Index

Note: Page numbers in *italics* refer to tables or figures.

Abbott nutrition 298
acid casein 234
manufacture
  conventional treatments 239–41
  superficial fluid processing 242–3
acid – alkali balance see pH values
acid-based cleaning agents 122
acidity in milk 214–15
actuator technologies 333
additives
  codes of practice 80–3
  defined 47
  functional classes 48
  GSFA proposals 83
in condensed milks 156–7, 162–4
in infant formulae 310–11, 319
in milk powders 180–1
key criteria 46–7
legislation and regulation
  EU 45–52
  US 72–3
*quantum satis* principle 50
age thickening 19
agglomeration techniques 188, 194–203
chemical structure and properties 200–3, 202–3
definitions 195
examples 195
forced primary 196
forced secondary 197
spontaneous primary 196
spontaneous secondary 196
use of combination methods 196–7
use of fines return systems 198–9
air content 11–12
analysis 215–16, 215
air filters see filter systems
air slugs 117
*Alcaligenes* spp. 185, 187
alkaline cleaning agents 119–21
American Dairy Products Institute (ADPI) 87
analysis and measurement technologies 332
animal health
  and bacterial load 182–3
  EU legislation 43–4
animal holdings, EU legislation 44
annatto 49
antioxidants additives 21
arsenic, in whole milk 9
ascorbates (E301/E304) 50
ascorbic acid (E300) 50
atomic force microscopy (AFM) 118
Australia and New Zealand, legislation and standardisation 73–5
β-lactoglobulin 5
  denaturation 18
  heat stability 16
*Bacillus cereus* 183, 184
*Bacillus* spp. 183, 184, 187, 188
back pulsing 117
bacteria in milk 183
  heat resistant 186–7
  spore-forming 183, 186–8
bacterial contaminants see bio-fouling
bacterial enzymes 6
bactofuges 186
beverage whiteners 268–71
chemical composition 268–9
definitions 81
functional properties 269–70
manufacture 269
new developments 270–1
bicarbonates (E500ii/E501ii) 50
bio-fouling 18–19, 104, 183, 187–8  
cleaning and control  
for evaporators 105–6  
for membrane filtration systems 116–23  
on heat exchange surfaces 18–19  
pathogen types 183  
refrigeration criteria 184  
see also microbiological control processes  
bitty cream 187  
bixin 49  
Bluetooth technologies 334  
BMP see buttermilk powder (BMP)  
Borden, Gail 28–9  
boron, in whole milk 9  
bulk density, defined 219  
bulk density analysis 219–22  
buttermilk, defined 36  
buttermilk powder (BMP) 7, 36  
legislation 36, 67, 72  
butylated hydroxyanisole (BHA) (E320) 50  
butylated hydroxytoluene (BHT) (E321) 50  
CAC see Codex Alimentarius  
cake layer formation 117  
calcium 9–10  
and heat stability 17  
calcium chloride (E509) 50  
calcium-rich supplements, milk mineral  
manufacture 276–8  
Campylobacter jejuni 183, 184  
caramelisation processes, ‘dulce de leche’ 159–64  
carbohydrates 8–9  
carbon dioxide coagulants 242–3  
carbon monoxide detectors 361  
carrageenan (E407) 50  
carriers, EU legislation 51  
caseins 2, 4–5, 233–49  
background 233–4  
compositional standards 37–9  
defined 36  
forms and structures 4–5, 233, 234–8  
functionality and applications 247–8  
formation of protein-stabilised emulsions 247  
heat stability 4–5, 247  
solubility 247  
use of peptides 248  
viscosity 247  
general preparation methods 4, 6  
legislation and standards 249  
EU requirements 36–9, 49  
Ireland 61  
UK requirements 57  
manufacturing 238–46, 240  
conventional methods 239–41  
fractionation 243–4  
supercritical fluid processing 242–3  
quality control 248–9  
use of adjuvants 37  
casein fragments 237–8  
casein number (CN) classification systems 192–4, 218  
casein peptides 238, 245–6  
casein phosphopeptides 237, 246  
caseinates 6, 234–5  
adjuvants 37  
compositional standards 37–8, 40  
defined 36–7  
legislation  
EU requirements 36–9, 49  
Ireland 61  
UK requirements 57  
manufacture 241–2  
caseinomacropeptides (CMP) 237  
CFCs (chlorinated fluorocarbon compounds) 363  
cheese manufacture  
regulations and legislation, casein use 38–9  
use of low-heat SMPs 210–12  
use of rennet casein 235–6  
use of whey proteins 275–6  
cheese powder 278  
chemical composition and properties evaporated  
milk, international comparisons 155  
chloride 9  
cholesterol 7  
chromium, in whole milk 9  
CIP-able bag filters 210  

