Index

Achromobacter, 288 Acinetobacter, 290 active packaging, 251-62 carbon dioxide scavengers/emitters, 254, 255 definition. 251 flavour/odour absorbers, 258, 259 food applications, 252 food safety, consumer and regulatory issues, 260, 261 adhesive lamination, plastics, 185, 186 Advisory Committee on the Microbiological Safety of Food (ACMSF), 291 aerobes, 266, 290 Aeromonas hydrophilia, 266 American Society of Testing and Materials (ASTM), 97-9 anaerobic digestion (AD), 314, 315 anaerobic respiration, 292 antifogging properties, 276 argon, 264, 265 biodegradable plastics, 209 biodeterioration, agents of bacteria, 33-6 enzymes, 32, 33 fungi, 36-8 non-enzymic biodeterioration, 38 bioplastics, 295-319 definitions, 209, 297 genetic modification (GM), 306, 316 life cycle model, 296 market drivers, 295, 296 market challenges, 316 bioplastics, materials, 298 aliphatic polyesters and derivatives, 306, 307 aromatic co-polyesters, 307 biocomposites, 308, 309 casein, 304 cellulose, fibre-based & derivatives, 302, 303 chitin & chitosan, 304 collagen, 304 gluten, 304 lignocelluloses, 303 natural fibre bio-composites, 303

polybutylene succinate (PBS), 307 polybutylene succinate adipate (PBSA), 307 polybutylene succinate terephthalate (PBST), 307 polybutyrate adipate terephthalate (PBAT), 307 polycaprolactone (PCL), 307 polyester amide (PEA), 307 polyethylene from bio-ethanol (Bio-PE), 306 polyethylene terephthalate (PET), modified, 307 poly (ethylene vinyl alcohol) (EVOH), 307, 308 polyglycolic acid (PGA), 306 polyhydroxyalkanoate (PHA), 308 polyhydroxybutyrate (PHB), 308 polyhydroxyhexanoate (PHH), 308 polyhydroxyvalerate (PHV), 308 polylactic acid or polylactide (PLA), 305, 306 polysaccharides, 300 polytetramethylene adipate terephthalate (PTMAT), 307 polyurethane (PU), 304 plant fibres, 300 polyvinyl alcohol (PVOH), 307, 308 proteins, animal-based & plant-based, 304 regenerated cellulose film (RCF), 302, 303 starch, starch blends, starch-based, 300, 301 starch complex (starch blends with other bioplastics), 301, 302 starch nano-composites, 301 thermoplastic Starch (TPS), 301 blanching, 39 bleaching of cellulose fibre, 215, 216 blow and blow process, glass container making, 142 blown plastic film, 161, 162 Botrytis cinerea, 292 brands, 1, 5, 6, 22, 23, 26 bread, modified atmosphere packaging of, 264 British Standards Institute (BSI), 100 Camplobacter jejuni, 266 cans, see metal cans carbon dioxide scavengers/emitters, 254, 255 effect on foods, 266, 267 carbon cycling & footprint, 26, 298, 299

Food and Beverage Packaging Technology, Second Edition. Edited by Richard Coles and Mark Kirwan. © 2011 by Blackwell Publishing Ltd. Published 2011 by Blackwell Publishing Ltd.

classification, 299, 300

composting, 311-4

carbon cycling & footprint (Cont.) home (or domestic/garden/backyard) composting, 313.314 industrial (municipal) composting, 311-3 Carbon Trust, 26 carbon monoxide effect on foods, 269 cast plastic film, 161-3 chemically separated cellulose fibre, 215, 216 climate change & greenhouse gas emissions, 6-9 cling film wrapping, 177 Clostridium botulinum, 35, 36, 40, 44, 54, 266, 267, 290, 291, 292 coating of plastics, 182-5 acrylic coatings, 182 DLC (diamond-like coating), 184 extrusion coating with PE, 184, 185 low-temperature sealing coatings (LTSC), 183 metallising with aluminium, 183, 184 PVdC coatings, 183 PVOH coatings, 183 SiOx coatings, 184 cold seal, 195 cold chain, 96 Comité Européenen de Normalisation (CEN) see also distribution performance tests communication, reference logistics, 88, 89 compression strength, 93 compression testing, 98, 99 consumer needs, 18-21 controlled atmosphere storage (CAS), 263, 264 definition, 263 corporate social responsibility (CSR), 2, 25, 26 corrugated fibreboard, 98-101, 237-9 crisps, modified atmosphere packaging of, 264 cube utilisation, 88, 91 Cytophaga, 290

