

## Index

### a

acceptor-labelled micelles (ECCM) 220, 221  
 acetan 64, 65  
 acetic acid bacteria (AAB) 150, 165  
 acetyl-CoA 77, 233, 236  
 acrylamide monomer (AM) 142, 157  
 acute toxicity 12, 22, 304, 305  
 Alexa Fluor 555-labeled streptavidin (AF555-Streptavidin) 217  
 algae cultivation 32  
 algal EPS (sEPS) 33, 36, 39  
 Algenist™ 40  
 alginates 67–68, 70, 80, 81, 86, 136, 137, 289  
 $\alpha$  scaffolds 271  
 alternan 69, 72, 106, 120  
 amphiphilic hydrophobin proteins 166  
 ampholytic hydrogels 27  
 amyloid fibrils (AF) 214, 216  
 amyloid-HA bone biomimetic composites 214  
 amyloid-like proteins 216  
 amyloid protein nanofibrils 209, 214, 232  
 anaerobic bacteria 103  
 anhydroglucose units (AGU) 138, 139  
 anionic hydrogel 27  
 anticoagulant activity of macroalgal polysaccharides 38  
 antihuman immunodeficiency virus (HIV) 36  
 anti-inflammatory activity 37–38  
 antiproliferative 37  
 antiviral activity 36, 117

articular cartilage 192, 193, 286  
 artificial lubricant 193  
 ATP-binding cassette (ABC) transporter-dependent mechanism 72  
*Aureobasidium pullulans* 20, 22, 66  
 Avicel® 139

### b

bacterial cellulose 149, 151, 284, 285  
 bacterial exopolysaccharides 85  
 bacterial nanocellulose (BNC) 149–151, 163, 164  
 bacterial polysaccharides  
   active precursor 71–72  
   alginate and cellulose 73  
   ATP-binding cassette (ABC) transporter-dependent mechanism 72  
   c-di-GMP 75  
   extracellular synthesis 72  
   genetic background 70–71  
   polymerization 71–72  
   regulatory RNA binding proteins 75  
   sRNAs regulatory networks 74  
   synthase-dependent mechanism 72  
   Wzx/Wzy-dependent mechanism 71–72  
*Bacteroides* 105, 118  
 beneficial bacteria 117–119  
 1,4- $\beta$ -D-glucose backbone 23  
 $\beta$ -D-glucuronic acid 68  
 $\beta$ -D-N-acetyl-glucosamine 68  
 $\beta$  scaffolds 270, 271