cleaning and maintenance 139–41, 141  
circulation evaporation 152–3  
citrates (E331/E332) 50  
cleaning systems  
actuator technologies 333  
for evaporators 105–6  
system control 339  
for membrane systems 118–23  
acid-based cycles 122  
alkaline cleaning cycle 119–21  
enzymatic cleaning cycle 121–2  
reuse of chemicals 122–3
Index 373

for spray drying systems 133–42
CIP-able bag filters 139–41
control systems 346–7
drying chambers 134–7, 140
ducts and cyclones 137–8
fluid-bed dryers 137
vapour proof dampers 141–2, 142

Clostridium spp. 188
CMP (satiety drug) 245–6
CN see casein number (CN) classification systems
co-precipitates 236
and casein manufacture 242, 275–6
co-balt, in whole milk 9
Code of Federal Regulations (CFR) (US) 63–4
Codex Alimentarius 33, 75–96
commission membership and structure 76, 77
concept defined 75–6
standards 76–96
general requirements 79–80
on additives 80–3
on concentrated and dried milks 84–6
on hygiene 79–80
on labelling infant formulae 300
coffee test 233
coffee whiteners 268–71
chemical composition 268–9
functional properties 269–70
manufacture 269
new developments 270–1
colour additives, EU legislation 45–50
combustion hazards 349–51
different forms 350–1
dust characteristics 351–4
dust explosions 360
explosion containment and isolation 365
explosion suppression 362–3
explosion venting 363–5
fire detection equipment 360–2
fire fighting 365–6
ignition sources 354–9
influencing factors 354
communication technologies 333–4
concentrated milks see condensed milks;
evaporated milk; milk powders
condensed milks
definitions 81
heat stability 14–17
labelling requirements 35

dairy terms, general standards 84
deflagrations 350
dehydrated milks see milk powders
detonations 351
direct heating systems, for milk powders 190–1, 192
dispersibility of powders 231–3
dried milk products see milk powders
drying technologies 99–143
background 99
evaporation principles and techniques 100–8
hazards 349–66
combustion 349–51
dust characteristics 351–4
ignition sources 354–9
membrane filtration systems 108–23
spray drying principles and techniques 123–42, 203–4
see also heat treatments
‘dulce de leche’ 150, 158–77
background 158–60
chemical composition and properties 164–5
rheological parameters 165–6
texture and microstructure 161, 169–77
manufacturing and production 160–4, 163
microbiological control 169–73
starch additives 165
ultrafiltration (UF) processes 166–77
packaging 164

Corynebacteria 187
cream powders 282–5
emulsion stability 282–3
physicochemical properties 284–5
processing 283–4
cross flow (CF) filtration 111–12
crystallisation microscopy 169–77
see also Maillard reactions

dust explosions 349–51
dust characteristics 351–4
ignition sources 354–9

EU 32–6
Ireland 60
UK 56–7
US 67–9
protein content 2
standardisation requirements 34–5, 85
see also sweetened condensed milk;
unsweetened condensed milk
control systems 331–2
see also manufacturing process control
Coriolis Effect mass flow meters 332
detached milks see milk powders
detonations 351
developments 270–1
dried milk products see milk powders
drying technologies 99–143
background 99
evaporation principles and techniques 100–8
hazards 349–66
combustion 349–51
dust characteristics 351–4
ignition sources 354–9
membrane filtration systems 108–23
spray drying principles and techniques 123–42, 203–4
see also heat treatments
‘dulce de leche’ 150, 158–77
background 158–60
chemical composition and properties 164–5
rheological parameters 165–6
texture and microstructure 161, 169–77
manufacturing and production 160–4, 163
microbiological control 169–73
starch additives 165
ultrafiltration (UF) processes 166–77
packaging 164

