

Index

a

- abbreviated new drug applications (ANDAs) 151, 340
- absorption, distribution, metabolism and excretion (ADME) 3, 5, 340, 356, 361
- absorption, distribution, metabolism, excretion and toxicity (ADMET) 362
- absorption number (A_n) 278
- acetal linkages 269
- acidic appendages 396–397
- acidic environments, liposomes 224
- acid-labile linkages 268
- active loading, liposome 215
- active pharmaceutical agent (API) 257
- active pharmaceutical ingredients (APIs) 1, 20, 85, 88, 116, 182, 299, 300, 305, 353, 368
 - intrinsic amorphization potential of 21–22
- active targeting liposomes 227
- adefovir dipivoxil 144
- adequate water solubility 139
- adsorption method 182, 189, 261, 262, 364
- Affinisol® 369
- Agenerase 333, 346
- aggregation 10, 88, 89, 91, 94, 96, 183, 217, 220, 222, 223, 233, 240, 300, 345
- AKT kinase inhibitors 399, 400
- alcohols 119, 179
- Alkeran® 312
- alpha, beta, and gamma CDs 298–299
- α -cyclodextrin 86
- α -D-glucopyranose 297, 298
- alpha relaxation 31, 32
 - process 24
 - time 24
- Alvaiz® 372
- amide bonds 410
- amide groups 400
- amines 217, 303, 396, 400
- p*-aminobenzoic acid 148, 150, 151
- ammonium ion gradient 217
- ammonium sulfate gradient method 217, 218
- amorphization 20–22, 45, 86, 267, 332
- amorphous forms 10, 45, 86, 125, 257, 261, 262, 266, 362, 367–369
- amorphous materials 20, 23
- amorphous solid dispersions (ASDs) 10, 19, 117, 339, 368–372
 - analytical characterization of 28
 - basic design principles of 20
 - biopharmaceutics of 46–50
 - biopharmaceutics screening 39
 - bulk and powder characterization of 37–38
 - characterization of molecular interactions in 33–34
 - chemical characterization 38

amorphous solid dispersions (ASDs)
(*contd.*)

- chemical stability assessment of 52–53
- composition screening 39–40
- computational tools for 54–59
- crystallinity analysis of 35–36
- design attributes of 20–21
- downstream processing of 45–46
- drug dissolution from 48–49
- drug loading selection 27–28
- drug-polymer interactions 24–25
- drug-polymer phase behavior 22–23
- emerging innovations in 59–60
- food effect of 50
- formulation development 25–28
- in vivo, ex vivo aspects of 47, 49–50
- manufacturing processes for 40–46
- miscellaneous analysis of 38
- molecular mobility 23–26
- physical stability assessment of 51–52
- polymers used in 26–27
- preformulation and screening 38–40
- process relevant screening 40
- product performance stability assessment of 53–54
- stability of 50–51
- surface characteristics of 36–37

amphotericin B-loaded liposomes 226

ampicillin 8, 14

amprenavir (Agenerase) 333, 407, 408

animal models 185, 338, 354, 356, 377

anionic liposomes 223

antibodies 220–223, 227, 230, 231, 242

antibody fragments 227

antigen-incorporated liposomes 235

anti-HER2 antibodies 227

antimicrobial agents, charged liposomes 223

anti-plasticization 21

anti-solvent precipitation method 129

aprepitant 375

aptamers 228

aqueous solubility 330, 389, 391, 410

- bioisosterism to address 404–407
- H-bonding modifiers to improve 401–403
- miscellaneous approaches to address weak 409–410
- prodrug approach to address 407–409
- of roniciclib 407
- of solid compounds 403–404

Aquipta® 372

6-O-aryl/alkyl-sulfonated CDs 303

aryl hydrocarbon receptor (AhR) 403

Ativan 9

b

baicalein-phospholipid complex SMEDDS (BAPC-SMEDDS) 185

basic appendages 400–401

BCS-based FDA/EMA guidelines 285

BCS Class I drugs 83, 277, 279, 286, 357

BCS Class II drugs 4–6, 82, 98, 99, 149, 173, 195, 277, 279, 281

bio relevant dissolution media for 284

biowaiver extension potential 285–286

dynamic lipolysis model 284–285

GI physiological variables affecting 280–283

implication for 285

in vitro dissolution tests for 284–285

volume available for dissolution 283

weak acid drugs 282

weak base drugs 282

BCS Class III drugs 83, 280, 286, 287, 307, 344, 361, 378

BCS-based biowaiver option 287

BCS Class IV drugs 7, 10, 12, 14, 46, 60, 82–84, 280, 345, 358

benzimidazole 342

benzooisochromene triazines 400

β -CD-centred triarm star polymer 308

β -cyclodextrin 86

beta relaxation process 24

bile acids 281

- bioactive carboxylic acid small molecules 397
- bioavailability 19, 148, 300, 391
- biocompatible gases 221
- bioequivalence (BE) 59, 194, 269, 277, 286
- bioisosteres
- classification of 404
 - development and application of 404–405
 - of elements and functional groups 405
 - of sulfonamide 406
- bioisosteric atoms 404
- bioisosteric moiety 406
- bioisosterism, to address aqueous solubility 404–407
- biological cell membranes 360
- biopharmaceutical classification system (BCS) 3, 4, 82, 93, 139, 277, 280, 357, 358, 363, 364
- drug solubility 4–5
- biopharmaceutics
- of ASD 46–50
 - modeling 58–59
- bioprecursors 407
- bio relevant dissolution media for BCS
- Class II drugs 284
- biosurfactants 47, 178
- biowaiver extension potential 285–286
- Brexin® 305
- brexpiprazole 144
- brinzolamide (BRZ)-HP- β -CD
- complexes 311
- British Pharmacopoeia (BP) 3
- British Standards Institution (BSI) 93
- Brivlera® 306
- bubble liposomes 221, 222
- C**
- Cabenuva® 11
- caffeic acid phenethyl ester (CAPE) 136, 137
- calcium acetate method 217
- calorimetric techniques 29–31
- Cambridge Crystallographic Data Centre (CCDC) 122–124
- cancer therapy, charged liposomes 223
- capsid assembly modulators (CAMs) 399, 409
- Captisol® 311, 312, 317, 318
- carbamazepine (CBZ) 126–129, 131, 132, 139, 140, 148, 281, 369, 408
- carbamazepine-nicotinamide nano co-crystals 129
- carbohydrates 228
- Carfilzomib 317
- carrier-controlled dissolution 371
- carrier-controlled release 370
- carrier-linked prodrugs 407
- cationic liposomes 222, 223
- ceftriaxone (CTX) 367
- celecoxib 11
- cell targeted drug delivery 235
- central nervous system (CNS) depression 337
- charged lipids 222
- charged liposomes 222
- applications of 223
 - composition of 222
 - mechanism of action of 222–223
- chemical conjugation 218
- chemical degradation 142
- chemical instability 142
- chemical linkers 225
- chemical modification, to enhance solubility 394–395
- chemical stability 142
- assessment of ASD 52–53
 - liposomes 219–220
- chitosan 310
- chlordiazepoxide injection 333
- chlorpromazine 7
- chlorpromazine hydrochloride 7
- cholecystokinin 187
- cholesterol 187, 212, 220–222, 226, 281, 315
- cholinium gallate 10
- cholinium salicylate 10