- biobased polymers
    - for biomedical applications
      - alginate 136, 137
      - biomaterials 132–135
      - chitin 137
      - poly(butylene succinate) 136
      - polyhydroxyalkanoates 136
      - polylactide 135
      - starch 136
      - synthetic/naturally occurring 135
    - biomedical engineering 130–132
    - first generation of 129
    - global production of 129
    - principal 129
  - biocompatibility
    - biopolymeric materials and devices 2–4
    - concept and definition of 1
    - cytotoxicity 11–12
    - implantation 14–15
    - risk based approach
      - chemistry screening of biopolymers 7–11
      - factors 5
      - PCL pipeline upstream 5
      - polyesters 7
      - polysaccharides 6
      - proteins 7
      - systemic toxicity 12–14
  - biocompatible 4
    - fibrous proteins 209
    - hydrogel 29
  - Biofill® 163, 164
  - biological polymers 30
  - biomaterials
    - cellulose 138
    - ceramics 132
    - definition 132
    - metals and metal alloy 132
    - nature derived polymers 135
    - petroleum derived polymers 134
    - synthetic polymers 134, 135
  - biomedical engineering 130–132, 135, 182, 190, 215–216
  - bionanocomposites 29–32, 44
  - biopolymers
    - biocompatibility evaluation of 2–4
    - chemistry of 6–7
    - chemistry screening of 7–11
    - cytotoxicity of 11–12
    - FucoPol 30
    - implantation 14–15
    - microbial polysaccharides 22–25
    - systemic toxicity 13
  - Biopreferred® program 129
  - Bioprocess® 164
  - Blue Lagoon ecosystem 38
  - bone tissue engineering 164, 165, 213–215, 276, 287–289
  - bovine serum albumin (BSA) 211
  - bovine submaxillary mucin MUC5B (BSM) 182
  - Brownian motion 189
  - 1,4-butanediol (BDO) 136
- C**
- calcium-alginate gels 137
  - cancer therapy, pullulan 22–23
  - capsular polysaccharides (CPS) 19, 72, 73, 82, 103
  - carbon nanofibers (CNFs) 218
  - carbon nanotubes (CNT) 22, 29, 30, 154, 211, 362
  - carboxymethylcellulose (CMC) 142, 192
  - cationic hydrogel 27
  - CdSe-ZnS quantum dots 216
  - cell-bound mucins 185
  - cellobiose 138, 148, 149
  - cell-permeating peptides (CPPs) 274–276
  - cellulose 67
    - anhydroglucose units 138
    - cell wall of plants 138
    - chemical and physical structure 138
    - chemical modification of 141
    - drug tableting industry 141
    - esters 141
    - hydrogels of 142
    - industrial scale use of 139
    - intra- and interchain hydrogen bonding 138
    - microcrystalline cellulose 139
    - medical uses of 142

- microfibers and wood fibers 140
  - polymerization degree of 138
  - wood 138
  - cellulose acetate phthalate (CAP) 141
  - cellulose microfibrils 143, 145
  - cellulose nanocrystals (CNC)
    - 142–145, 154
  - cellulose nanofibrils (CNF) 142, 143
    - biodurability of 163
    - enzymatic pre-treatment 146–148
    - general procedures 146
    - genotoxicity of 156
    - health and environmental safety 154
    - high energy consumption 146
    - industrial production of 146
    - mechanical treatment devices 146, 147
    - medical applications 164–169
    - TEMPO mediated oxidation
      - pre-treatment 148–149
    - terminology 145
    - toxicological assessment of 157
    - wood and annual plants 146
  - cellulosic nanomaterials (CNMs) 151
    - characterization of 151–153
    - health and toxicology 154–163
  - cellulosics 44, 141–146, 149, 154
  - ceramics 29, 132, 134, 357
  - cetyltrimethylammonium bromide (CTAB) 163
  - chemically crosslinked hydrogels 26
  - chitin 137
    - advantage 40
    - biomedical 42
    - deacetylation reaction of 40
    - fungal 41
    - microbial 40
    - textile industry 44
  - chitin–glucan complex (CGC) 41–44
  - chitinous polysaccharides
    - biomedical 42–43
    - food applications 43
    - metals absorption capacity of 44
    - pharmaceutical applications 43
    - properties and applications 41, 42
  - chitosan (CN) 137, 282–284, 285–287
    - biomedical field 42
    - cosmetic products 43
    - deacetylation reaction of 40
    - food preservation 43
    - hydrogels 27
    - properties of 41, 42
  - chitosan–glucan complex (ChGC) 41, 42
  - Chlorophyta 33
  - chronic toxicity 13
  - Chrysophyta 33
  - Clostridia 118
  - collagen 43, 129, 137, 209, 213, 267, 269, 276, 277, 279, 284–287, 358, 360, 361
  - collagen-binding peptides (CBPs) 274
  - commercial microalgae products 33
  - commercial mucins 183
  - core-crosslinked micelles (CCMs) 220
  - crosslinker 26, 163, 168, 214, 359
  - curdlan 24, 64, 67, 72, 78, 85
  - cyclic-3'5'-diguanylic acid (c-di-GMP)
    - 75, 76, 81, 86
  - cyclic peptides (CPs) 270, 273, 276
  - cysteine-rich regions 185
  - cytotoxicity 11–12, 83, 154, 156–163, 190, 216, 285
- d**
- database of PS 111
  - deacetylated gellan 27
  - deacetylation degree (DD) 41
  - degenerative diseases 209
  - degree of mucin aggregation 189
  - degree of polymerization (DP) 67
    - cellulose nanofibrils 148
    - galacto-oligosaccharides 118
  - dendritic cells (DCs) 36, 160
  - design of donor-labelled SP1 (DSP1)
    - 220
  - detrimental bacteria 117
  - dextrans (Dex) 20, 22, 24, 28, 32, 68–69, 72, 106, 107, 111, 267, 268, 282
  - dextranucrase genes 111
  - dietary fibers 43, 69, 118, 119
  - diguanylate cyclases (DGC) 75
  - dimethyl succinate 136