Index 373

for spray drying systems 133–42
CIP-able bag filters 139–41
control systems 346–7
drying chambers 134–7, 140
ducts and cyclones 137–8
fluid-bed dryers 137
vapour proof dampers 141–2, 142

Clostridium spp. 188
CMP (satiety drug) 245–6
CN see casein number (CN) classification systems
co-precipitates 236
and casein manufacture 242, 275–6
co-balt, in whole milk 9
Code of Federal Regulations (CFR) (US) 63–4
Codex Alimentarius 33, 75–96
commission membership and structure 76, 77
concept defined 75–6
standards 76–96
general requirements 79–80
on additives 80–3
on concentrated and dried milks 84–6
on hygiene 79–80
on labelling infant formulae 300
coffee test 233
coffee whiteners 268–71
chemical composition 268–9
functional properties 269–70
manufacture 269
new developments 270–1
colour additives, EU legislation 45–50
combustion hazards 349–51
different forms 350–1
dust characteristics 351–4
ignition sources 354–9

EU 32–6
Ireland 60
UK 56–7
US 67–9
protein content 2
standardisation requirements 34–5, 85
see also sweetened condensed milk;
unsweetened condensed milk
control systems 331–2
see also manufacturing process control
Coriolis Effect mass flow meters 332
detached milks see milk powders
detonations 351
developments 270–1
dried milk products see milk powders
drying technologies 99–143
background 99
evaporation principles and techniques 100–8
hazards 349–66
combustion 349–51
dust characteristics 351–4
ignition sources 354–9
membrane filtration systems 108–23
spray drying principles and techniques 123–42, 203–4
see also heat treatments
‘dulce de leche’ 150, 158–77
background 158–60
chemical composition and properties 164–5
rheological parameters 165–6
texture and microstructure 161, 169–77
manufacturing and production 160–4, 163
microbiological control 169–73
starch additives 165
ultrafiltration (UF) processes 166–77
packaging 164

Index 373

for spray drying systems 133–42
CIP-able bag filters 139–41
control systems 346–7
drying chambers 134–7, 140
ducts and cyclones 137–8
fluid-bed dryers 137
vapour proof dampers 141–2, 142

Clostridium spp. 188
CMP (satiety drug) 245–6
CN see casein number (CN) classification systems
co-precipitates 236
and casein manufacture 242, 275–6
co-balt, in whole milk 9
Code of Federal Regulations (CFR) (US) 63–4
Codex Alimentarius 33, 75–96
commission membership and structure 76, 77
concept defined 75–6
standards 76–96
general requirements 79–80
on additives 80–3
on concentrated and dried milks 84–6
on hygiene 79–80
on labelling infant formulae 300
coffee test 233
coffee whiteners 268–71
chemical composition 268–9
functional properties 269–70
manufacture 269
new developments 270–1
colour additives, EU legislation 45–50
combustion hazards 349–51
different forms 350–1
dust characteristics 351–4
ignition sources 354–9

