38	scanning electron micrograph, 59
prostate cancer, 37–38, 40–41	safety of, 42–46
skin cancer, 38	antinutrients, 42–43
clinical and epidemiological studies, 29-32	role in reproduction, 43–46
components of, 3–20	sensory properties, 47–48
cyanogenic glycosides, 10, 12–14	tocopherol in, 20
dietary fiber, 15–17, 24	tocotrienols in, 20
flaxseed oil, 3–5, 21–22, 24–26, 53–55, 56	triacylglycerols in, 3, 4
gum, 15–17, 18, 19, 55–57	Flaxseed macaroni, 66
lignans, 17–19, 22–24	Flaxseed oil
mucilage, 15–17	affect on lipid status, 24–26
polyphenols, 17–19	extraction of, 52–53
protein, 5–10	fatty acid composition, 4
daily recommendation for, 76	α -linolenic acid content, 4–5, 21–22
dairy products, 67–69	stability of, 53–55, 56
fatty acid profile of ice cream containing	Flaxseed protein fractions
flaxseed oil, 68–69	amino acid profiles of, 9, 11
diacylglycerol in, 3	protein contents of, 6, 8
domestication of, 2	Fluorescence microscopy, 214, 216
extraction of, 52–53	Food and nutraceutical industries
extruded products, 65–67	interest in food components that reduce
conjugated diene contents of lipid	cholesterol absorption, 173–174, 193
extracted from, 65–66	Food components
fatty acid distribution in, 3	impact on cholesterol absorption, 170–190
health benefits from, 2–3, 21–46	fiber, 176–181
cancer prevention, 32–41	phospholipids, 186–189
cardiovascular disease prevention,	plant sterols and stanols, 170-176
24–32	saponins, 181–184
diabetes prevention, 41–42	soy protein, 184–186
hydrogen cyanide in, 13–14	stearic acid, 189–192
impact on wheat flour with added ground	Food industry
flaxseed, 62, 64	brackish and seawater desalination,
lignans in, 17–19, 22–24	305–309
linoleic (La) acid in, 3	dairy industry, 309-316
α-linolenic acid contents, 4–5, 21–22	electrodialysis application in, 269-351
linolenic (Ln) acid in, 3, 5, 21-22	fermentation industry, 326-341
neutral lipids in, 3	fruit juice industry, 321–323

interest in food components that reduce	IEM, see Ion-exchange membranes
cholesterol absorption, 173–174, 193	IER, see Ion-exchange resins
sugar industry, 324–325	Image acquisition techniques
table salt production, 309	absorption microtomography, 229, 231
wine industry, 316–321	atomic force microscopy, 209, 224-226
Food microstructure studies, see Microstructure studies	confocal laser scanning microscopy, 208–209, 216
Food quality, CT number and, 237-238	electron microscopy, 208, 216-218
Food safety, CT number and, 238	infrared microspectroscopy, 210, 226–228
Fouling and scaling, of electromembranes,	light microscopy, 208, 214–216
300–304	magnetic resonance imaging, 209, 218–221
Free radical damage, vulnerability of	microstructure studies, 214–233
brain to, 145	phase contrast microtomography, 228-233
Fresh pasta, effect of flaxseed concentration	Raman microspectroscopy, 210, 226–228
on, 68	ultrasound measurements, 209
Frozen dessert containing flaxseed oil, fatty acid	vibrational microspectroscopy, 226-228
profile of, 68–69	Image-processing analysis
Fruit juice industry, electrodialysis application	classification, 214
in, 321–323	image acquisition, 212, 214-233
Fruit juices, deacidification of, 321–323	object measurement, 214
Fruits and vegetables, lycopene content in, 105	preprocessing
	local preprocessing, 213
G	pixel preprocessing, 212–213
Glycyrrhizin-free juice, 342	segmentation, 213-214
Guar gum, 16	Infertile man, sperm quality in, 144
Gum arabic, 16	Infertility, see Male infertility
	Inflammatory markers, flaxseed affect on, 27-29
Н	Infrared microspectroscopy, for image
Health benefits of flaxseed, 2-3, 21-46	acquisition, 210, 226-228
antinutrients, 41–43	Internal features and mechanical properties,
in cancer prevention, 32-41	238–256
breast cancer, 32-37, 39-40	anisotropy degree, 244-254
colon cancer, 38	cell size distribution, 240-243
prostate cancer, 37-38, 40-41	cell wall thickness distribution, 238, 243-244
skin cancer, 38	connectivity index, 254-256
in cardiovascular disease prevention, 24-32	volume fraction, 239–240
in diabetes prevention, 41–42	International Desalination Association, 305
metabolism of flaxseed lignan, 46	International Wine Office, 318
role in reproduction, 43–46	Ion-exchange membranes, 269, 275
High blood pressure, see Hypertension	anionic membrane, 275, 276
Huntington's disease, see Neurodegenerative	cationic membrane, 275, 276
diseases	chemical stability, 277
Hydrophobicity index, 169	commercially available, 278-279
Hypertension, lycopene role in prevention of,	heterogeneous, 275
140–142	homogeneous, 275
	ion-exchange capacity of, 277
Ι	stack construction, 280-284
Ice cream containing flaxseed oil, fatty acid	Ion-exchange polymers, 276
profile of, 68–69	Ion-exchange resins, 275
IDA, see International Desalination Association	IR, see Infrared microspectroscopy