- diutan 66, 72
- doxorubicin (DOX) 215, 269
- drug delivery 131, 280–284
  - hydrogels components of 194
  - targeted 273, 274
  - vehicles 267–273
- e**
- ectromelia virus (ECTV) 36
- elastin-like polypeptides (ELPs) 272, 276–278
- electrospinning 210–212, 222, 223, 286, 358, 360–362, 368, 371, 376
- electrospun fibrous protein membranes 222
- electrospun protein nanofibers 218
- electrospun SF nanofiber membranes 221
- engineered mucins 194–195
- engineering polysaccharide-producing cell factories
  - controlling processivity via copy number of polymerase/synthase 82
  - controlling processivity via coupling with modification events 80
  - controlling processivity via substrate concentration 82
  - controlling processivity via substrate tethering mechanism 80
  - controlling processivity via Wzz protein and homologues 81
  - generally regarded as safe 76, 77
  - genetic and metabolic pathways 78–79
  - processive or non-processive mechanisms 80
  - production 77
  - recombinant production
    - alginate 86
    - bacterial exopolysaccharides 85
    - cellulose and hyaluronate 84, 85
    - gram-negative bacteria 84
    - heterologous hosts 86
    - nonpathogenic 84
    - nonvirulent 84
    - toxin-free cell factories 84
- enzyme-linked immunosorbent assay (ELISA) 194
- epidermal and dermal wounds 137
- eukaryotic organisms 33
- European Medicines Agency (EMA) 8
- European SUNPAP project 154
- exopolysaccharides (EPS) 19, 33, 66, 70, 75, 84, 103–104
- exotoxins 83
- extracellular matrix (ECM) 130, 277, 357
- extracellular polymeric substances (EPS) 76, 150
- f**
- fabricate hydrogels 28
- fecal bifidobacteria 118
- fibrin 267, 276, 363, 364
- fibrous proteins
  - advantages 209
  - biocompatible 209
  - biomedical engineering 215–216
  - bone tissue engineering 213–215
  - characterizations 213
  - energy application 218–220
  - environmental application 220–222
  - formation of 209
  - molecular self-assembly 209
  - nanodevices 217–218
  - sensors and biosensors 216–217
  - structure 212–213
  - synthesis methods 210–212
    - electrospinning 210–212
    - self-assembly of biomolecules 211
    - solution blowing 210, 211
    - template-assisted synthesis 211
- fluorescently labeled mucins 189
- food for specified health use (FOSHU) system 119
- fructo-oligosaccharides (FOS) 117
- FucoPol 22, 30
- fucose 19–21, 30, 33, 78
- functional mucin glycoproteins 183
- fungal chitin 41