EU 32–6
Ireland 60
UK 56–7
US 67–9
protein content 2
standardisation requirements 34–5, 85
see also sweetened condensed milk;
unsweetened condensed milk
control systems 331–2
see also manufacturing process control
Coriolis Effect mass flow meters 332
detached milks see milk powders
detonations 351
developments 270–1
dried milk products see milk powders
drying technologies 99–143
background 99
evaporation principles and techniques 100–8
hazards 349–66
combustion 349–51
dust characteristics 351–4
ignition sources 354–9
membrane filtration systems 108–23
spray drying principles and techniques 123–42, 203–4
see also heat treatments
‘dulce de leche’ 150, 158–77
background 158–60
chemical composition and properties 164–5
rheological parameters 165–6
texture and microstructure 161, 169–77
manufacturing and production 160–4, 163
microbiological control 169–73
starch additives 165
ultrafiltration (UF) processes 166–77
packaging 164
dust explosions 360
  containment 365
  isolation 365
  suppression 362–3
  venting 363–5
EDTA 120
  electrical malfunctions, combustion hazards 357
  electron microscopy 173–4
  electron spectroscopy for chemical analysis (ESCA) 284–5
  enriched casein fractions 236–7
  Enterobacterium spp. 185
  enzymatic cleaning agents 121–2
  enzymes, protein 5–6
  equipment hygiene and safety legislation 43–4
  Escherichia coli 183, 184
European Food Safety Agency (EFSA) 52
European Union legislation
  background policy developments 29–31
  information and study access 31
  on additives 45–52
  on caseins and caseinate 36–9
  on food labelling 52–3
  on hygiene and food safety 41–5
  on infant formulae and follow-ons 39–41
  on packaging 53–4
  on preserved milks 32–6
evaporated milk 151–6
  chemical composition and properties 154–6
  legislation
    EU 34
    US 67–9
  methods and processes 101–3, 151–4
  production variations and stages 154, 155
  sterilisation 154
  storage 154
evaporation
  general principles 100–1, 151
  methods and systems 101–3, 151–4
    circulation evaporation 152–3
    falling film evaporation 153
    for infant formulae 314–15
    mechanical vapour compression 154
    multiple-effect evaporation 152
    thermal vapour recompression 153–4
  vacuum evaporation 151
  process control 330, 335–9
  vs. membrane filtration 106–8
  evaporators 100–8, 151
  background and principles 100–3
  configurations and plant design 104
  fouling and microbial growths 104
  general methods and techniques 101–3
    comparison charts 103
  heat economy 104–5
  maintenance and cleaning 105–6
    system control mechanisms 339
  process control 330, 335–9
  modelling approaches 338
  process dynamics 335
  explosion pressure 353
  see also combustion hazards
  falling film evaporators 101–3, 149–50, 153
  fats 6–8
    on powder surface 12–14
    standardisation requirements 34–5
  fibre-optic cabling 334
  filter systems
    for air contamination 188–9
    see also membrane filtration
  Filtermat dryers 131–2
  fines return systems 198–9, 198–9
  fire detection equipment 360–2
  fire fighting methods 365–6
  fires see combustion hazards
  flavourings, EU legislation 45–52
  flow systems, and membrane filtration 108–9,
    110
  flowability, powders 13, 223
  fluid-bed dryers 137
  fluoride, in whole milk 9
  follow-on formulae
    definitions 82, 295
    legislation and standardisation