- cholinium vanillate 10
- chronic hepatitis B (CHB) 409
- citric acid 142
- classical bioisosteres 404
- cloud point of micelles 233
- cocrystallization 115, 117, 122, 123, 125, 127, 128, 141
 - of drug 139
 - with supercritical solvent 129
- cocrystals 12, 115, 116, 118
 - polymorphism 156
 - from solutions 126–129
- coformers 118–119
- colloidal stability, of liposomes 220
- co-milling 266–267
- computerized tomography (CT) 243, 308
- conductor-like screening model for real solvents (COSMO-RS) 57, 123
- constant supersaturation 48, 183
- controlled and sustained drug delivery 235
- conventional baicalein-SMEDDS (CBA-SMEDDS) 185
- conventional emulsions 187
- conventional liposomes 225
 - applications of 226
 - composition of 226
 - mechanism of action of 226
 - structure of 226
- cooling crystallization 128
- cooperatively rearranging region (CRR) 24
- copolymer-mixed micelles 229
- co-polymers 26
- copovidone 10, 367, 369, 372
- co-precipitation technology 44
- corallopyronin A (Coro A) 367, 369
- core-shell silica-gold conjugate 269
- Coronavirus Disease 2019 (COVID-19) 306, 317
- cosmetic products 93
- cosolvency 9–10, 85, 117, 328, 329, 345
 - advantages of 334
 - disadvantages of 334
 - theory 329–330
- cosolvents 9, 85, 328, 329, 333
 - adverse events 336–337
 - based formulations using 505(b)(2) pathway and IP protection 340–341
 - comprised formulations for hydrophobic drug solubilization 341–342
 - design of formulations using 339
 - formulations 344
 - preclinical studies using 337–339
 - regulatory aspects 339–340
 - types of 334–336
- co-surfactant 174, 175, 179–182
- covalent grafting 266
- critical micelle concentration (CMC) 213, 232, 233, 281
- CRLX101 317
- cross over temperature 24
- crystal engineering 117, 118
- crystalline compound 362
- crystalline forms 362
- crystalline silica 257
- crystallinity analysis of ASD 35–36
- Crystallography Open Database (COD) 124
- crystal structure prediction (CSP) 123
- curcumin 126, 128, 141, 148, 149, 182, 220
- cyclic oligosaccharides 297
- cyclodextrin-gated silica nanoparticles 268
- cyclodextrin inclusion complexes 10
- cyclodextrins (CDs) 85, 86, 257, 268, 297
 - based biomaterials 312–314
 - based formulations and commercial impact 305–306
 - based nanomaterials 300
 - based pharmaceutical formulations 304–306
 - based polymers 300
 - based products containing blockbuster drugs 305
 - definition and structural properties 297

deoxy CDs 303
 derivatives and modified 300–301
 drug-associated toxicity 315
 in drug delivery 298
 drug delivery applications of 306
 drug delivery systems 316
 in drug formulations 298
 in enhancing bioavailability 300
 for enhancing bioavailability of
 pharmaceutical compounds
 299–300
 esterification of 302–304
 hepatic and metabolic considerations
 315–316
 inclusion complexes 315–316
 internal cavity of 297
 manufacturing and patent challenges
 317–318
 manufacturing and scale-up challenges
 314
 modified CDs 316
 nasal delivery 309–310
 nephrotoxicity 315
 non-pharmaceutical uses 316
 ocular delivery 310–311
 oral delivery 306–308
 O-substituted CDs 303–304
 oxidation of 303–304
 parenteral delivery 307–308
 patentability considerations 317
 patent scenario regarding use of
 316–317
 physical-chemical parameters of 299
 polymer conjugates and advanced
 therapeutics 316
 and polymeric derivatives 300
 rectal delivery 310
 regulatory challenges and
 considerations 312–314
 route-dependent and dose-related
 toxicity 314–315
 substitution reactions 301–302
 toxicological considerations of 314
 transdermal delivery 309
 cyclohexane 259

d

danazol 6, 148, 284, 367, 373, 374
 dantrolene sodium 341, 376
 dasatinib 141
 database and knowledge-based
 approaches 124
 data-driven and hybrid modeling 59
 density functional theory (DFT) 56, 120,
 122, 146
 deoxy CDs 303
 deoxy-functionalized CDs 301
 6-deoxy-6-halogenated CDs 303
 Depo-Provera® 14
 Depo-SubQ Provera 104® 14
 detergent removal method 213–214
 developability classification system (DCS)
 358, 363
 DHP107 344
 diacetyl phosphate 220
 diacylglycerol *O*-acyltransferase 1
 (DGAT1) inhibitors 410
 Diazepam injection 333
 dicetylphosphate (DCP) 222
 di-6-deoxy-substituted CDs 303
 diethylene glycol (DEG) 336–337
 differential scanning calorimetry (DSC)
 28, 29, 31, 35, 36, 39, 52, 132–134,
 136, 354, 357, 362, 370
 diffusion supported loading 265
 Digoxin pediatric elixir 333
 dimensionless parameters 278, 279
 disruption of crystal packing 403, 404,
 410
 dissolution 6, 12, 19, 20, 22, 23, 27, 34,
 35, 37, 38, 40, 41, 47–49, 53, 54,
 57–59, 81–99, 117, 128, 140, 141,
 148, 149, 154, 155, 156, 176, 180,
 189, 194, 210, 213, 231, 261–263,
 265, 267, 268, 277–288, 298, 300,
 327, 328, 329, 330, 332, 341–343,
 346, 356, 360, 362, 363, 364, 368,
 369, 370, 371, 372, 373, 376, 378,
 390, 391, 392, 394, 402
 dissolution number (Dn) 278
 docetaxel 194, 342, 344