**g**

galacto-oligosaccharides (GOS)  
117–119

galactoglucan 64–66

Gal–Gal linkage 118

gastric/intestinal mucins 183

gastrointestinal microflora 117

gelatine 267, 269, 276, 286, 289, 359,  
361, 363–367, 370–372

gel electrophoresis 187, 188

gel-forming mucins 185

gellan 22, 25, 27, 64, 66, 72

gellan gum 22, 24–27, 32, 267, 288

gellan hydrogels 27

generally recognized as safe (GRAS)  
25, 76, 115

glucans 20, 24, 105–107

glucuronic acid 19–21, 23, 25, 64–66

glycogen 19, 63

glycoproteins 181–187, 189–190, 193,  
195

glycosyltransferases 70–73, 75, 76, 79,  
80, 105, 111, 119

gram-negative bacteria 84, 85, 105

GrowDex<sup>®</sup> 164

gut microbiome 181

**h**

Hayashibara Co., Ltd. (Japan) 23

headspace gas chromatography with  
mass spectroscopy (HS-GC/MS)  
9

herpes simplex virus types 1 (HSV-1)  
36

hetero-PS  
biosynthesis 111, 112  
instability production of 116–117  
monosaccharides composition of  
111–112  
monosaccharides, types of 104  
yield of 112–116

heteropolymers 64, 66, 67, 71, 72, 82

high-performance liquid  
chromatography (HPLC) 166,  
188

high-resolution accurate mass (HRAM)  
10

homofermentation 103

homo-PHAs  
improved microbial production of  
243–245  
integrated production process of  
246–247  
material properties of 245–246  
medium-chain-length PHA  
monomeric constituents  
240–241  
pathway engineering for 242–243

homopolymers 23, 26, 64, 67, 72, 232,  
233, 242–244, 246, 253

homo-PS  
biosynthesis of 104–105  
composition and structure 106  
glucansucrase or levansucrase 104  
instability production of 106–111  
single type of monosaccharide 104

human cytomegalovirus (HCMV)  
36

human herpes virus type 6 (HHV-6)  
36

human mucin sources 183

hyaluronate 68

hyaluronic acid (HA) 3, 7, 20, 22, 25,  
26, 28, 29, 39, 68, 72, 77, 78, 191,  
192, 267, 268, 281, 282, 287–289,  
358, 359

hydrogels  
chemically crosslinking agent 26  
chitosan 27, 28  
definition 25  
dextran 28  
fabrication of 27  
homopolymer 26  
interpenetrating polymeric network  
26  
physically crosslinking agent 26  
polysaccharide 27  
of pullulan 23  
semi-IPN 26  
smart/stimuli-sensitive 27  
3D crosslinked polymeric network  
25  
xanthan gum 28

hydrophobic drugs 30, 166, 270

- hydroxyapatite (HA) 137, 213, 272, 286, 365
- hydroxyethylcellulose (HEC) hydrogels 142
- hydroxyethyl-methacrylate-derivatized dextran (Dex-HEMA) 28
- hydroxymethylpropylcellulose (HPMC) 141
- i**
- Implantation, biopolymers 14–15
- influenza A virus 36
- International Conference on Harmonization (ICH) 8
- International Union of Pure and Applied Chemistry (IUPAC) 130
- interpenetrating polymeric network (IPN) hydrogels 26
- inulin 69, 72, 106, 110, 117, 120
- ionic hydrogel 27
- ISO 10993 1, 12
- isothermal titration calorimetry (ITC) 166
- j**
- jellyfish mucins 183
- k**
- KNK-005, genotype of 238
- l**
- L929 mouse fibroblast cell line 11
- lactate-polymerizing enzyme (LPE)
- biosynthesis 249–251
  - creation of 247–248
  - integrated production process 251–252
  - properties 253–254
- lactic acid bacteria (LAB)
- biofilm inhibition activity 105
  - definition 103
  - exopolysaccharides 103–104
  - health benefits 105
  - hetero-PS
    - biosynthesis 111, 112
    - instability production of 116–117
    - monosaccharides composition of 111–112
    - monosaccharides, types of 104
    - sugar transportation 104
    - yield of 112–116
- homo-PS
- biosynthesis of 104–105
  - composition and structure 106
  - glucansucrase or levansucrase 104
  - instability production of 106–111
  - single type of monosaccharide 104
- polysaccharides 105, 118–119
- prebiotics
- definition 117
  - dietary fiber 119
  - in Japanese FOSHU 119
  - oligosaccharides 117–119
  - rheological effects of 105
- Lead Market Initiative (LMI) 129
- levan 25, 69, 72, 106, 109
- liver tissue engineering 137
- low critical solution temperature (LCST) 27–28
- lyophilisation 184, 185
- m**
- macroalgal 38, 39
- macrophage activation 37
- mannan 111, 112
- measles virus 36
- medium-chain-length PHAs (mcl-PHAs) 240–242
- MEM Elution 11
- metallic nanoparticles (MNPs) 29, 30
- metals and metal alloy biomaterials 132
- microalgae
- biological activity and potential applications 33–39
  - commercialization 39–40
  - growth requirements 32
  - polysaccharide-producing microalgae 33
  - production 32, 33