      EU requirements 39–41
      UK requirements 57
  food additives see additives
  food colours see colour additives
  Food and Drugs Administration (US) (FDA) 63
  Food Safety Act-1990 55
  food safety requirement, EU legislation 41–5
  fouling 18–19, 104
  cleaning and control
    for evaporators 105–6
    for membrane filtration 116–23
  forms and mechanisms 117
  FOUNDATION Fieldbus system 334
  fractionation processes
    caseins 243–4, 244
    whey 257–8
  free fat, 226–8
  applications 7
friction, and ignition hazards 356
functional foods, whey products 263, 271–2
galactose 8
gallates (E310/E311/E312) 50
gelation processes 19
glucose syrup 163–4
goats milk products, ‘dulce de leche’ 158–77
GSFA (General Standards for Food Additives) 79, 80–3
GSUDT see dairy terms
HACCP (hazard appraisal critical control points) systems 43
HCT (heat coagulation time) test 14–15
health mark requirement see identification marking systems
heat exchanges, deposit formation 18–19
heat stability 14–17
pre-treatments 21–2
unconcentrated products 14–15
see also crystallisation microscopy
heat treatments
direct methods 190–1, 192
effect on surface compositions 12–14
fouling and deposit formations 18–19
indirect methods 189–190, 190
stability issues 14–17
see also condensed milks; drying technologies; evaporated milk; milk powders; pasteurisation
HEPA (high-efficiency particulate air) filters 188–9
high-protein powders 346
history of milk products development 28–31
homogenisation processes 16–17, 187
hot water test 232–3
hydrolysates 278–81
manufacture 279
hydroperoxides 21
hygiene issues
codes of practice 79–80
legislation
EU 41–5
Ireland 60
UK 58
US 64–5
hypoallergenic products 279–81
identification marking systems 44–5
ignition characteristics 352–3
imported milk products, hygiene and safety standards 43, 44
indirect heating systems 189–190, 190
infant formulae 292–36
background and history 292–4
classification systems 294–5
composition 303–9, 304–5
carbohydrates 307–8
lipids 307
minerals 308–9
proteins 303–7
vitamins 309
definitions 82, 294–5
food safety issues 309–10
hygiene standards 309–10
presence of additives 309
hypoallergenicity 280–1
labelling requirements 299–300, 302
legislation and regulations 299–302
cultural and religious aspects 299
EU 39–41
UK 57
manufacture
basic ingredients 310–11
dry mix processes 311–12
key stages 313, 314–19
liquid forms 319–25
microbiological examination 318–19, 324–5
powder structure 316–17, 317
preparation of the mix 314
wet mix processes 312–14
manufacturers 297–9
microbiological criteria 47
placing on the market 300–1
production figures 295–7
infra-red optical detectors 360
insolubility index 225
instant milk powders, manufacturing processes 204–9
interstitial air 222–3
iodine, in whole milk 9
Ireland, legislation 59–61
iron, in whole milk 9
Kenics static mixer 117
labelling requirements
Codex Alimentarius 300
EU directives 43, 52–3
labelling requirements (continued)
  UK requirements 57–8
  US requirements 66–71
lactalbumin 272–3
lactic acid 8, 260–1
Lactobacillus helveticus 246
β-lactoglobulin 5
denaturation 18
heat stability 16
lactose 8–9, 181
  hydrolysis 8
  hygroscopicity 260
  Maillard reactions 8, 19–20, 156–7, 160–1
  solubility 260
  stabilising treatments 8
  surface concentrations 14
lactose crystallisation 8, 160–1, 169–77, 258–9
lactose products 255–7