dairy products, modified atmosphere packaging of, 293 data matrix bar code, 5 diamond-like-carbon (DLC) coating, 184, 273 distribution centres, 93 distribution costs, 11, 23, 24 distribution needs & hazards, 13–16, 26, 27 distribution performance testing, 97 compression testing, 98, 99 equipment, 97–9 impact, shock, vibration testing, 97, 98 standards, *see* ASTM; ISO; ISTA *see also* transit testing

efficient consumer response (ECR), 95 electronic data interchange (EDI), 23, 88 environmental management systems, 26 environmental performance of packaging, 24–6, 153–5, 205–9, 243–9 environmental impact of bioplastics, 298, 299 environmental policy, 8, 26 equilibrium modified atmosphere, 292 equilibrium relative humidity (ERH), 50 ergonomic standard, 88 Escherichia coli, 35, 36, 49, 266, 288, 292 ethanol emitters, 256 ethylene, 255, 256, 268, 291, 292 scavengers, 255, 256 EU Directives Packaging & Packaging Waste, 2 Packaging and Landfill, 2, 296, 310, 311 Plastics, 157 Renewable Energy, 2 EU Regulations Animal By-Products (ABPR), 313 extrusion blow moulding, 167 extrusion lamination, plastics, 186, 187 facultative anaerobes, definition, 266 fat, see lipid fish modified atmosphere packaging of, 290, 291 Flavobacterium, 290 flavour/odour adsorbers, 258, 259 food biodeterioration, 31-58 contact approval (packaging materials), 273 distribution systems, 6 poisoning, 288 quality, 263 shelf life, see shelf life food contact issues for plastics, 189, 190 food preservation methods, 31-58 blanching, 39 chilling and cooling, 48, 49 continuous thermal processing (aseptic), 44-6 curing, 51, 52 drying and water activity control, 49-51 fermentation, 53 freezing, 47, 48 high pressure processing, 55 irradiation, 55, 56 membrane processing, 56 microwave processing, 56 modification of atmosphere (MAP), 53, 54 ohmic heating, 55 pasteurisation, 46, 47 pickling, 52 pulsed light, 55, 56 smoking, 52, 53 thermal processing, 40-46, 125, 126, 148, 149, 202 - 4food product quality, factors affecting enzyme activity, 66, 67 flavour scalping (loss), 73 ingress of off-flavours, prevention thereof, 73 insect damage, 71 microbiological processes, 67-70

moisture changes in food, 71, 72 oxidation, 63-6 physical damage, 70 food spoilage enzyme, 203 gas, see carbon dioxide and oxygen effect on foods microbiological, 288-93 physical, 270 fruit modified atmosphere packaging of, 291-3 respiration, 292 gas permeation definition, 274 gas exchange, 263 gas transmission rate definition. 274 measurement, 286-8 gas barrier properties, 274, 275 flushing, 281 flushing, compensated vacuum, 281 headspace composition determination, 288 gaseous composition of air, 263 measurement of transmission rate, 286-8 properties, 264, 265 glass composition, 138, 139 amber (brown), 139 blue, 139 dark green, 139 pale green (half white), 130 white flint (clear glass), 138, 139 glass container closure selection, 147, 148 normal seals, 147, 148 pressure seals, 147, 148 vacuum seals, 147, 148 glass container manufacture, 141-6 cold end treatment, 144 container forming, 141-4 design parameters, 142-4 furnace (melting), 141, 142 hot end treatment, 142-4 inspection and quality, 145, 146 low-cost production tooling, 144, 145 surface treatments, 142-4 glass container usage cleaning, 152 consumer acceptability, 141 due diligence in the use of, 152, 153 food market sectors, 138 labelling and decoration, 149 marketing benefit, 139-41 pack design and specification, 150-52 pack integrity, 141 pack safety, 141 glass attributes of packaging in, 139,140 definition. 137

