Index

Note: Italicized b, f and t refer to boxes, figures and tables, respectively.

a
academia 35
academic institutions 441
accelerated shelf life testing (ASLT) 121–2
acidity 110–11
acrylamide 105
adulteration 52, 105
economically motivated 27, 39, 64, 66, 265, 266, 279
advocacy groups 36–7
aeroplane, relative efficiency of 48t
affordability 317
aflatoxin 100, 124, 125t
Africa, food trade 40t
agriculture 315–30
case studies
BSE 318–19
Quality Egg 325–6
Red Tractor 320, 321–4b
risk mitigation at farm level 327–9
risks 320–1
supply chain governance 326–7
value as food attribute in 316–17
alfalfa sprouts, contamination of 25t
Algeria, food trade 40t
allergens 99–100, 356. See also chemical hazards
additions to prerequisite programmes 70
control of 143–4
food safety case study. 366–9
in high-risk food ingredients 125t
labelling requirements 196–7t
regulated 54t
regulations 53
allergies, peanut (case study) 366–9
alternative energy sources 46–7
ambiguity 319
ammelide 105
ammeline 105
amnesic shellfish poisoning 101
Anisakis simplex 99t
antibiotics 102
aqueous ingredient 141–2
arable land 43–4
Argentina, food trade 40t
arsenic 104
Ascaris lumbricoides 99t
Asia/Pacific, food trade 40t
Aspergillus 100
Aspergillus flavus 100
audit 286, 289–90. See also food safety management
auditor competency 57
checklist 292
criteria 290
evidence 290
findings 290
global food safety audit standards 54
PRP 203b
questions used in 291
supplier 59–60
auditee 290
Index

auditors 57
  elements of competence 291f
  skills 290–2
Australia, food trade 40t
automobile, relative efficiency of 48t

B
Bacillus cereus 88t, 90t, 92, 124, 133t, 138t, 356
Bacillus coagulans 133t
Bacillus stearothermophilus 133t
bacterial infections 85t
bacterial pathogens 91–4
  emerging pathogens 89–91, 91t
  growth limits 91t
  non spore-forming 92–4
  sources of 90t
  spore-forming 91–2
bait stations 205b
Bangladesh Dairy Enhancement Project (BDEP) 346
Bangladesh milk supply chain development project 346–8
  context 346–7
  insights and lessons learned 347–8
  project 347
barcode scanning 426
Bauman, Howard 6
benzene 23t
best practice programmes 158
biodiesel 47
biofuels 46–7, 78
biological hazards 84–99. See also chemical hazards; physical hazards
  bacterial pathogens 91–4
  consumer food safety 356, 359
  epidemiological data 84–6
  foodborne illnesses 86–91
  morbidity statistics 84–6
  parasitic worms 98
  prions 96–8
  process control of 130–43
  destruction of microorganisms 130–7
  prevention of contamination 140–3
  prevention of microbial growth 137–40
  protozoan parasites 98
  viral pathogens 94–6
  zoonoses 98–9
biosecurity 98–9, 155
bird control 204b
blast chilling 424t
blue crab meat 131t
blue water 44
bottled water, contamination of 23t
Botulinum toxin 24t
botulism 85t, 86
  See also Clostridium botulinum
bovine spongiform encephalopathy (BSE) 97–8, 327
  case study 318–19
brand, protection of 16
Brazil
  food trade 40t
  labour cost in 42t
breakfast cereal, contamination of 23t
British Retail Consortium Global Standard for Food Safety 56, 293
brittle plastic 145
business continuity planning 60
C
Cadbury 298
cadmium 104
cafés, owner-led 381–3
cake mixes 4
calibration records 286
Campylobacter jejuni 90t, 93, 138t
Campylobacter spp. 31, 85t, 356
Canada, food trade 40t
canning industry 7
canning processes 134
canteloup 26t, 27
caramel-coated apples 26t
carbon dioxide 115, 140
Cargill Inc. 61
Carrefour 56
carrot juice, contamination of 24t
case studies
  allergen food safety 366–9
  Bangladesh food safety 366–9
  Bangladesh milk supply chain development project 346–8
  BSE 318–19
Kenya Development Project:  
International Water and Health Alliance (IWHA) 349–53  
microbiological food safety (fictional) 364–5  
prepared meals 417–37  
envisaged consumer misuse 418  
HACCP control chart 436–7t  
HACCP modules 420f  
HACCP plan 417  
HACCP review 419  
HACCP team 417  
hazard analysis 428–35  
hazard analysis procedure 419  
intended consumer use 418  
prerequisites 418–19  
product description 418  
scope 417  
terms of reference 417  
Quality Egg 325–6  
Red Tractor 320, 321–4b  
Rwanda dairy development projects 342–6  
Sri Lanka hygiene and management systems development projects 332–41  
celebrity chefs 383–5  
culinary student attitudes toward 384b  
Centers for Disease Control (CDC) 55, 85  
cereal, contamination of 23t  
certificates of analysis (CoAs) 31  
chain characteristics 325  
challenge testing 118–21  
Chartered Institute of Environmental Health  
CIEH National Guidance for Outdoor and Mobile Catering 385  
chemical agents 125t  
chemical disinfectants 135  
chemical food preservatives 111–15  
carbon dioxide 115  
essential oils 115  
nisin 115  
organic acids 111–14  
sodium nitrite 114–15  
sulphur compounds 114  
chemical hazards 99–105. See also biological hazards; physical hazards  
allergens 99–100  
consumer food safety 356, 360  
in food packaging materials 104  
in food processing 104  
hazard analysis 241  
heavy metals 103–4  
marine foodborne toxins 101  
mycotoxins 100–1  
overview 66  
potential 104–5  
process control of 143–4  
allergen control 143–4  
cleaning chemicals 144  
maintenance chemicals 144  
sanitation chemicals 144  
white powder control 144  
China 42  
food exports 39  
food trade 40t  
labour cost in 42t  
chocolate, contamination of 24t, 298  
CIES 56  
ciguatera poisoning 101  
citizens 316  
Claviceps purpurea 100  
cleaning 190, 359–60  
cleaning chemicals 144  
cleaning-in-place 201b  
cleaning programmes 199–203. See also prerequisite programmes  
appropriate methods 200b  
audit/assessment 203b  
cleaning-in-place programmes 201b  
drain and janitorial cleaning 201b  
equipment and chemicals 201–2b  
risk evaluation 200b  
sanitary design 199b  
schedules and procedures 200–1b  
training 203b  
validation 202b  
verification 202b  
operators 203b  
climate change 44, 78, 387  
closed questions 291
Index