pharmaceutical applications 256
residual free moisture control 261–2

see also whey powders
α-lactose monohydrate 8
lactosylation 19–20
lecithin 7–8
  applications 7–8
  heat stabilisation processes 17
lecithin-dosing equipment 208–9, 210
legislation and standards 28–88
  background history 28–31
  EU horizontal legislation 41–54
    food additives directives 45–52, 52–3
    hygiene and food safety requirements 41–5
    packaging legislation 53–4
  EU vertical legislation 31–41
  Irish legislation 59–61
  New Zealand and Australia 73–5
  possible future developments 88
  private specifications and standards 87
  role of Codex Alimentarius 75–86
  UK legislation 54–9
  US legislation 61–73
lipases 5–6
lipoprotein lipases 5
liquid infant feeds 319–25
  basic manufacturing steps 319–22
  microbiological examination 324–5
  storage and packaging 323–4, 324
  UHT sterilisation 322
liquid milk, chemical composition 1–12
  ‘list of ingredients’ 53
Listeria monocytogenes 183, 184
low-heath skimmed milk powders 210–12
low-protein powders 346
lysine 20
magnesium, in whole milk 9
Maillard reactions 8, 19–20
  ‘dulce de leche’ production 160–1
  evaporated milk production 156
  sweetened condensed milk production 156–7
  whey powder production 261
manganese, in whole milk 9
manufacturing premises, EU legislation 44
manufacturing process control 330–42
  background 330–1
  actuator technology 333
  communication technology 333–4
  control technology 331–2
  key principles 334
  measurement technology 332
  of evaporators 330, 335–9
  of spray drying systems 339–46
mastitis 182
Mead Johnson 298
measurement technologies (control systems) 332
  see also manufacturing process control
mechanical vapour recompression (MVR)
  102–3, 102, 154
  heat economy 104–5
  plant design 104
medicinal residues, EU regulations 43
melanoidins 19–20
membrane filtration 108–23
  applications 109, 115–16
  design configurations 114–15
  dynamics and general principles 108–12
  heat economy 115
  methods and systems 112–13
  performance enhancement methods 117
  system maintenance and cleaning 116–23
    alkaline cleaning cycle 119–21
    fouling control 116–18
    membrane cleaning 118–19
  vs. evaporation 106–8
membrane lipids 7
membrane proteins 4
microbiological control processes
  background 183–6
    pathogens in raw milk 183
    primary control mechanisms 183
    secondary process-based mechanisms 183–5
  see also pasteurisation
microbiological safety standards
   EU legislation 42, 45
   infant formulae 47
   milk and whey powders 47
*Micrococcus* spp. 186–7
microfiltration (MF) 186
microparticulated whey protein (MWP)
   279–80
microscopy, and crystallisation processes
   169–77
milk see raw milk; skimmed milk
milk components 1–22
   air 11–12
   carbohydrate 8–9
   fat 6–8
   minerals 9–10
   protein 1–6
   water 11
   typical specifications 213
   US/EU comparisons 69–70
milk mineral 276–8
milk permeate 181
milk powders 180–233
   chemical composition 1–12
      air content 11–12
      moisture content 11
      and protein content 345–6
   definitions 81, 180–2
   environmental contamination 188–9
   heat stability 14–17
   labelling requirements 35
   legislation
      EU 32–6
      Ireland 60
      UK 56–7
      US 67–8, 70–1
   manufacturing systems 203–12
      for instant powders 204–9
      for ordinary powders 202–3
   moisture control 345
   oxidation problems 192–3
   processing 186–9
      basic steps 181
      bactofugation 185
      clarification and microfiltration 185
      fat/protein standardisation 186
      heat treatments 186–7, 189–94
      homogenisation and concentration 187
      monitoring 188–9
      spray drying and agglomeration 188
   use of agglomeration and instantisation technologies 194–203
   use of direct heating systems 190–1, 192