packaging, 137, 138, 137-56 strength in theory and practice, 149, 150 hard sizing of paper and board, 225 hazard analysis critical control point (HACCP), 90, 96 heat sealing, 192-5, 201, 202 importance in MAP. 276 integrity, 202, 285, 286 measurement, 285, 286 helium, 265 inert gases, see noble gases injection blow moulding, 168 injection moulding, 169 injection stretch blow moulding, 168 intelligent packaging, 251 International Organization for Standardization (ISO), 98, 99, 104 International Safe Transit Association (ISTA), 98 labelling of rigid plastic containers, 188, 189 Lactobacilli, 266, 290 lamb (red meat), modified atmosphere packaging of, 264, 268, 288 levels of packaging, primary, secondary etc., 15 life cycle assessment (LCA), 8 life cycle model for bioplastics, 296 lipid, oxidation, 268 Listeria monocytogenes, 35, 36, 49, 266, 292 logistical packaging issues, 89-97 packaging issues in food processing, 89, 90 retail customer service, 94, 95 supply chain integration, 97 transport, 90-93 warehousing, 93, 94 waste management, 95, 96 logistical packaging, functions, 86-9 communication, 88, 89 food marketing systems, 85-106 protection, 76-87 productivity, 87, 88 utility, 87, 88 logistics packaging materials and systems, 99-104 corrugated fibreboard boxes, 99-101 reusable totes, 101, 102 shrink bundles/wrapping, 101 unitisation, 102-4 meat modified atmosphere packaging of, 264, 267, 268, 269, 289, 290 oxygen, its effect on pigments, 268, 269 mechanical properties of packaging, 276 mechanically separated cellulose fibre, 215 mesophilic microorganisms, 33 metal can manufacture coatings, film laminates and inks, 120 easy-open can ends, 119, 120 plain food can ends, 118, 119

metal can manufacture (Cont.) three-piece welded cans, 114, 115 two-piece drawn and ironed (DWI), 116-8 two-piece single drawn and multiple drawn (DRD), 115, 116 metal can packaging issues can reception at packer, 121, 122 filling and exhausting, 122-32 handling, 126, 127 heat processing, 125, 126 post processing, cooling, drying and labelling, 126 seaming, 123, 124 storage and distribution, 127 metal can shelf life issues aluminium, 132 dissolution of tin, 130, 131 environmental stress cracking aluminium ends, 133, 134 external corrosion, 134, 135 function of tin, 129, 130 interactions between can and contents, 128 internal corrosion, 138 iron, 131, 132 lacquers, 132 stress corrosion cracking, 133 sulphur staining, 134 tin toxicity, 130 metal cans container designs, 108-10 packaging overview, 107 performance requirements, 107 raw materials, aluminium, 111 raw materials, steel, 110, 111 recycling, 112, 113 metallising of plastic films (OPP, PET, PA), 164, 183, 184, 198, 273 metal packaging, 107-36 microaerophiles, definition, 266 migration avoiding migration and taint, 79 factors affecting, 78, 79 from other packaging materials, 77 from plastics, 74 issues for plastics, 189, 190 monitoring and measuring, 80 Mitsubishi Gas Chemical Company, 253, 255 modified atmosphere packaging machinery chamber, 277 compensated vacuum gas flushing, 281 form-fill-seal, 277-9 gas flushing, 281 negative forming, 278, 279 negative forming with plug, 278, 279 positive forming with plug, 279 snorkel, 277 modified atmosphere packaging, 263-94 carbon dioxide scavengers/emitters, 254, 255 carbon dioxide headspace determination, 288