Clostridium botulinum 43, 64, 90, 92, 356
canned food contamination 7
challenge testing 120–1
growth limits 91t
growth temperature 138t
oxidation–reduction potential and 118
spores 134
symptoms of contamination 89t
thermal property values 133t
Clostridium perfringens 64–5, 88t, 90, 92, 133t, 138t, 356
Clostridium sporogenes 133t
coconut processor 339–40
Codex Alimentarius Commission
Committee on Food Hygiene (Codex) 8, 9, 55, 75, 158
Codex General Principles of Food Hygiene 289–94
Codex General Standard for the Labelling of Prepackaged Goods 209
Codex logic sequence 228–57. See also HACCP plan
corrective actions 255
critical control points 249–52
critical limits 252
documentation and record-keeping 257
HACCP teams 230–2
hazard identification and analysis 238–49
intended use identification 233–4
monitoring system for CCPs 252–4
on-site confirmation of flow diagram 237–8
overview 228–9
process flow diagram 234–6, 236–7, 238–40f
product/process descriptions 232–3
scope 230, 231t
terms of reference 230, 231t
verification procedures 255–6
Colilert test 350
Commission on Microbiological Criteria for Foods 8
consultants 21
consulting organisations 442
consumer awareness 207–9
consumer education 360–1
consumer food safety 355–69
case studies
allergen food safety 366–9
microbiological food safety (fictional) 364–5
consumer education 360–1
control measures 358–60
heating (cooking) 358–9
refrigeration 358
safe water and raw materials 357–8
separation, cleaning, sanitation, and personal hygiene 359–60
good consumer practices (GCPs) 361–2, 362–4t
potential CCPs and preventive controls (PCs) in the home 360
potential hazards 356–7
consumers 35–6, 316
shopping habits 49
contamination 140–3, 359
economically motivated 27, 39, 64, 66, 265, 266, 279
from foreign materials 145
major food incidents 23–5t
prevention of 130, 140–3
allergenic ingredient control 141
aqueous ingredient control 141–2
high-risk ingredient control 140–1
moisture control 142–3
sanitary design and sanitation 142
continuous improvement programmes 158–9, 173–4
control measures 65, 240, 248–9
consumer food safety 358–60
corporate offices 71
corrective actions 183–5, 255
costs 16
of appraisal 16f
of failure 16f
misconceptions 18–19
counterfeiting 54
Coxiella burnetii 131
Creutzfeldt–Jakob disease (CJD) 90, 97
variant 97–8, 318
crisis management 33
critical control points (CCPs) 249–52, 328
See also Codex Alimentarius
Commission Committee on Food Hygiene (Code); Codex logic sequence
critical limits 252
decision record 251
decision tree 249
farm-to-table HACCP and 11
hazard analysis/determination of 28, 249–52
in the home 360
management systems 261–2
monitoring system 252–4
critical limits 28–9
Cronobacter 87
Cronobacter sakazakii 94
cross-contamination 71, 357, 359
Cryptosporidium 65, 85
Cryptosporidium parvum 98
culture 388–9
See also food safety culture
customer complaint records 286
customer offices 71
cyanuric acid 53, 105
Cyclospora 65, 85
Cyclospora cayetanensis 90, 98
dairy-based curd 334–6
defective units 4, 5
Defined Substrate Technology (DST) 350
deli meats, contamination of 24
deoxynivalenol 100, 125
Department of Health and Human Services 55
detection techniques 147
developing markets 331–54
assignees, keypoints learned 348–9
case studies
Bangladesh milk supply chain development project 346–8
Kenya Development Project:
International Water and Health Alliance (IWHA) 349–53
Rwanda dairy development projects 342–6
Sri Lanka hygiene and management systems development projects 332–41
diarrhoetic shellfish poisoning 101
diethylene glycol 52
dioxins 103
Diphyllobothrium latum 99
dipstick test 144
documentation 173
of HACCP system 257
misconceptions 19
operational control 198
domoic acid poisoning 101
drains 201