- dose number (D_0) 83, 278
 - downstream processing of ASD 45–46
 - Doxil® 219, 223, 227, 234, 235, 238
 - doxorubicin 217, 219, 223, 226, 227, 231, 232, 234, 235, 238, 269, 307, 308
 - drug absorption 3, 4, 5, 13, 49, 81, 82, 83, 84, 173, 178, 187, 211, 235, 277–280, 282, 287, 356, 358, 370, 371, 378, 392, 393, 396, 410
 - drug carrier systems 210
 - drug-coformer cocrystal 115
 - drug-controlled dissolution 370, 371
 - drug delivery systems 46, 98, 178, 196, 210, 212, 227, 228, 229, 270, 271, 297, 306, 309, 314, 316
 - drug dissolution from ASD 48–49, 56
 - drug formulation approaches 9–13
 - cosolvency, hydrotrophy, and solubilizing agents 9–10
 - cyclodextrin inclusion complexes 10
 - nanoformulation spectrum 11–13
 - solid dispersions and solid solutions 10–11
 - drug-laden lipid nanoparticles 211
 - drug-like properties 4–5, 405, 406, 409
 - drug loading improvement, in liposomes 215–218
 - drug master file (DMF) 311, 318, 340
 - drug material engineering 1, 5–9
 - particle size engineering 6
 - prodrugs 8–9
 - salts, solvates, polymorphs, and co-crystals 6–7
 - drug molecule 22, 25, 48, 57, 60, 86, 87, 116, 117, 129, 139, 146, 185, 210, 222, 225, 228, 261, 262, 264, 265, 266, 297, 298, 307, 327, 329, 354, 355, 360, 361, 363, 364, 365, 366, 367, 369, 370, 375, 376
 - drug-nutraceutical cocrystals 152, 154–155
 - drug particle size 6, 283, 376
 - drug payload 222
 - drug-polymer binary phase diagram 22
 - drug-polymer interactions 24–27, 33, 34, 49, 55, 57
 - drug-polymer phase behavior 22–23, 29–31
 - drug potency 5
 - drug precipitation 1, 39, 92, 175, 177, 179, 180, 183, 186, 192, 282, 337, 338
 - drug salts, for poorly soluble drugs 6
 - drug's hygroscopicity 28, 141
 - drug solubility 1–15, 26, 39, 57, 60, 86, 139, 148, 178, 183, 186, 188, 209–245, 262–267, 281, 308, 328, 329, 333, 338, 359
 - drug solubility enhancement approach 10–13, 15, 299, 300, 309, 310, 329, 391–395
 - drugs with optical properties 146
 - dry and solvent assisted grinding 125–126
 - dry milling 88, 89
 - duodenum 187, 282, 307, 377
 - dynamic heterogeneity 24, 29, 31, 32
 - dynamic light scattering (DLS) 39, 48, 189, 232, 233, 240, 241, 260
 - dynamic mechanical analysis 354
 - dynamic vapor sorption 37, 370
- e**
- EDTA ion gradient method 217–218
 - Elagolix 287, 288
 - emulsification method 232
 - emulsions 11, 44, 90, 92, 97, 98, 141, 173, 174, 176, 183, 185, 187–192, 195, 213, 239, 335, 344, 365, 373, 374
 - encapsulation in soft gelatin capsules 185–186
 - endothermic mixing region 22
 - enhanced permeability and retention (EPR) effect 94, 226–228, 235
 - Enlicitide chloride 344
 - enteric polymers 27, 44, 60
 - entrapment efficiency of drug 215
 - Entresto® 7, 152, 153

environmental scanning electron
microscopy (ESEM) 240

enzyme-responsive liposomes 224, 225

Epidiolex® 375

equilibrium solubility 46, 117, 278, 328,
358, 359, 366, 392

esterification 53, 302, 304

ethanol 42, 85, 126, 195, 214, 261, 265,
328, 333, 338, 339, 341, 342, 344,
345, 346, 369, 375, 376

ethanol-based vehicles 338

ethanol injection method 214

ether injection method 214

European cosmetic authorities 93

European Medicines Agency (EMA) 98,
116, 151, 152, 194, 237, 238, 241,
279, 285, 286, 317, 340

evaporation cocrystallization 128

Evomela® 312

excipients 7, 10, 12, 46, 52, 53, 54, 59,
118, 142, 186, 194, 219, 229, 261,
263, 280, 306, 311, 336, 337, 338,
340, 345, 353, 364, 376, 378, 379,
395

exothermic mixing region 22

external stimuli-triggered liposomes
224

f

faster dissolution 84, 94, 283, 287,
369

fasting-state simulated intestinal fluid
(FaSSIF) 284, 358

fed-state simulated intestinal fluid
(FeSSIF) 284, 358

Federal Food Drug and Cosmetic Act of
1938 337, 340

first in animal formulations, formulation
consideration for 353–379

first in animal studies
bridging gap of 377–378
excipients and applications in
364–365
pre-formulation considerations for
356–362

fluid bed coating/layering 44

fluorination 410

fluorine 403, 410

fluoro-L-DOPA formulations 308

Food Drug and Cosmetic Act of 1938
337

food effect of ASD 50

fosamprenavir 407, 408

Fourier transform infrared (FTIR)
spectroscopy 34, 132, 134–138,
370

fragility 22, 29

free energy of emulsion 187

freeze drying 42, 131

furosemide 146, 147, 280

g

γ-cyclodextrin 86

gas-entrapped (bubble) liposomes 221
applications of 221–222
mechanism of action of 221
structure of 221

gastric pH 281, 285, 377

gastrointestinal (GI) dissolution
277–288

gastrointestinal (GI) tract 3, 173, 211,
244, 307, 315, 360, 391, 393

gene delivery, charged liposomes 223

General Solubility Equation (GSE) 330,
346

generally recognized as safe (GRAS)
115, 117, 178, 312, 318, 328, 364,
373

GI transit 282, 287

giant unilamellar vesicles (GUV) 212,
213

glass transition region 20, 24, 29

glass transition temperature 20, 22, 29,
43, 55, 368, 369

global molecular motion 24

glutathione (GSH) 224, 267

glycerophospholipids 212

glycoproteins 50, 228

gonadotropin-releasing hormone (GnRH) 287
 good laboratory practice (GLP) 271, 354
 gut-associated lymphoid tissue (GALT) 307