Isolariciresinol, 17–18, 19	antioxidant properties of, 107-108, 109, 114
Itaconic acid, 328–329, 333–336	bioavailability of, 110, 112
Tracome acid, 320-329, 333-330	in bone cells, 135–137
K	chemistry and dietary sources of, 102–105
Kohlrausch limiting law, 272	isomeric forms of, 103
Kohlrausch's law of the independent migration	structures of, 103–104
of ions, 272	trans and <i>cis</i> isomeric forms of, 104, 111
01 10113, 272	cis and trans isomers in rat serum and
L	tissues. 111
Lactic acid, 329, 333–336, 338	dietary intake levels of, 146–148
LDL, see Low density lipoprotein	dietary source of carotenoid antioxidant, 100
Light microscopy	dietary supplements effect on serum
bright field microscopy, 214–215	α -linolenic acid oxidation, 132
dark field microscopy, 215	effect of processing temperatures and storage
differential interference contrast	on, 107–108, 109
microscopy, 215	effect on osteoblasts, 136–137
fluorescence microscopy, 216	effect on osteoclasts, 138–139
image acquisition technique, 208, 214–216	effect on sperm functionality, 143
oil immersion microscopy, 215	in food and other biological materials,
phase contrast microscopy, 215	106, 107
polarizing microscopy, 215	in fruits and vegetables, 105, 112
Lignans	human diseases and, 115–146
in isolariciresinol, 18, 19	bone disorders, 133–140, 149
in matairesinal, 17–18, 19	cancer, 116–128, 149
Lignans in flaxseed, 17–19, 22–24	cardiovascular diseases, 128–133, 149
metabolism of, 46	hypertension, 140–142, 149
studies on breast cancer, 35–37	male infertility, 142–144, 149
Linoleic (La) acid, in flaxseed, 3, 5	neurodegenerative diseases, 144–146
α-Linolenic acid	osteoporosis, 133–140, 149
affect of, on lipid status, 24–26, 30–32	in human tissues, 112, 113
in flaxseed, 4–5, 21–22	mechanisms of action of, 113-115
prevention of breast cancer and, 37	metabolism of, 108–113
Linolenic (Ln) acid, in flaxseed, 3, 4, 21–22	prevention of chronic diseases,
Linseed, see Flaxseed	115–146
Lipid status, affect of α-linolenic acid and	bone disorders, 133–140
flaxseed oil on, 24–27	cancer, 116-128, 149
Liquorice extracts, 342	cardiovascular diseases, 128-133
Liver and small intestine, movement of cholesterol	hypertension, 140-142, 149
and bile acids between, 167	hypothesis of, 116
LM, see Light microscopy	male infertility, 142–144, 149
Low density lipoprotein oxidation	neurodegenerative diseases, 144-146
coronary heart disease and, 129	osteoporosis, 133–140, 149
effect of dietary lycopene supplements on	prostate cancer, 120-125, 149
serum, 132	role in postmenopausal women at risk of
Lycopene	osteoporosis, 137–140
absorption and translocation, 109-110	safety of, 108-113
analytical methods of measuring of	stability of, 107–108, 109
high-pressure liquid	tissue distribution of, 108-113
chromatography, 106	in tomatoes and tomato-based products, 105,
spectrophotometric methods, 106	107–108, 112