dried cake mixes 4
dried ingredients 4
dried milk powder, contamination of 25

dry cleaning 202
dry heat processes 134
due diligence 320, 328
Dutch HACCP Code 293–4
economically motivated
contamination/adulteration 27, 39, 64, 66, 265, 266, 279
education 71–2, 73f
resources 61
eggs, Salmonella contamination 4
electric insect killers 51, 205
emerging economies 42–3
emerging issues 61
employees, commitment of 29–30
end product testing 79
enforcement 76–7
Entamoeba histolytica 98
tenterotoxins 87
environmental hygiene 190
environmental management plans 332–4
environmental surveillance programmes 202
enzyme-linked immunosorbent assay (ELISA) 144
epidemiology 84–6
equilibrium relative humidity 108
equipment 193
ergot 125
<table>
<thead>
<tr>
<th>Term</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ergotism</td>
<td>100</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>10, 131t, 298</td>
</tr>
<tr>
<td>faecal contamination of water and disease</td>
<td>349–50, 350b</td>
</tr>
<tr>
<td>Shiga toxin-producing</td>
<td>85t</td>
</tr>
<tr>
<td>testing in water</td>
<td>351–2</td>
</tr>
<tr>
<td>E. coli 026</td>
<td>26t</td>
</tr>
<tr>
<td>E. coli 0104:H4</td>
<td>26t</td>
</tr>
<tr>
<td>E. coli 0157:H7</td>
<td>26t, 27, 31, 61, 74, 80, 78t, 90, 93, 125t, 131t, 138t, 356</td>
</tr>
<tr>
<td>essential management practices</td>
<td>157–8</td>
</tr>
<tr>
<td>essential oils</td>
<td>115</td>
</tr>
<tr>
<td>ethanol</td>
<td>47</td>
</tr>
<tr>
<td>Europe, food trade</td>
<td>40t</td>
</tr>
<tr>
<td>European Union</td>
<td></td>
</tr>
<tr>
<td>food trade</td>
<td>40t</td>
</tr>
<tr>
<td>labour cost in</td>
<td>42t</td>
</tr>
<tr>
<td>exclusion techniques</td>
<td>145–6</td>
</tr>
<tr>
<td>experimental design and analysis</td>
<td>118–23</td>
</tr>
<tr>
<td>accelerated shelf life testing</td>
<td>121–2</td>
</tr>
<tr>
<td>challenge testing</td>
<td>118–21</td>
</tr>
<tr>
<td>mathematical modelling</td>
<td>122–3</td>
</tr>
<tr>
<td>predictive microbiology</td>
<td>122–3</td>
</tr>
<tr>
<td>theory vs. reality</td>
<td>123</td>
</tr>
<tr>
<td>experts</td>
<td>37</td>
</tr>
<tr>
<td>external cost of failure</td>
<td>16f</td>
</tr>
<tr>
<td>facilities</td>
<td>194</td>
</tr>
<tr>
<td>failure modes and effects analysis</td>
<td>5–6</td>
</tr>
<tr>
<td>Farina (baby food)</td>
<td>6</td>
</tr>
<tr>
<td>farm-to-table HACCP</td>
<td>20</td>
</tr>
<tr>
<td>fermented milk processor</td>
<td>343–4</td>
</tr>
<tr>
<td>festivals</td>
<td>385–6</td>
</tr>
<tr>
<td>filtration</td>
<td>135</td>
</tr>
<tr>
<td>fine-dining</td>
<td>383–5</td>
</tr>
<tr>
<td>finfish poisoning</td>
<td>101</td>
</tr>
<tr>
<td>fish allergen</td>
<td>25t</td>
</tr>
<tr>
<td>flexible intermediate bulk container (FIBC)</td>
<td>336</td>
</tr>
<tr>
<td>industry</td>
<td></td>
</tr>
<tr>
<td>Food and Agriculture Organisatiion (FAO)</td>
<td>9, 75, 316, 375</td>
</tr>
<tr>
<td>Egg Safety Rule</td>
<td>325</td>
</tr>
<tr>
<td>Food and Drug Administration (FDA)</td>
<td>7, 52</td>
</tr>
<tr>
<td>Food Business Forum</td>
<td>56</td>
</tr>
<tr>
<td>food commodity trade</td>
<td>40t</td>
</tr>
<tr>
<td>food defence</td>
<td>154, 156–7, 182, 316</td>
</tr>
<tr>
<td>food distribution</td>
<td>49</td>
</tr>
<tr>
<td>food fraud</td>
<td>51–2, 155, 316</td>
</tr>
<tr>
<td>prevention</td>
<td>156–7, 182</td>
</tr>
<tr>
<td>food incidents</td>
<td>23–6t</td>
</tr>
<tr>
<td>food poisoning</td>
<td>86</td>
</tr>
<tr>
<td>food preservatives</td>
<td>111–15</td>
</tr>
<tr>
<td>carbon dioxide</td>
<td>115</td>
</tr>
<tr>
<td>essential oils</td>
<td>115</td>
</tr>
<tr>
<td>nisin</td>
<td>115</td>
</tr>
<tr>
<td>organic acids</td>
<td>111–14</td>
</tr>
<tr>
<td>sodium nitrite</td>
<td>114–15</td>