   use of indirect heating systems 188, 190–1
   quality issues 192–3, 212–33
      CN analysis 218
      dispersibility 231–3
      fat content analysis 226–8
      flowability 223
      interstitial air analysis 222–3
      moisture analysis 216–18, 217
      particle density analysis 219–22
      presence of scorched particles 216, 226
      solubility 216, 223–5
      wettability 228–31
      use of the coffee test 233
      use of the hot water test 232–3
      use of the sludge test 232
      standardisation requirements 34–5
      surface composition 12–14
      types 183, 209–12
   see also specialised and novel powders
milk protein concentrates (MPC) 236, 345
   manufacture 245
milk protein fractions 236–7
milk protein isolates (MPI) 236
milk retentate 181
milk solids 220
   minerals 9–10
      and heat stability 17
   moisture content analysis, milk powders
      216–18, 217
molybdenum, in whole milk 9
MPC see milk protein concentrate (MPC)
Multi-Fluidisation Technology (MFT) 132
Multi-Stage Dryer (MSD) 132
   cleaning systems 135–6
   multiple-effect evaporation 152
MVR see mechanical vapour recompression (MVR)
MWP see microparticulated whey protein (MWP)
*Mycobacterium avium* subsp. *paratuberculosis* 183
   names and designation of foods 53
   ‘natural flavourings’ 52
   Nestlé Company 28–9, 297–8
   Neural Net 331
   New Zealand and Australia, legislation and standards 73–5
nickel, in whole milk 9
nitrogen conversion factor (NCF) 41
norbixin 49
novel milk powders see specialised and novel powders
oxidation reactions, lipids 20–2
packaging
EU legislation 53–4
evaporated and condensed milks 150
pasteurisation 183
UK codes of practice 58–9
US legislation 65–6
peptides
biologically active 280–1
casein-derived 245–6, 248
pH values
determination techniques 212–15
and heat stability 15–16
phosphates, EU standards 50–1
phosphatidyl choline 7
phosphatidyl ethanolamine 7
phosphocasein 235
phosphopeptides, from caseins 246
phosphorus 9–10
plasmin 5–6
potassium 9–10
potassium sorbate 160
pre-heat treatments 21–2, 104
premises see animal holdings; manufacturing premises
pressure sensors 361
probiotic bacteria 280–1
process control mechanisms see manufacturing process control
processing aids, defined 48
PROFIBUS system 334
programmable logic controllers (PLCs) 331
proteases 5–6
proteins
composition in milk products 1–6
enzymes 5–6
forms 4
heat stability and denaturation 4–5, 14–17
age thickening 19
standardisation
EU 33–5
infant formulae 41
storage 6
surface concentrations 13–14
see also caseins; caseinates; milk protein concentrate (MPC)
Pseudomonas spp. 184, 185
psychrotrophic bacteria 184–5, 185
quality of milk and milk powders 212–33
general considerations 212
bulk density analysis 219–22
fouling concerns 18–19
heat stability issues 14–17
liquid milk analyses 211–15
milk concentrate analyses 215–16
milk powder analyses 216–33
CN analysis 218
dispersibility 231–3
fat content analysis 226–8
flowability 223
interstitial air analysis 222–3
moisture analysis 216–18
particle density analysis 219–22
presence of scorched particles 216, 226
solubility 216, 223–5
wettability 228–31
use of the coffee test 233
use of the hot water test 232–3
use of the sludge test 232
quantum satis principle 49–50
raw milk 182–5
pathogens 183–6
specifications 214
standards and criteria 46
refrigeration, of raw milk 183–4
rennet casein 325–6
composition requirements 39
manufacture 241
‘Rheinesgebot’ 30–1
rotating discs 117, 118
Royal numico 298
safety requirements, EU legislation 41–5
Salmonella typhi 183, 184
Salmonella typhimurium 183, 184
salt balance theory 17
SCADA (supervisory control and data acquisition) software 331
scanning electron microscopy (SEM), for fouling control 118
SCC see somatic cell counts (SCC)
Index