Lycopene, role in osteoporosis	Modified fouling index, 302
osteoblasts and, 134	Molecular markers of cancer, 100, 117-119
osteoclasts and, 134-135	cyclin D1 and cyclin E, 117-118
prevention, 133-140, 149	estrogen and progesterone receptors, 119
Lysine, 329, 340-341	Her2/neu, 119
	Ki-67, 117
M	matrix-assisted laser desorption ionization
Magnetic resonance imaging, for image	time-of-flight mass spectrometry, 120
acquisition, 209, 218-221	osteopontin, 119
MALDI-TOF MS, see Matrix-assisted laser	p53 protein, 117–118
desorption ionization time-of-flight	prostate-specific antigen expression,
mass spectrometry	118–119
Male infertility, lycopene role in prevention of,	prostate-specific membrane antigen, 119
142–144, 149	prostate stem cell antigen, 119
Malic acid, 329, 337, 338	surface enhanced laser desorption/
Mammalian lignans, 22–23	ionization-mass spectrometry, 120
oxidized mammalian lignans, 23	survivin, 117–118
MAT, see Matairesinal	tumor lymph node metastases staging
Matairesinal, 17-18, 19	system, 117
Matrix-assisted laser desorption ionization	vascular endothelial growth factor
time-of-flight mass spectrometry, 120	expression, 118
MFI, see Modified fouling index	Monopolar membranes, 275–286
Microstructure studies	MRI, see Magnetic resonance imaging
computing and imaging tools, 211	Mussel cooking juice, 341
data-processing techniques, 211, 233-256	
image acquisition techniques, 214-233	N
image-processing analysis, 212-214	NDD, see Neurodegenerative diseases
importance of, 207–208	Neurodegenerative diseases, lycopene role in the
internal features and mechanical properties,	prevention of, 144-146, 149
238–256	Nuclear magnetic resonance imaging, see
need of imaging technique for, 210-211	Magnetic resonance imaging
techniques for	
atomic force microscopy, 209, 224-226	O
confocal laser scanning microscopy,	Oil immersion microscopy, 214–215
208–209, 216	OIV, see International Wine Office
Fourier transform infrared	Osteoblasts
microspectroscopy, 210	evidence associating oxidative stress and
light microscopy, 208, 214-216	antioxidants with, 134
magnetic resonance imaging, 209,	lycopene effect on, 135-136
218–221	Osteoclasts
nuclear magnetic resonance, 209	evidence associating oxidative stress and
Raman microspectroscopy, 210,	antioxidants with, 134-135
226–228	lycopene effect on, 136-137, 138
scanning electron microscopy, 208,	Osteoporosis
217–218	evidence associating oxidative stress and
small-angle neutron scattering, 210	antioxidants with, 133-134
transmission electron microscopy, 208,	lycopene role in postmenopausal women at
217–218	risk of, 137–140
ultrasound measurements, 209	lycopene role in prevention of,
X-ray diffraction, 209	133–140, 149