</tr>
<tr>
<td>sulphur compounds</td>
<td>114</td>
</tr>
<tr>
<td>food protection</td>
<td>153–4</td>
</tr>
<tr>
<td>Food Protection Organization (FPO)</td>
<td>75</td>
</tr>
<tr>
<td>food quality</td>
<td>315–16, 317</td>
</tr>
<tr>
<td>food safety culture</td>
<td>74, 155, 158, 174–5, 297–31</td>
</tr>
<tr>
<td>assumptions</td>
<td>297–8</td>
</tr>
<tr>
<td>definition</td>
<td>298, 299t</td>
</tr>
<tr>
<td>dimensions of</td>
<td>300</td>
</tr>
<tr>
<td>maturity</td>
<td></td>
</tr>
<tr>
<td>evaluation</td>
<td>303</td>
</tr>
<tr>
<td>map to</td>
<td>303</td>
</tr>
<tr>
<td>model</td>
<td>304–6t</td>
</tr>
<tr>
<td>tactics</td>
<td>309–10, 309t, 310f</td>
</tr>
<tr>
<td>organisational culture and</td>
<td>302–3, 302f</td>
</tr>
<tr>
<td>supply chain</td>
<td>298–300, 299f, 300–2, 301t</td>
</tr>
<tr>
<td>food safety events</td>
<td>22–7</td>
</tr>
<tr>
<td>food safety hazards</td>
<td>83–106</td>
</tr>
<tr>
<td>biological hazards</td>
<td>84–99</td>
</tr>
<tr>
<td>bacterial pathogens</td>
<td>91–4</td>
</tr>
<tr>
<td>consumer food safety</td>
<td>356, 359</td>
</tr>
<tr>
<td>epidemiological data</td>
<td>84–6</td>
</tr>
<tr>
<td>foodborne illnesses</td>
<td>86–91</td>
</tr>
<tr>
<td>morbidity statistics</td>
<td>84–6</td>
</tr>
<tr>
<td>parasitic worms</td>
<td>98</td>
</tr>
<tr>
<td>prions</td>
<td>96–8</td>
</tr>
<tr>
<td>process control of</td>
<td>130–43</td>
</tr>
<tr>
<td>protozoan parasites</td>
<td>98</td>
</tr>
<tr>
<td>viral pathogens</td>
<td>94–6</td>
</tr>
<tr>
<td>zoonoses</td>
<td>98–9</td>
</tr>
<tr>
<td>chemical hazards</td>
<td>99–105</td>
</tr>
<tr>
<td>allergens</td>
<td>99–100</td>
</tr>
<tr>
<td>consumer food safety</td>
<td>356, 360</td>
</tr>
<tr>
<td>in food packaging materials</td>
<td>104</td>
</tr>
</tbody>
</table>
in food processing 104
hazard analysis 241
heavy metals 103–4
marine foodborne toxins 101
mycotoxins 100–1
overview 66
potential 104–5
process control of 143–4
definition of 83
exceptions 83–4
physical hazards 105–6
consumer food safety 356
hazard analysis 241
injuries associated with 106
process control of 145–7
sources of foreign material 105–6
food safety issues 64–6
allergens 65–6
antibiotic-resistant pathogens 65
changes in pathogen distribution 65
chemical hazards 66
control measures 65
economically motivated contamination
66
emerging pathogens 64–5
physical hazards 66
food safety management 68–78
additions to prerequisite programmes 70
HACCP preliminary steps and principles
68–70
history of 3–5
human factor 70–4
mistakes in 28–30
food safety management system 319
food safety maturity
evaluation 303–7
multiple methods 307–8, 308t
map to 303
model 304–6t
tactics 309–10, 309t, 310f
food safety objectives (FSOs) 78
food safety professionals, availability of 73
food safety programme 151–86
continuous improvement of 160
corrective actions 183–5
definition of 152
elements of 164f
essential management practices 157–8, 165–74
assignment of roles and responsibilities 166
continuous improvement programmes 173–4
documentation 173
management commitment 165–6
resource management 172–3
supplier/customer partnership 173
training and education 166–72
food safety culture 158, 174–5
fundamental elements of 152–3, 152f, 155–7
food defence 156–7
food fraud 156–7
HACCP 156
prerequisite programmes 156
safe product/process design 155–6
in global food supply chain 159–60
overview 151–2
preparation activities 175–83
gap assessment 176–83
HACCP programme restructuring 176
project plan 175–6
food safety programme, supporting
elements 157–8
food safety programme maintenance 283–95
audit 289–94
auditor 290–2
certification schemes 293–4
checklist 292, 292t
definitions 289–90
external 293–4
skills 290–2