scorched particles, measurements 216, 226, 227
secondary explosions 351
seeding technologies 161
selenium, in whole milk 9
self-ignition 358–9
sensors 332
silicon, in whole milk 9
skimmed milk
  defined 36
  legislation
    EU requirements 32–6
    UK requirements 57–8
  protein content 2
  subsidies 37–8
skimmed milk powder (SMP)
  defined 36
  manufacturing
    instant powders 204–6
    low-heat powders (cheese production) 210–12
  stability and classification systems 191–2
  see also milk powders
sludge test 232
SMP see skimmed milk powder (SMP)
sodium, in whole milk 9–10
sodium caseinate 6
sodium chloride 17
sodium hypochlorate (NaOCl) 121
solubility measures, milk powders 216, 223–5
somatic cell counts (SCC) 183
specialised and novel powders 266–86
  basic principles 266–8
  carbohydrate contents 267
  fat contents 267
  moisture content 266–7
  oxidation 267–8
  particle solubility 268
  processing control 268
  cheese powder 278
  coffee whiteners 268–71
  cream powders 282–5
  hydrolysates 278–81
  milk mineral 276–8
  nutriceutical whey products 271–2
  other whey protein products 272–6
spore-forming bacteria 183, 186–8
Spray Bed Dryer (SBD) 132, 208–9, 208
spray drying technology 123–42
  design configurations 130–2, 208
  dynamics and general principles 123–7
heat economy 132–3
maintenance and cleaning 133–42
  CIP-able bag filters 139–41
  control systems 346–7
  drying chamber 134–7
  ducts and cyclones 137–8
  fluid-bed dryers 137, 140
  vapour proof dampers 141–2, 142
methods and systems 127–30
  for infant formulae 315–16
process control 339–46
  of air-flow stability 341–2
  of chamber pressure 342
  of concentrate flow rate 340–1
  of energy input 340
  of evaporative demand 339
  of inlet air flow rate 341
  of inlet air temperature 342
  of moisture content 340
  of outlet temperatures 342–5
standardisation of milk products see legislation and standards
Staphylococcus aureus 183, 184
starch additives 165
storage of milk products
  carbohydrate changes 8
  oxidation changes 20–2
  protein changes 6
  gelation and thickening 19
  temperature requirements 46
Streptococcus brevis 186–7
Streptococcus faecalis 186–7
Streptococcus thermophilus 186–7
stress-relieving peptides 246
subsidies, skimmed milk products 37
sucrose, in condensed milks 156–8
  in ‘dulce de leche’ 150, 159, 162–4
supercritical fluid processing 242–3
surface composition of powders 12–14
  surface free fat measures 226–8, 228
sweetened condensed milk 156–8
  composition and properties 158
  rheological properties 166
  definitions 156
  manufacturing stages 157
  packaging 158
sweeteners, EU legislation 45–52
temperature sensors 360
terminology see dairy terms
tertiary-butyl hydroquinone (TBHQ) (E319) 50
thermal vapour recompression (TVR) 102–3, 153–4
thermocompressors 105
Tixotherm process 259
Torulopsis bacteria 158
total milk protein 245
see also milk protein concentrates (MPC)
transmission electron microscopy 173–4
transport of milk products, temperature requirements 46
turbulence promoters 117
TVR see thermal vapour recompression (TVR)
udder disease 183
UHT sterilisation processes 322
UK legislation 54–9
  background and history 54–6
  on caseins and caseinates 57
  on condensed and dried milks 56–7
  on infant formulae and follow-ons 57
  on other concentrated products 58
  on skimmed milk with non-milk fat 57–8
ultrafiltration (UF) processes
  for ‘dulce de leche’ 166–77
  for hypoallergenic products 279–81
ultrasound technologies, in fouling control 118
unsweetened condensed milk 156
US legislation 61–73
  background and history 61–3
  on hygiene requirements 64–5
  on labelling and identification standards 66–71
  on pasteurised milk ordinance 65–6
  USDA specifications 71–2
vacuum evaporation methods 151
van t’Hoff equations 109
vapour proof dampers 141–2, 142
vent ducts 364
venting practices 363–5
veterinary residues, EU regulations 43
vibratory shear-enhanced filtration (VSEP) 118
Vibrio-Fluidizers 204, 207–9
vitamins, as additives 48
water content 11
wettability 228–31, 230
whey 30, 253
  definitions 81–2
  forms and composition 253–4
  fat content 6–7
whey deposits, cleaning methods 106, 107
whey powders 254
  definitions 81–2
  forms and composition, protein content 3
  manufacture 257–9
  technical complexities 259–62
  modified versions and applications 262
  as functional foods 263, 271–2
  future trends 262–3
whey proteins 2–3, 4, 254–5
  as co-precipitates 236, 275–6
  cold-gelling 274–5
  foam formation 261
  as functional foods 271–2
  heat sensitivity 259–60
  heat-denatured products 272–4
  stability 5
  under shear forces 276
see also whey powders
whey protein nitrogen index (WPNI) 191–2, 193, 218
whey protein powders
  composition 2–3, 4
  definitions 82
  see also whey powders
whiteners 268–71
  definitions 81
whole milk, protein content 2
whole milk powders (WMP)
  manufacturing, instant powders 206–9, 207
  stabilisation and quality issues 193–4
  with high free-fat content 209–10
  see also milk powders
WiFi technologies 334
wireless communication systems 334
WMP see whole milk powders (WMP)
Wyeth nutrition 298–9
zinc 9