h

Haldol® 14
 haloperidol 14
 Hansen Solubility Parameters (HSPs) 9, 55, 123, 153, 379
 H-bonding modifiers, to improve aqueous solubility 401–403
 heparin sodium 7
 hepatitis B virus (HBV) 398, 399, 409
 hetacillin 8, 14
 heterocyclic modifications 411
 heterosynthons 119, 120
 higher doses 11, 82, 83, 279, 339, 366
 highly lipophilic drugs 9, 11
 highly soluble polymorph 7
 high-pressure homogenization (HPH) 89–90, 92, 94, 95, 99, 375
 high-solubility, high-permeability drugs 279
 high-solubility, low-permeability drugs 280
 high-throughput screening (HTS) 1, 5, 40, 59, 120, 327, 353, 360, 390, 393
 homosynthons 119, 120
 hot melt extrusion (HME) method 10, 20, 23, 24, 26, 37, 38, 40–45, 52, 58, 60, 126, 127, 156, 358, 367–372, 379
 hot stage microscopy (HSM) 134–135
 HPMC-acetate/succinate (HPMC-AS) 26, 27, 34, 43, 44, 50, 52, 53, 369, 370, 371
 hydrazone bond linkers 269
 hydrochloride salts 7
 hydrophilic drugs 12, 213, 215, 221, 222, 226, 374
 hydrophilic group, on lipids 220
 hydrophilic oral drugs 390
 hydrophobic drugs 89, 91, 95, 176, 212, 215, 218, 221, 222, 225, 226, 232,

234, 262, 263, 264, 283, 297, 298, 312, 328, 341–342, 374
 hydroquinone 116
 hydrotropes 9, 345
 hydroxyl groups 144, 183, 212, 297, 298, 301, 302, 303, 304
 of CDs 297, 300, 303
 2-hydroxypropylated CDs 303
 hydroxypropylated CDs 304
 hydroxypropyl- β -cyclodextrin (HP- β -CD) 86, 299, 300, 305, 308, 309, 310, 311, 312, 315, 316, 317, 318
 hydroxy propyl methyl cellulose (HPMC) 26, 43, 52, 183, 369
 hydroxypropyl methylcellulose acetate succinate (HPMC-AS) 26, 27, 34, 43, 44, 50, 52, 53, 369, 370, 371
 hypromellose 10, 369

i

ibuprofen 10, 126, 128, 130, 131, 140, 180, 182, 189, 263, 269, 270, 281, 282
 ideal solubility 330, 331
 idebenone 310
 ileum 307, 377
 impurities 38, 53, 144, 183, 314, 318
 Inactive Ingredient Guide (IIG) 334–336, 338
 incipient wetness impregnation method 265
 inclusion complexes 1, 10, 86, 297, 298, 300, 302, 304, 305, 307, 309, 310, 314–316, 395
 indomethacin 12, 128, 129, 131, 132, 133, 370
 insufficient dissolution 81
 internal stimuli-triggered liposomes 224
 International Council for Harmonization (ICH) 42, 155, 194, 241, 286
 International Union of Pure and Applied Chemistry (IUPAC) 2
 intraconazole 10

intraperitoneal drug delivery 235
 intrinsic amorphization potential, of API
 21–22
 intrinsic solubility 9, 140, 330, 391,
 392
 in vitro dissolution tests for Class II drugs
 284–285
 in vitro–in vivo correlation (IVIVC) 49,
 59, 185, 284, 287
 in vitro permeability, of NCEs 360–361
 in vitro tests for SEDDS 185
 ionic CDs 301
 ionic liquids 9, 10, 259, 260, 345
 ionizable drugs 6, 48, 85, 281, 329, 334,
 359, 360
 pH-modified cosolvent formulations for
 342–343
 ionizable substances 281
 ionization constant (pKa) 328, 361–362
 ionophore generated pH gradient method
 217
 iopromide 243
 isavuconazole 8
 isavuconazonium sulfate 8
 isoniazid 125, 148, 149
 isothermal calorimetry (ITC) 29–31
 isothermal ternary phase diagram 127
 itraconazole (ITZ) 12, 44, 59, 92, 197,
 262, 263, 270, 305, 307, 364, 369,
 377

j

Jaypirca® 371
 jejunum 307, 377
 Johari–Goldstein (JG) relaxation process
 24

k

kinetic solubility 12, 47, 48, 359, 391,
 392, 405
 versus thermodynamic solubility
 392–394
 kinetic solubility studies 12
 kinetic solubility values 359

l

Labrasol® 180–182, 188, 189, 194, 344,
 374
 lacidipine 343
 large unilamellar vesicles (LUVs)
 212–215, 217, 226
 lattice energy minimization 122, 123
 lenacapavir 12
 ligands 98, 220, 227, 228, 230, 236, 240,
 242, 243, 268, 271, 311, 312
 light-responsive liposomes 225
 light-sensitive polymeric micelles 231
 lipid based nanoformulations 11
 lipid based systems 60, 209, 358, 365,
 368, 372–375
 lipid components 234, 284
 lipid constituent of liposomes 209
 lipid formulations 175, 176, 209, 374
 lipid-based drug delivery systems 176,
 224, 284
 lipid-based formulations 1, 83, 185, 187,
 284, 285, 344, 372, 395
 lipid-based nanocarriers 211
 lipid-based SEDDS 344
 lipid-based systems (LBS) 60, 209, 244,
 358, 365, 368, 372–375
 in drug delivery 209
 low solubility of 211
 lipid-formulation classification system
 (LFCS) 175
 lipid nanocarriers 12, 211
 lipids 11, 174, 175, 176, 178, 179, 185,
 187, 195, 209, 210, 211, 213, 214,
 218, 220, 221, 222, 224, 225, 226,
 233, 240, 242, 244, 271, 367, 372,
 379, 391
 lipoceramic hybrid silica 269
 lipophilicity 5, 11, 14, 22, 192, 218, 277,
 330, 331, 346, 360, 361, 375, 389,
 396, 410
 of NCEs 360
 liposomal formulation 211, 213, 223,
 226, 227, 233, 236, 237, 238, 240