elements of 283–4, 284f
HACCP system elements 286–8
maintenance activities 287–8
verification activities 286
incident management 294
prerequisite programme elements 285
responsibility for 285
food safety 153
food safety risk 329
food security 154–5
Food Standards Agency 355
food supply chain 298, 299f, 300–2, 301t
t
food traceability systems 57
food vans/trucks 385–6
food waste 47–8
  reduction 58
Foodborne Diseases Active Surveillance
  Network (FoodNet) 55, 84
foodborne illnesses 4
  characteristics of 86–91
    emerging pathogens 89–91
    incubation period 88
    infectious dose 88
    principal types 89
    sources of pathogens 89
    symptoms 88
    toxic dose 88
  epidemiology and morbidity statistics
    84–6
  predisposition to illness 87–8
  statistics 84–6
  types of illness 86–7
  under-reporting of 89
foodservice 371–86
  fine-dining, star ratings, and celebrity
    chefs 383–5
  institutional catering 380, 381f
  landscape mapping 372–6, 373–4t
  mobile foodservice: market stall, food
    vans/trucks, festivals, and pop-up
    facilities 385–6
  owner-led restaurants, cafes, and snack
    bars 381–3
  quick-service restaurants 376–9
    challenges in 376–7
    ongoing control in 378–9, 378–9b
    strong-evidence outbreaks 372f
  foodservice establishments 34
  foot and mouth disease (FMD) 96
  foreign material, control of 147
  fossil fuels 45
  fresh water supply 44
  frozen meals, contamination of 25t
  frozen meat, first cargo of 41
  fruits 40t
    imports 39
fugu poisoning 101
fumonisn 100–1, 125t
fungicides 103
Fusarium 100
g
Gambier discus toxicus 101
gap assessment 176–83
  food defence 182
  food fraud prevention 182
  human resource 183
  management commitment 182–3
  world-class food safety programme
    176–83
  HACCP programme 181–2
  prerequisite programme 177–82
  safe product design 176–7
  genetically modified foods 101–2
GFSI Guidance Document 56
Giardia lamblia 98t
glass contamination, control of 145
global food safety assurance 74–8
  combined approach 77–8
  enforcement 76–7
  oversight and harmonisation 74–6
global food safety audit standards 56
Global Food Safety Initiative (GFSI) 56,
  74, 182, 293
  global food safety resources 439–42
    academic institutions 441
    consulting organisations 442
    governmental organisations 439–40
    intergovernmental organisations 439
    laboratories 442
    nongovernmental organisations 440
    professional associations 441
    public–private partnerships (PPPs) 440
    trade associations 440–1
Global Food Traceability Centre (GFTC) 57
  global food traceability systems 57
  Global Initiative for Food Systems
    Leadership 56
global sourcing 39
global supply chain
  economic factors 41–3
    emerging economies 42–3
labour 41–2, 42t
land 41–2
environmental factors 43–7
  alternative energy sources 46–7
  arable land 43–4
  climate change 44
  fossil fuels 45
  pathogen range 43
  water availability 44–5
history 39, 41
import/export statistics 40t
social factors 47–9
  food waste 47–8
  human overpopulation 47
  immunocompromised people 48
  living standards 48–9
  retailing and consumer shopping habits 49
  year-round sourcing 48
world-class food safety programme 159–60
global trade
  food safety issues in 49–55
  audit requirements 54–5
  regulations and requirements 52–4
GlobalGAP 315, 316, 319, 329
good agricultural practices (GAPs) 319, 361
good consumer practices (GCPs) 361–2, 362–4t
good hygienic practices (GHPs) 361
Good Manufacturing Practices (GMPs) 51, 361
government 33
government communications systems 55–6
government offices 71
governmental organisations 439–40
Great Depression 3
Grocerant 388
groundwater 44
Gymnodinium breve 101