definition, 263 ethylene scavengers, 255, 256 MAP gases, 264-6 MAP packaging materials, 270-73 market for foods, 263 measurement of carbon dioxide transmission rate. 287 measurement of oxygen transmission rate, 287 measurement of transmission/permeability rates, 287 oxygen headspace determination, 288 oxygen scavengers, 252-4 water vapour transmission rate, 286 modified atmosphere packaging, food applications cooked, cured and processed meat products, 289, 290 dairy products, 293 fish and fish products, 290, 291 fruits and vegetables, 291, 292 raw poultry, 288, 289 raw red meat, 288 moisture absorbers, 257 moisture spoilage of food, 263 Moraxella, 290 narrow neck press process, glass container manufacture, 142 neon, 265 nitrogen effect on foods, 267 effect on microbial growth, 287 gaseous composition of air, 263 properties, 265 noble gases

properties, 265, 305 use in modified atmosphere packaging of foods, 264, 265 nylon, *see* plastics in food packaging, polyamide

oil, 2

optical properties of packaging, 164, 266 oriented plastic film, 161-4 oxygen effect on microbial growth, 266 effect on foods, 263, 268 gaseous composition of air, 263 headspace composition measurement, 288 properties, 265 transmission rate, measurement, 287 oxygen scavengers, 252-4 AgelessTM 253 beer, 252, 254 food applications, 252-4 iron based scavengers, 252 market, 252 non-metallic scavengers, 253 ZerO2TM, 254

plastic packaging, 157-212, 295-319 packaging papers and paperboards bag papers, 221 folding boxboard (FBB), 222 glassine, 220 greaseproof, 220 impregnated papers, 221 laminating papers, 221 microcreping, 220 paper labels, 221 sack kraft, 221 solid bleached board (SBB), 221 solid unbleached board (SUB), 222 tissues, 220 vegetable parchment, 220 wet strength paper, 220 white lined chipboard (WLC), 228 packaging specifications and standards, 26, 27 packaging definition, 9, 11 design and development, 1-3, 11, 13-27 functions of, 9, 10 historical perspective, 3-5 machinery & production processes, 16-18 material properties, 16-18 optimisation, 11, 12 product quality and shelf life, 59-84 recovery, 154, 206-8, 215, 216, 245, 246 recycling, 95, 96, 154, 206-8, 214-6, 237, 245-7 reduction, 95, 96, 154, 155, 205, 206 reuse, 95, 96, 154, 206, 207 strategy, 10 supplier selection, 26 total quality management (TQM), 26, 27 pallet, 102-4 construction, 103 plastic, 102 wood, 102 paper and paperboard-based systems, 243 paper and paperboard environmental profile, 243 paper and board types of packaging, 242, 243 cap liners and diaphragms, 242, 243 composite containers, 236 corrugated fibreboard packaging, 237-9 fibre drums, 236 folding cartons, 231-3 induction sealed disc, 242, 243 interlocking dividers, 242 labels, 240, 241 liquid packaging cartons, 233-5 moulded pulp cushioning 242 moulded pulp containers, 239 multiwall sacks, 230 paper bags and wrapping paper, 228, 229 pulpboard disc, 242 rigid cartons or boxes, 235 sachets/pouches/overwraps, 229 sealing tapes, 241, 242

shredded paper, 242 tea and coffee bags, 228 tubes, 235 tubs. 235 paper and paperboard acrylic dispersion coating, 225 added processes, 225-8 fluorocarbon dispersion coating, 225 hard sizing, 225 lamination, 225, 226 plastic extrusion/laminating, 226 printing and varnishing, 227 varnishing/coating/laminating, 227, 228 wax sizing, 225 paper and paperboard, fibre sources and pulping, 215, 216 paper and paperboard manufacture coating, 219 drying, 218 finishing, 219 pressing, 218 reel-up, 219 sheet forming, 217 stock preparation, 217 paper and paperboard packaging, 213-50 design 228 paper and paperboard, properties, 223-5 pasteurisation, see thermal processing pathogens, 31, 35, 36, 60, 61, 68 permeability coefficient, 274, 275 permeability issues for plastics, 190, 191 permeation, see gas permeation pest control, 93 plastic packaging manufacture, 161 packs based on plastic films laminates, 165-7 plastic film and sheet for packaging, 161-5 rigid plastic packaging, 167-70 plastics environmental issues, 205 plastics in food packaging acrylonitrile butadiene styrene (ABS), 179 cellulose based materials, 181 ethylene vinyl acetate (EVA), 176 ethylene vinyl alcohol (EVOH), 179. 271 fluoropolymers, 180, 181 gas and water vapour barrier properties, 15 high nitrile polymers (HNP),180 ionomers, 175, 176, 271 polyamide (PA), 176, 177, 271 polycarbonate (PC), 175 polyethylene (PE), 101, 170, 171, 271 polyethylene naphthalene dicarboxylate (PEN), 174, 175 polyethylene terephthalate (PET or PETE), 173, 174, 272 polymethyl pentene (TPX), 180 polypropylene (PP), 171-3, 272 polystyrene (PS), 178, 179, 272 polyvinyl acetate (PVA), 182