- microalgae polysaccharides
    - bioactive properties
      - anticancer activity 36–37
      - anticoagulant/antithrombotic activity 38
      - anti-inflammatory activity 36–37
      - antioxidant activity 38–39
      - antiviral activity 36
      - immunomodulatory activity 36, 37
      - sulfated polysaccharides 39
    - biomedicine 44
    - cosmetics 44
    - exploitation of 39
    - nutraceuticals 44
    - pharmaceuticals 44
    - polysaccharide-producing microalgae 33
  - microbes 63, 76
  - microbial celluloses 67, 84
  - microbial chitin 40–42
  - microbial chitosan 27
  - microbial polysaccharides
    - acetan 64
    - alginates 67–68
    - application 19
    - biological activities 20
    - bionanocomposites 29–32
    - biopolymers 22
    - biosynthesis pathways of bacterial polysaccharides 69–76
    - carbohydrates 20
    - cellulose 67
    - curdlan 24, 67
    - definition 19
    - dextrans 20, 24, 68–69
    - engineering
      - polysaccharide-producing cell factories 76
    - galactoglucan 64–66
    - gellan gum 24, 27
    - hyaluronate 68
    - hyaluronic acid 20, 25, 68
    - hydrogels 25
    - inulines 69
    - levan 25, 69
    - properties of 20
    - pullulan 20, 22, 66
    - scleroglucan 20, 23
    - sphingan 66
    - succinoglycan 64–66
    - xanthan 20, 64
    - xanthan gum 23
  - microbial protein nanofibers 218
  - microcrystalline cellulose (MCC) 139, 154
  - microfibrillated cellulose (MFC) 143, 145, 153
  - microscale thermophoresis 188, 189
  - misfolded protein aggregation 209
  - modified pullulan 22
  - molecular lubricant 185, 189, 190
  - monomer peptides 277
  - mouth sprays 192
  - MTT/XTT assays 11
  - mucin glycoproteins 182–184, 186, 187, 195
  - mucin-mimetic polymers 194–195
  - mucins
    - atomic force microscopy 189
    - of biomedical engineering 182
    - in breast milk 181
    - engineered and mucin-mimetic polymers 194–195
    - gel electrophoresis 187
    - in human body 182
    - light scattering techniques 189
    - mechanical characterization method 189
    - molecular weight of 187
    - mucus systems 181
    - physiological processes 181
    - of pigs and cows 183
    - purified 190
    - sources and purification process 182
    - structure–function relation 185–187
  - multi-domain peptides (MDPs) 280
  - mumps virus 36
  - mutan 69, 72, 106, 107
- n**
- nano life cycle risk assessment (nanoLCRA) 156