- liposomes 209–245
 - analysis of drug encapsulation 218–219
 - benefits and limitations of 234–237
 - categories of 210, 212
 - clinical application of 241–244
 - clinical diagnosis and imaging 242–243
 - composition 211–213
 - detergent removal method 213–214
 - in drug delivery 241–242
 - as drug delivery carriers 236–237
 - drug loading improvement in 215–218
 - ethanol injection method 214
 - ether injection method 214
 - formulation methods 213–215
 - in vivo safety of 233–234
 - lipid constituent of 209
 - microfluidic channel method 214–215
 - patent landscape of 244, 245
 - process development of 211
 - regulatory guidelines for 237–241
 - reverse phase evaporation 213
 - solvent injection method 214–215
 - stability of 219–220
 - structural properties of 235
 - structure of 212
 - supercritical fluidic method 215
 - susceptibilities of 244
 - thin film hydration method 213
 - types of 220–228
 - uses 212
 - in vaccine and gene delivery 243–244
 - lithium chloride 142
 - local molecular motion 22, 24
 - long-chain triglycerides (LCTs) 372, 373
 - low-angle x-ray scattering (LAXS) 261
 - low bioavailability 148, 390, 391
 - low drug solubility 5, 13, 14, 308
 - low encapsulation efficiency 215, 218
 - low-solubility, high-permeability drugs 277, 279
 - low-solubility, low-permeability drugs 280
 - lymphatic absorption 185
- m**
- machine learning (ML) 59, 99, 122–124, 156, 345, 379
 - macroscale modeling 57–58
 - magnetic field-responsive liposomes 225
 - magnetic resonance imaging (MRI) 225, 240, 242, 243
 - marketed micellar and liposomal products 237
 - marketed nanosized drug formulations 96, 97
 - maximum absorbable dose (MAD) 83, 313
 - mechanism of stability 96
 - media milling process 88
 - medium chain triglyceride oil formulation (MCT-SNEDDS) 374, 375
 - medium-chain triglycerides (MCTs) 185, 366, 372–374
 - medroxyprogesterone acetate 14
 - meloxicam (MLX) 263, 310
 - melt method 266
 - MeltDose® technology 45
 - mesoporous silica 12, 257, 261–262, 264–267, 269, 367
 - mesoporous silica nanoparticles 258, 268
 - mesoporous silica particles (MSN) 117, 257–272
 - aspect ratio of 261
 - characterization of 260–261
 - colloidal size distribution of 260
 - for drug dissolution 261–262
 - drug loading methods in 262
 - to improve bioavailability 267–269
 - solvent based methods 264–266
 - solvent-free methods 266–267
 - synthesis of 259, 260
 - methylated β -CD 86, 303, 305, 316
 - Micardis® 342
 - micellar solubilization 85, 371, 373
 - microemulsion method 173, 174, 179, 180, 187, 191–195, 258–259
 - microfluidic channel method 214–215
 - microfluidizer 90

micronization 6, 84, 116, 117, 284, 394
 microprecipitation 6, 92–93
 microwave irradiation 266
 milling techniques, in pharmaceutical industry 88, 375
 mixed micelles 47, 209–245
 benefits and limitations of 234–236
 clinical application of 241–244
 drug carriers 233–234
 as drug delivery carriers 236–237
 for drug solubility 228–233
 method used to prepare 232
 patent landscape of 244
 regulatory guidelines for 237–241
 types of 229–231
 moderately lipophilic molecules 333
 modulated differential scanning calorimetry (MDSC) 370
 moisture and temperature 20
 molecular docking 57, 122, 123
 molecular dynamics simulation 122–123, 345
 molecular mobility 19, 21, 25, 28, 31–33, 56, 57, 369
 in ASDs 23–25, 31–33, 52, 54, 369
 molecular modeling 56, 397
 Monistat® 14
 monoclonal antibodies 220, 227, 231, 242
 monosubstituted CDs 303
 monosubstitution and persubstitution of CDs 301, 303
 mouse animal model 374
 multidrug cocrystals (MDCs) 144, 154, 155
 multidrug resistance, charged liposomes 223
 multilamellar vesicles (MLVs) 212–214, 226
 multiscale molecular simulation and modeling 56–57
 multivesicular vesicles (MVVs) 212, 213, 226
 Myocet® 235

n

nano-cocrystals (NCCs) 129, 131, 155
 nano-colloids 46–50, 58
 nanocrystals 1, 6, 11, 12, 84, 92, 93, 94, 97, 98
 advantages 94–95
 disadvantages 95
 nanoemulsions 93, 95, 97, 173, 174, 176, 179, 189, 209, 344
 advantages 95
 disadvantages 95
 nanoformulation spectrum 11–13
 nanoparticle tracking analysis (NTA) 240, 241
 nanosized particles 84, 85, 93, 98
 nanosizing 81–99
 bottom-up approaches 91–92
 challenges and limitations in 96–98
 combination techniques 92–93
 in enhancing dissolution and bioavailability 84
 formulation strategies for 93–96
 hybrid and advanced approaches 92–93
 regulatory considerations and safety concerns 98
 scale-up and manufacturing constraints 96–98
 stability issues 96
 techniques for 87–93
 top-down approaches 87–88
 nanosuspensions 6, 11, 84, 93–95, 97, 98, 358, 365, 368, 375–376
 nanotechnology 99, 155, 173, 210, 211, 241, 244, 395
 nanotechnology-based formulations 87, 375
 Nanotoxicological Classification System (NCS) 93
 Neoral® 194, 195, 239
 Nernst equation 140
 neutral appendages 397–400
 neutral polar groups 397