plastics in food packaging (Cont.) polyvinyl chloride (PVC), 177, 272 polyvinylidene chloride (PVdC), 178, 272 styrene butadiene (SB), 179 plastics waste management, 206-8 plastics, sealing and closing, 192-5 plastic packaging, 157-212, 295-310 pork, modified atmosphere packaging of, 264, 288 poultry, modified atmosphere packaging of, 264, 288, 289 press and blow, glass container manufacture, 142 printing of plastic films digital, 188 flexographic, 188 gravure, 187, 188 printing of rigid plastic containers dry offset printing, 189 heat transfer printing, 189 product packaging needs, 13, 14 properties of paper and board, 223-5 appearance, 224 performance, 224, 225 protection, reference logistics, 86, 87 Pseudomonas, 266, 288, 290, 293 psychrotrophic, 33

radio frequency identification (RFID), 89, 94 recovered (secondary) cellulose fibre, 215, 216 retail distribution centre (RDC), 85, 93, 94 retail market needs, 21 retail logistics, 23, 24 retort pouch, 198–205 reusable totes, 101, 102

Salmonella, 36, 49, 56, 266, 292 self-cooling cans, 259, 260 self-heating cans, 259, 260 shelf life, 20, 59, 59-84, 204, 205, 263, 264 factors affecting, 62, 63 shock testing, 97, 98 shrink bundles, 101 shrink sleeving (labels), 149, 159 shrink wrapping, 101, 104, 159, 166, 177 silicon oxide (SiOx) coating, 273 silk screen printing, 189 slip sheet (logistics), 103, 104 Staphylococcus, 35, 266 stock keeping units (SKU), 88, 94 stretch blow moulding, plastics, 168 stretch wrapping, 104, 177 sustainable packaging, 7 sustainable sourcing of packaging materials, 7, 25 tea packaging innovation, 10-12 temperature controlled packaging, 259, 260 thermal lamination, plastics, 186 thermal processing, 39-47 aseptic, 44-6, 169, 180, 234 canned foods, 40-43, 125, 126 glass packed foods, 148, 149 pasteurisation, 46, 47 retort pouches, 198-205 total packaging system cost, 12 total product concept, 11, 13 total product cost, 7 total systems approach to packaging optimisation, 13 thermoduric, 33 thermoforming, 166, 169, 277-9 thermophilic, 33 transit issues, 90-93 see also distribution performance tests transit testing, 90, 97-9 transmission rate, definition, 274, 275 see also CO₂, O₂ and water vapour transport air, 91, 92 rail. 91 road, 90-91 sea, 92

US Fibre Box Association, 100 US Occupational Safety and Health Administration (OSHA), 88

vacuum packaging, 290 value of packaging to society, 7, 8 vegetables modified atmosphere packaging of, 264, 291–3 respiration, 291, 292 vibration testing, 97, 98 *Vibrio parahaemolyticus*, 266 virgin (primary) cellulose fibre, 215, 216

warehouse issues, 93, 94
waste management issues, 6–8, 95, 96, 153, 154, 205–9, 245, 246, 299, 310, 311
waste treatments, biological, 311–6
water activity (aw), 35
water management, 6–8
water vapour transmission rate (WVTR) definition, 274, 275
effect of relative humidity (RH), 274, 275
measurement of, 286, 287
test standard ASTM E96, 286
test standard ASTM F 1249, 286

zenon, 265