H
H1N1 influenza 43
H5N1 influenza 43

HACCP
  applying through food supply chain 30–2
  barriers to effective use 20–2
  benefits of 15–18
  costs of 16
  future of 12–13
  implementation 257–64
    action planning 259
    CCP management systems 261–2
    handover to operations staff 263
    mistakes in 28–30
    project Gantt chart 260f
    required activities 262–3
    stages 163
    steps 258f
    training 259–61
  updates and changes to existing systems 263–4
  validated HACCP plan 258–9
  verification of 263
  misconceptions 18–20
modules. See HACCP modules
origin and evolution of 5–11
plan. See HACCP plan
preliminary steps and principles 68–70
prerequisite programmes 11
principles 8–9, 157t, 226, 227t
reasons for failure 22–30
  implementation mistakes 28–30
  lessons from food safety events 21–7
  mismanagement of food safety programmes 28–30
regulatory developments in the USA 11–12
roles and responsibilities 32–7
  academia 35
  advocacy and pressure groups 36–7
  consumers 35–6
  foodservice establishments 34
  government 33
  industry 33
  influencers and experts 37
  media 36
  retailers 34
  trade and professional associations 34–5
HACCP (contd.)
rules 9
significant events 7t
teams 230–2
HACCP modules 420f
combining and mixing component
meals 425f
cooking/cooling 424f
decant/batch weigh-in/pre-preparation 422f
flow diagram 382f
goods receipt 421f
materials storage 421f
packaging/decant/unwrap 423f
secondary and tertiary packaging 426f
storage and dispatch 427f
HACCP plan 18, 225–64
application process 228, 229f
Codex logic sequence 228–57
corrective actions 255
critical control points 249–52
critical limits 252
documentation and record-keeping 257
HACCP teams 230–2
hazard identification and analysis 238–49
intended use identification 233–4
monitoring system for CCPs 252–4
on-site confirmation of flow diagram 237–8
overview 228–9
process flow diagram 234–6, 236–7, 238–40f
product/process descriptions 232–3
scope 230, 231t
terms of reference 230, 231t
verification procedures 255–6
core plan 226
documenting study and plan development 228
support documentation 227
validated 256
HACCP records 286
haemolytic-uremic syndrome 85t
handling 190