- nanocellulose  
 bacterial nanocellulose 149–151  
 cellulose nanocrystals 142, 144–145  
 cellulose nanofibrils 142, 145–149  
 cellulosic nanomaterial 151–153  
 characteristics of 143  
 drawback for 143  
 industrialization of 153–154  
 isolation and characterization of 143–151  
 natural and renewable polymer 142  
 traditional cellulose-derived products 143
- nanocomposites 29–31, 220
- nanofibrillated cellulose (NFC) 143, 145, 153
- nanofibrous protein materials 222
- natural polypeptides 269
- naturally occurring polymers 135
- nature derived polymers 135
- Naviculan 36
- neural stem cells (NSCs) 279
- neutral red uptake assay 11
- nonmammalian mucin sources 183
- non-volatile organic compounds (NVOCs) 9, 10
- nylon filtration 214
- O**
- oil industry 23
- oligosaccharides 19, 24, 79, 82, 117–119, 267, 281
- orbitrap 10
- organized protein self-assembly 209
- osteoarthritis 25, 192, 193, 278, 284
- osteogenesis biomaterials 214
- oxidative stress 38, 163, 289
- oxygen reduction reaction (ORR) 219
- P**
- palm kernel fatty acid distillate (PKFAD) 246
- particulate matter (PM) 222
- PEDOT-S coating 217, 218
- pentacosadiynoic acid (PCDA) 216
- peptides  
 amphiphiles 271–272  
 collagen-binding peptides 274  
 cyclic peptides 270, 273, 276  
 monomer 277  
 multi-domain peptides 280  
 in regenerative medicine 276–280  
 in tissue engineering 276–280
- petroleum derived polymers 134
- PHBH  
 chemical structure of 234  
 DSC analysis of 235  
 fermentative production of 234  
 industrial production process of 235, 236  
 industrialization 239  
 material properties of 234  
 producing bacteria, molecular breeding of 236, 237  
 synthesis pathway 237
- photosynthetic organisms 32
- physically cross-linked hydrogels 26
- PilA 218
- plant cellulose 150, 284, 285
- poly(A)<sub>15</sub> DNA 217
- poly(butylene succinate) (PBS) 129, 136
- polycaprolactone (PCL) implant 3, 5, 134, 231, 286, 361
- polyhydroxybutyrate (PHB) 136
- polyelectrolytes 20, 27, 269, 284
- poly(3,4-ethylenedioxythiophene) (PEDOT) 217
- polyethylenimine (PEI) 163, 278
- poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) 232–234
- polyhydroxyalkanoates (PHAs) 136, 231  
 chemical structure of 232  
 physicochemical and thermal properties of 241
- polylactic acid (PLA) 3, 7, 13, 129, 135, 281, 362
- polylactide (PLA) 231
- polymeric carbohydrates 63
- polymerization degree (DP) 79–83
- polysaccharide-based nanomaterials 31
- polysaccharide hydrogels 27, 265