- new chemical entities (NCEs) 1, 19, 327, 353, 365
 conventional approach 366
 definition 356
 lipophilicity of 360–361
 physical state and polymorphism 362
 physicochemical characterization of 354
 solubility behavior of 358–359
 suspension formulation of 353
 new drug applications (NDAs/BLAs) 151, 340
 nicorandil 144, 145
 nicotinamide 9, 126, 134–137, 139, 140, 142, 144
 Nimodipine IV injection 333
 Nimotop 333, 346
 Nitrophen® 10, 305
 nonclassical bioisosteres 404
 Nonclinical Studies for the Safety Evaluation of Pharmaceutical Excipients 340
 nonionic hydrophilic CDs 301
 non-ionizable compounds 85, 333
 nonionizable drugs 9, 117
 non-ionizable substances 281
 non-sink dissolution test 53
 novel drug delivery systems 195, 210
 Noyes–Whitney equation 83–84
 nuclear magnetic resonance (NMR) 30, 33, 135
 nutraceutical 154, 155, 312, 318
- O**
- octanol–water partition coefficient 331
 oenography 243
 oils 11, 14, 95, 174–176, 178, 180, 182, 183, 187, 189–192, 194, 195, 209, 233, 259, 333, 334, 344, 365, 366, 372–376, 403
 oleic acid 343, 372
 oligoethylene glycol 220
 Olmetec® 306
 one-pot drug loading and synthesis procedure 265–266
 oral drug delivery 189, 191, 192, 211, 269, 315, 338
 oral drugs 5, 38, 81, 278, 280, 337, 363, 377, 378, 390
 oral gavage 353, 365–367, 375
 oral mini-tablet/mini-capsule 367
 oral route 173, 310, 365, 372, 391
 oral solution 10, 11, 239, 333, 341, 366, 367, 375, 376
 oral suspension 97, 357, 366–367
 Oraxol 344
 organic solvents 20, 26, 39, 41, 42, 44, 60, 85, 91, 92, 96, 126, 130, 213, 214, 215, 229, 232, 233, 236, 264, 265, 304, 328, 345, 368, 376, 393
 Ostwald ripening 95, 96, 376
 O-substituted CDs 303–304
 over-the-counter (OTC) products 14, 337, 340
 oxidation of CDs 303, 304
 oxidation of lipid excipients 186
- P**
- pair distribution function (PDF) 30
 particle size engineering 6
 particle size reduction technologies 6, 10, 11, 83, 84, 89, 90, 92, 147, 257, 358, 363, 375, 376, 394
 partition coefficient (P) 5, 9, 331, 341, 361
 passive loading, liposomes 215
 passive targeting liposomes 227
 patent protection, for liposomal-based treatments 236
 PDE4 inhibitors 396
 Peceol® 180–182, 374
 PEG 400 190, 191, 328, 333, 335, 337–339, 341, 366
 PEGylated lipid micelles 229–231
 peptides 60, 173, 218, 220, 221, 222, 223, 224, 227, 228, 229, 242, 264, 268, 269, 270, 344, 345
 Pepto Bismol® 14
 per-acetylated CDs 304
 per-6-halogenated-per-6-deoxy CDs 303

- per-6 modified CDs 303
- per-6-*O*-(*tert*-butyldimethylsilylated) CDs 303
- pH gradient method 217
- pH-modified cosolvent formulations 342–343
- pH-responsive MSNs 268
- pH-responsive silica particles 268
- pH sensitive polymeric micelles 231
- pharmaceutical cocrystallization 117, 143, 154, 156
- pharmaceutical cocrystals 115–157
 - basic concept and definitions 116–118
 - challenges in product development 153–154
 - characterization techniques of 132–138
 - chemical stability 142–146
 - cocrystals, salts and polymorphs 118
 - commercially available 153
 - computational approaches and software tools for 119–124
 - enhancement of bioavailability 148
 - for formulation advantages 141–147
 - fundamentals of 115–119
 - historical background 115–116
 - importance in pharmaceutical industry 115
 - mechanical properties 146–147
 - microscopy techniques 138
 - modulation of drug release profiles 148–149
 - for pharmacokinetics advantages 148–151
 - physical stability 141–142
 - regulatory considerations and approval pathways 151
 - selection of cofomers 118–119
 - solid state approaches 125–127
 - solubility aspects of 139–141
 - from solutions 126–129
 - spectroscopic techniques 135–138
 - supercritical fluid-based methods 129–131
 - synthesis of 124–132
 - synthons in 119
 - to tailor optical property 146
 - for therapeutics advantages 149–151
 - thermal analysis 132–135
- pharmaceutical compounds 7, 299–300
- pharmaceutical development 14, 82, 99, 122, 195, 236, 328, 330, 345, 391
- pharmaceutical research 99, 185
- pharmaceutical science 87
- pharmacokinetic study (PK) 279, 355–356, 408
- pharmacology/pharmacodynamic study 338, 355
- phase diagrams 22, 23, 39, 51, 55, 56, 57, 126, 127, 188, 189, 374
- phosphate buffer solution (PBS) 217, 403
- phosphatidic acid 178, 222, 226
- phosphatidylcholine (PC) 178, 179, 212, 220–222, 226, 376
- phosphatidylethanolamine (PE) 178, 212, 222, 226
- phosphatidylserine (PS) 178, 179, 212, 222, 226
- phosphoinositide 3-kinase (PI3K) 402
- phospholipids 23, 47, 60, 178, 187, 211–215, 218–222, 225, 226, 240, 243, 281, 284, 360, 361, 374, 376
 - amphiphilic nature of 233
 - in liposomal carriers 233
- photodegradation through isomerization 143
- photodimerization degradation 144
- physical stability assessment of ASD 51–52
- physical stability, liposomes 219
- physiological fluids 48, 389, 391
- Physiologically based Biopharmaceutics Models (PBBM) 58, 59, 286, 287
- physiologically based dissolution testing (PBDT) 48, 389, 391
- Physiologically Based Pharmacokinetic (PBPK) models 58, 59, 286–288
- pluronics 229, 245
- polar or ionizable appendages 396–401