Oxidative stress	Protein contents of
and antioxidants associating with	flaxseed, 5–10
osteoblasts, 134	flaxseed fraction, 7
and antioxidants associating with	flaxseed protein extract, 6, 8
osteoclasts, 134-135	PS, see Plant sterols
and antioxidants associating with	Pyruvic acid, 329, 340
osteoporosis, 133–134	
chronic diseases and, 99, 101-102	R
effect on sperm functionality, 143	Raman microspectroscopy, for image
hypothesis of, 116	acquisition, 210, 226-228
P	Reactive oxygen species, oxidative stress induced by, 100–101
Palmitic (P) acid, in flaxseed, 3	Real-time ultrasound technique, 223
Parkinson's disease, <i>see</i> Neurodegenerative	Reproduction, flaxseed role in, 43–46
diseases	Roasted flaxseed, 58–62
Phase contrast microscopy, 215	concentration of secoisolariciresinol
Phase contrast microtomography, for image	diglucoside of, 61, 62
acquisition, 228–233	fatty acid compositions of, 60–61
Phospholipids	flavor compounds in, 59
impact on cholesterol absorption, 186–189	peroxide values of, 61–62, 63
present in food supply, 187	scanning electron micrograph, 59
Plant stanols, impact on cholesterol absorption, 170–176	RTU, see Real-time ultrasound technique
Plant sterols	S
cholesterol-lowering properties of, 174–175	Saponins
consumer demand for products containing,	content of common plant foods, 182
173–174	impact on cholesterol absorption, 181–184
content of common plant foods, 171, 172	structure of, 181
impact on cholesterol absorption, 170–176	Scanning electron microscopy, 208, 217–218
movement of between liver and small	Scanning probe microscopy techniques, 224
intestine, 167	Secoisolariciresinol diglucoside, 2
structure of, 171	SEM, see Scanning electron microscopy
transport of, 169	Silt density index, 302
Plasma cholesterol, 193	Skin cancer, flaxseed role in prevention of, 38
Polarizing microscopy, 215	Soluble fiber, impact on cholesterol absorption,
Postmenopausal women at risk of osteoporosis	176–181
lycopene intake effect on serum lycopene	Soy protein, impact on cholesterol absorption,
in, 139	184–186
lycopene role in, 137–140	Sperm functionality
serum lycopene effect on protein oxidation	effect of oxidative stress and lycopene on, 143
and bone turnover markers in, 140	in infertile man, 144
Prostate cancer	Stearic acid
lycopene absorption kinetics in, 125	in edible fats and oils, 189, 190
role of lycopene in the prevention,	impact on cholesterol absorption,
120–126, 149	189–192
serum and tissue carotenoid levels in, 123,	Succinic acid, 329, 340
124	Sugar industry, electrodialysis application in,
serum prostate-specific antigen,	323–325
thiobarbituric acid substances and	Surface enhanced laser desorption/
thiols in, 123, 125	ionization-mass spectrometry, 120

X-ray tomography, 229

T	V
Table salt production, electrodialysis application	Vascular endothelial growth factor, 118
in, 309	VEGF, see Vascular endothelial growth factor
TEM, see Transmission electron microscopy	Vibrational microspectroscopy, for image
Thermodynamic electrode potential, 270-271	acquisition, 226–228
TNM, see Tumor lymph node metastases	
Tomatoes and tomato-based products	W
effect on systolic and diastolic blood	Whey
pressure, 141	de-ashing, 310–311
epidemiological studies on role in cancer, 128	demineralization, 311-316
lycopene content in, 105	Wine, tartrate stabilization of, 317-318, 320
effect of heating in presence of lipids	Wine industry
on, 108	electrodialysis application in, 316-321
effect of processing on, 107	tartrate stabilization of wine, 318
effect of storage on, 107	
Tomography, 228	X
Transmission electron microscopy, 217–218	Xanthan gum, 16
Tumor lymph node metastases staging	X-ray absorption microtomography,
system, 117	232–235
	X-ray computed tomographic scanners,
U	211, 256
Ultrasound imaging/measurements, for image	X-ray computer tomography, 223

acquisition, 209, 221-224