- polysaccharide-producing microalgae 33, 34, 35
- polysaccharides  
 fabrication techniques 285  
 lactic acid bacteria 129  
 structures of 268
- porcine gastric mucin (PGM) 182
- Porphyridium cruentum* 33, 34, 36
- prebiotic LAB  
 definition 117  
 in Japanese FOSHU 119  
 oligosaccharides 117–119  
 polysaccharides 118
- prokaryotic organisms 33, 70, 74, 76
- pullulan 20, 22–23, 66, 82, 267
- purge and trap GC/MS 9
- purified mucins  
 biomedical applications  
 animal tissue samples 190  
 artificial joint fluids 192–193  
 clinical evaluation of 194  
 coating 193  
 eye drops/contact lens coatings 190–191  
 high-quality mucin 190  
 hydrogels for drug delivery 194  
 mouth sprays 192
- Pyrrophyta 33, 34
- q**
- quantitative time of flight (qTOF) 10
- quartz crystal microbalance (QCM) 189
- r**
- Ralstonia eutropha* 232, 238–239
- reduced graphene oxide (RGO) 220
- regenerative medicine 137  
 peptides in 276–280  
 tissue engineering 137, 276–280, 284–289
- rhamnan 64, 66
- Rhodophyta 33, 34
- ring-opening polymerization (ROP) 7, 247
- S**
- scleroglucan 20, 22, 23
- secreted gel-forming mucins 185
- secreted non-gel-forming mucins 185
- self-assembled fibrous protein scaffolds 220
- semi-volatile organic compounds (SVOCs) 9, 10
- SF/PEO membranes 222
- silylated hydroxypropylmethyl-cellulose hydrogels 142
- silk-elastin-like protein polymer (SELP) 216
- silk fibrils 214–216
- silk fibroin (SF) 209, 214, 267, 269, 270, 286, 362
- silk nanofiber network-based bio-triboelectric generator (Silk Bio-TEG) 220
- silk protein 210, 211, 220, 222
- small noncoding RNAs (sRNA) 74
- smart/stimuli-sensitive hydrogels 27
- sodium-carboxymethylcellulose (Na-CMC) 142
- solution blowing 209–211, 223
- sphinganolipid polysaccharides 66, 72
- Sphingomonas sanxanigenens* 66
- stable protein one (SP1) 220
- standard biocompatibility test 13
- starch 22, 28, 29, 135, 136, 239, 286
- Streptococcus zooepidemicus* 20, 25, 82
- subacute toxicity 4, 12
- subchronic toxicity 4, 12
- succinoglycan 64–66, 72
- sulfated polysaccharides 36, 38, 39
- sulfur-containing EPS 36
- synthase-dependent mechanism 72
- synthetic and natural substrates 267  
 cell-permeating peptides 274–276  
 drug delivery vehicles 267–273  
 polysaccharides applications 280, 289  
 regenerative medicine 276–280  
 targeted drug delivery 273–274  
 tissue engineering 276–280
- synthetic biopolymers 135, 267, 286, 287

synthetic peptides 270, 271, 278, 280  
synthetic polymers 2, 30, 134, 135,  
139, 193, 278, 281, 358  
synthetic polypeptides 270–280  
systemic toxicity 4, 8, 11–14, 283

**t**

tailor-made products 70, 83–86, 251  
targeted drug delivery 273, 274  
template-assisted synthesis 209, 211  
TEMPO mediated oxidation  
pre-treatment 146, 148–149  
tetrodotoxin 105  
thermostable biopolymer 23  
tissue engineering 130, 131  
bone 164, 213–215  
drug delivery *see* drug delivery  
liver 137  
peptides in 276–280  
regenerative medicine 137,  
276–280, 284–289  
tobacco mosaic virus (TMV) 220  
toxicological concern (TTC) 8  
tribological shear stress 187  
two-component systems (TCS) 74  
type III secretion system (T3SS) 84

**u**

UDP-glucose 71, 78  
UDP-*N*-acetylglucosamine 78, 82,  
85  
ultrasmall peptides 269–270  
upper critical solution temperature  
(UCST) 27

Ure2-alkaline phosphatase (Ure2-AP)  
212, 285  
US Department of Agriculture (USDA)  
129  
US Food and Drug Administration  
(FDA) 8, 70, 76, 80

**v**

vaccinia virus (VACV) 36  
vascular graft prostheses design 134  
volatile organic compounds (VOCs) 9  
von Willebrand factor-like domains  
185

**w**

welan 66, 72  
wide-angle X-ray diffraction (WAXD)  
245  
wound healing 24, 27, 42, 43, 130, 137,  
164, 165, 167, 170, 191, 194, 265,  
370

**x**

xanthan 20, 23, 24, 26, 28, 64, 71–73  
xanthan-based polymers 24  
xanthan gum 22–24, 28, 29, 32, 39, 64,  
115, 267, 284  
*Xanthomonas campestris* 23, 64, 112  
XCell<sup>®</sup> 164  
xerostomia 192  
xylo-oligosaccharides 118

**z**

zero-order kinetic release rate 132