- polar or ionizable groups 409, 410
 - polycondensation 304
 - polycondensation reaction of CDs 304
 - polyethylene glycol (PEG) 9, 12, 26, 45, 56, 85, 192, 220, 222, 227, 229, 230, 235, 242, 267, 269, 271, 339, 341, 342, 343, 346, 366, 400
 - polyglycerols 229, 342
 - polyion complex (PIC) micelles 229
 - polymer dispersion, in aqueous solvent 232
 - polymeric micelles 228, 229, 231, 345, 395
 - polymeric precipitation inhibitors (PPIs) 338
 - polymers 10, 22, 24, 26, 27, 33, 34, 38, 39, 41, 43, 47, 56, 59, 60, 86, 96, 140, 142, 154, 220, 231, 267, 271, 304, 343, 365, 368, 371, 379
 - used in ASD 19, 25–27, 39, 43, 47, 49, 52, 54, 57
 - polymersomes 307, 308
 - polymer vesicles 307
 - polymorphism 10, 119, 153, 156, 362
 - of lipid excipients 186–187
 - polymorphs 6–7, 117, 118, 126, 138, 146, 156, 186, 362
 - polyphenols 154
 - polyvinylpyrrolidone (PVP) 26, 27, 33, 43, 53, 56, 220, 343, 369
 - poor aqueous solubility 1, 5, 14, 46, 139, 300, 304, 327, 330, 341, 353, 360, 390, 396, 402, 403, 405, 407, 410
 - poor drug solubility 1, 244
 - addressing challenge 5–14
 - on drug-like properties 4–5
 - drug material engineering 6
 - poorly water-soluble drugs 9, 14, 81–84, 86, 90, 93, 99, 115, 148, 194, 210, 221, 223, 265, 285, 316, 328, 333, 339, 345, 366, 378
 - challenges in formulating 82–83
 - poor solubility 1–15, 60, 81, 285, 286, 307, 358, 390, 391, 396, 407, 410
 - poor water solubility 5, 19, 139, 341, 345
 - porous carriers 262
 - porous silica structure 262
 - positive allosteric modulators (PAMs) 405
 - positively charged liposomes 220, 223
 - powder X-ray diffraction (pXRD) 30, 35, 36, 132, 134, 136, 138
 - preclinical formulations 353–363, 365, 377, 379
 - preclinical models 345, 354, 377
 - preclinical studies 337–340, 353–356, 365, 366, 369, 375, 378
 - pre-formulated NCEs 356
 - precipitation 91
 - of drugs 177, 183, 217
 - primary relaxation time 24
 - prior approval supplement (PAS) 340
 - process analytical technology (PAT) 36, 155–156
 - prodrug approach, to address aqueous solubility 407–409
 - prodrugs 1, 8–9, 14, 144, 332, 394, 396, 407–410
 - product performance stability assessment of ASD 53–54
 - propylene glycol 9, 85, 195, 328, 333, 334, 335, 337–339, 341–346, 366, 374, 376
 - protein-encapsulated CDs 300
 - pseudo rotaxanes 269
 - pulmonary drug delivery, charged liposomes 223
- q**
- Quantitative Structure-Activity Relationship (QSAR) 124
 - quantum dots (QDs) 242, 243, 409
 - quantum mechanical (QM) methods 120–122
 - quinhydrone 115, 116
 - quinolinyltriazole inhibitors 397
 - quinone 115, 116
 - Qulipta® 372

r

Raman spectroscopy 30, 34, 36, 132, 135, 136, 240, 370, 392
 randomly methylated β -CD (RAM β -CD) 86, 303
 randomly substituted CDs 303
 Rapamune® 11, 376
 Rapid Expansion of Supercritical Solution (RESS) 92, 125
 redox-responsive liposomes 224
 reference listed drug (RLD) 340
 refined Developability Classification System (rDCS) 286
 remdesivir 306, 312, 317
 remote loading, liposome 215
 renal toxicity 86, 315, 372
 representative targeted liposomes 227
 reticulate formation 183
 reverse phase evaporation 213
 ribavirin 310
 ritonavir 7, 344, 362
 RNA-dependent RNA polymerase (RdRp) 306
 Ryanodex® 376

s

saikosaponin-d (SSD) 309
 salt formation 1, 34, 60, 83, 85, 99, 117, 118, 148, 153, 332, 394, 395, 406
 salts 1, 6–7, 34, 47, 50, 60, 85, 117–119, 138, 151, 153, 287, 342, 392, 394
 Sandimmune® 11, 195, 239, 333
 saquinavir 334
 SARS-CoV-2 306
 saturation solubility 2, 3, 83, 84, 96, 139, 183, 281
 scanning electron microscopy (SEM) 36, 37, 132, 134, 138, 240, 370
 secondary relaxation 24
 Seglantis® 7, 152, 153
 self emulsifying systems 12, 346
 self-emulsification 11, 174, 176, 180, 182
 mechanism of 187
 and uptake of drugs in vivo 187–188

self-emulsifying drug delivery systems (SEDDS) 11, 173–197, 339, 344, 345, 365, 366, 373, 374
 advantages of 175, 176
 applications of 188–194
 challenges in formulation development of 182–187
 clinical status of 195
 commercial aspects of 194–195
 disadvantages of 175, 177
 formation of 175–178
 in soft gelatin capsules 185–186
 lack of prognostic in vitro tests 185
 lipid oxidation 186
 lymphatic uptake of 185
 for nasal drug delivery 188–189
 for oral drug delivery 189–191
 for parenteral delivery 191–194
 patents on 195
 polymorphism of lipid excipients 186–187
 regulatory updates on 194
 self-microemulsifying drug delivery system (SMEDDS) 174
 self-nanoemulsifying drug delivery system (SNEDDS) 174–175
 self-microemulsifying drug delivery system (SMEDDS) 12, 173–175, 178–180, 182, 365, 372, 373, 379
 advantages of 175, 176
 challenges in formulation development of 182–187
 disadvantages of 175, 177
 drug recipitation 183
 formation of 175–177
 handling and stability 185
 lymphatic uptake of 185
 for nasal drug delivery 188–189
 for oral drug delivery 189–191
 for parenteral delivery 191–194
 regulatory updates on 194
 self-nanoemulsifying drug delivery system (SNEDDS) 173–175, 178–180, 189, 191, 192, 194, 196, 374, 375
 semi-empirical screening methods 123

- short chain triglycerides (SCTs) 372, 373
- silanol 258, 259, 262
- silica 257, 258, 260–268
 - clinical application of 270
 - crystallinity and nature 261
- silica–lipid nanoparticles 269
- silica nanoparticles 258, 267–269, 300
 - in different dosage forms 263–264
- silica surface coating with polymers 267
- silicon alkoxide 258
- similarity factor 287
- simulated gastric fluid (SGF) 140, 284
- single-crystal X-ray diffraction (XRD) 132, 133
- SiO₄ tetrahedron 257
- slightly lipophilic CDs 301
- slurry method 128–129
- small angle X-ray scattering (SAXS) 30, 37, 48
- small hydrophilic molecules 389–390
- small intestinal transit time 282
- small unilamellar vesicles (SUVs) 212–214, 217, 226
- sodium taurocholate 281
- sol-gel method 258, 261
- solid dispersion formulations 369
- solid dispersion for solubility enhancement 343–344
- solid dispersions 1, 6, 10–12, 83, 86, 99, 257, 262, 263, 266, 270, 341, 365, 368–370, 379, 394, 395
- solids' optical properties 146
- solid-state nuclear magnetic resonance (ssNMR) 30, 132, 136–138, 370
- Sol-Moiety 8
- solubility 2, 46, 48, 81, 327, 391, 392
 - in bioavailability 327
 - chemical modification to enhance 394, 395
 - concept of 330, 334
 - by disruption of molecular planarity and symmetry 403, 404
 - of drugs 139
 - of drug substance 328
 - enhancement 328
 - expression terms 139
 - improvement of poorly soluble lead compounds 398
 - limitations 395
 - of poorly water-soluble lead compounds 394
 - of poorly water-soluble medications 345
 - structural modification to enhance 395, 396
 - thermodynamic principles of 139, 141
- solubility behavior of NCE 358–359
- solubility screening 358, 359
- solubilization
 - of drugs 11, 19, 20, 27, 47, 50, 58, 139, 176, 183, 215, 328, 329, 338, 339, 341–342
 - process of 332
- solubilization methods 117, 369
- Solutol HS 15 180, 191, 192, 193, 194
- solvent-assisted active loading technology (SALT) 218
- solvent evaporation 23, 92, 124, 183, 262, 265, 309, 329, 334, 368
- solvent injection method 214–215
- spironolactone 283
- Sporanox® 10, 270, 305, 377
- spray drying (SD) 6, 10, 20, 23, 24, 26, 37, 40–42, 44, 56, 58, 60, 124, 125, 131, 358
- stabilizers 11, 25, 45, 88, 91, 92, 95, 96, 129, 261, 262, 376
- stable polymorph 7, 140, 362
- staurosporine 218
- stealth liposomes 227, 234, 243
- stealth particle by PEGylation 267
- stearyl amine 220
- stimuli-sensitive micelles 231
- stimuli-triggered liposomes 224
 - applications of 225
 - mechanism of action of 225
 - types of 224–225
- Stokes Raman scattering 136
- structural modification 332, 389–411
 - to enhance solubility 391, 394–401

structure–activity relationships (SAR) 410
 sugars 60, 219
 sulfamethazine 129, 150, 151
 sulfanilamide tragedy 340
 sulfobutyl ether- β -cyclodextrin (SBE- β -CD) 300, 305, 306, 308, 311, 312, 316, 318
 sulfoximines 406, 407
 Sunlenca® 12
 supercritical anti-solvent (SAS) approach 92, 130–131
 supercritical assisted spray drying (SASD) 131
 supercritical carbon dioxide (scCO₂) 44
 supercritical fluid-based methods 129–131
 supercritical fluidic method 215
 supercritical fluid technology (SCF) 6, 91–92, 265
 supercritical solvents 129
 rapid expansion of 129–130
 supersaturation 19, 23, 27, 39, 40, 46–49, 57, 84, 91, 126, 128, 131, 148, 154, 183, 282, 338, 343, 369, 370, 393, 394
 supramolecular heterosynthons 119
 supramolecular homosynthons 119
 surface area relationship 83–84
 surface characteristics of ASD 36–37
 surface-modified bubble liposomes 221
 surfactant-cosolvent hybrids 343
 surfactants 9–11, 26, 43, 44, 47, 52, 60, 85, 91, 92, 94–96, 116, 148, 154, 174–183, 187–192, 194, 195, 209, 210, 230, 233, 259–262, 266, 284, 304, 331, 333, 341–344, 357, 365, 366, 371–376
 synthesis of silica particles 266
 different techniques for 258–260
 synthons in pharmaceutical cocrystals 119
 syringic acid 149, 150

t

tabletability 38, 41, 147
 tacrolimus (FK 506) 45, 53, 191, 192, 194
 targeted drug delivery 175, 225, 234–235, 244, 258, 267, 306
 by silica conjugates 268–269
 targeted liposomes 210, 227, 228, 241, 242
 applications of 228
 mechanisms of 228
 types of 227–228
 targeted micelles 230
 targeting ligands 221–223, 227, 228, 242, 258, 306
 tegafur 149, 150
 telmisartan 179, 342, 343, 359, 364
 temperature-responsive liposomes 224
 temperature-sensitive polymers 231
 template-assisted synthesis 259–260
 tenable resistive pulse sensing (TRPS) 240, 241
 tetraethyl orthosilicate (TEOS) 258, 259, 261, 266
 theragnostic liposomes 243
 thermodynamic and phenomenological models 55–56
 thermodynamic principles of solubility 139–141
 thermodynamic solubility 19, 27, 29, 391–394, 396, 400, 401, 404
 versus kinetic solubility 392–394
 thermodynamic (equilibrium) solubility 358, 359
 thermogravimetric analysis (TGA) 132–135, 354, 370
 thin film hydration method 213
 TNO gastrointestinal model (TIM) 377
 total solubility 55, 392
 toxicokinetic study 340, 356, 357
 traditional liquid SEDDS 186
 traditional vs. nanosizing techniques in solubility enhancement 84–87

Transcutol® 180, 182, 191, 192, 342
 triazolopyridine 405
 TRPV1 antagonists 403
 twin screw extrusion method 126
 type I lipid formulations 176
 type II lipid plans 176
 type II-LBDDS 176
 type IV-LBDDS 176

U

ultra-high-pressure homogenizers
 (UHPHs) 90
 ultrasonication 87, 90–91, 95
 ultrasound 221, 222, 224, 225, 242, 243,
 268
 ultrasound assisted approach 131–132
 ultrasound imaging 221, 243
 ultrasound-responsive liposomes 225
 ultrasound-sensitive polymeric micelles
 231
 United States Pharmacopoeia (USP) 3,
 284, 327, 341
 unsaturated phosphatidylcholine 220
 untested solvent 340
 U.S. Food and Drug administration
 (USFDA) 7, 8, 10, 11, 19, 50, 87,
 92, 93, 98, 115–118, 139, 151–153,
 155, 234, 238, 241, 285, 306, 334,
 337, 340, 356, 363, 370
 US6136799A patent 341, 346
 US6361758B1 patent 341

V

vaccine delivery, charged liposomes 223
 vaccines 223, 226, 243–244, 306, 318
 delivery of 223, 235
 vacuum compression molding (VCM)
 40, 368
 Veklury® 306, 311, 317
 vesicular lipid nanocarriers 12
 vigorous hydration 213
 vinyl polymers 26, 33
 virtual bioequivalence (VBE) study 59,
 287, 288
 virtual screening 55, 122, 124
 vitamin D 337, 341, 346
 volatile co-solvents 177, 179
 voriconazole 286, 317

W

water-in-oil (W/O) microemulsion 259
 wet media milling 88–89, 94, 99
 World Health Organization (WHO) 279,
 285

X

X-ray diffraction (XRD) spectroscopy 28,
 30, 35, 40, 132, 133, 261, 262, 370
 X-ray powder diffraction (XRPD) 357,
 362

Z

Ziprasidone mesylate 317