Hazard Analysis and Critical Control
Points. See HACCP
hazard analysis 79–80, 239
chart headings 242t
questionnaires 246–8t
hazard 239
hazards 83–106
biological 84–99
bacterial pathogens 91–4
consumer food safety 356, 359
epidemiological data 84–6
foodborne illnesses 86–91
morbidity statistics 84–6
parasitic worms 98
prions 96–8
process control of 130–43
protozoan parasites 98
viral pathogens 94–6
zoonoses 98–9
chemical 99–105
allergens 99–100
consumer food safety 356, 360
in food packaging materials 104
in food processing 104
hazard analysis 241
heavy metals 103–4
marine foodborne toxins 101
mycotoxins 100–1
overview 66
potential 104–5
process control of 143–4
physical 105–6
consumer food safety 356
control of 145–7
hazard analysis 241
injuries associated with 106
sources foreign material 105–6
risk evaluation 243
significance assessment 242–8
significance assessment table 243t
hazelnut yogurt, contamination of 23t
health status 206
heating (cooking) 358–9
heavy metals 103–4
arsenic 104
cadmium 104
as food safety hazard 51
Index

lead 103
mercury 103
uranium 104
hedonistic features, value of 317
Henderson–Hasselbalch equation 112
hepatitis A virus 86, 88t, 95t
hexachlorobenzene 103
high hydrostatic pressure (HHP) 136–7
high-risk ingredients 124–6, 140–1
histamine poisoning 101
home delivery 388
Home Food Safety Plan 360, 361
hot-holding 139
human resource, gap assessment 183
human resources 21
hygienic production 190
hypothetical questions 291

i
ice cream
contamination of 23t, 26t
mix, pasteurisation of 131t
processor 337–9
iceboxes 3
illnesses 207
illnesses, foodborne 4
characteristics of 86–91
emerging pathogens 89–90
incubation period 88
infectious dose 88
principal types 89
sources of pathogens 89
symptoms 88
toxic dose 88
epidemiology and morbidity statistics 84–6
predisposition to illness 87–8
statistics 84–6
types of illness 86–7
under-reporting of 89
immunocompromised people 48, 78, 87–8, 90
incident management 294
incubation period 88
India 42
food trade 40t
Indonesia, food trade 40t
Industry Council for Development 72
Industry Guide to Good Hygiene Practice: Markets and Fairs Guide 385
infections 86–7
infectious dose 88
influencers 37
influenza viruses 95
information searching 287–8
ingredients 123–6
allergenic 141
aqueous 141–2
high-risk 124–6, 140–1
novel 126
injuries 207
insect control 205b
institutional catering 380, 381f
intergovernmental organisations 439
internal cost of failure 16f
internal traps 205b
International Food Standard 56
International Register of Certificated Auditors (IRCA) 57
International Scientific Forum on Home Hygiene (IFH) 355
International Water and Health Alliance (IWHA) 349–53
intoxications 86
intrinsic control factors 107–18
chemical food preservatives 111–15
oxidation–reduction potential 115–16
pH 110–11
preservative factors 116–18
water activity 108–10
ionising radiation 136
irrigation water 44
ISO 22000:2005 211–12, 293

j
jalapeno peppers, conditions associated with 24t
janitorial cleaning 201b
Japan
food trade 40t
labour cost in 42t
Jensen Farms 298
Joint FAO/WHO Food Standards Programme 55
Index

k
Kenya, food trade 40
Kenya Development Project:  
International Water and Health Alliance (IWHA) 349–53
knowledge resources 73
kuru 96–7

l
labelling 58, 207–9
requirements 196
transportation and 196
laboratories 442
laboratory detection equipment 67
labour 41–2, 42
land 41–2
arable 43–4
use for biofuel production 78
landscape mapping 372–6, 373–4
Latin America, food retail sales in 43
lead 103
leadership 71–2
leading questions 291
learning pyramid 168, 168
liquid eggs, pasteurisation of 131
Listeria monocytogenes 62, 90, 93–4, 356
control of 10
eliminating hazards of 61
growth limits 91
growth temperature 138
in high-risk food ingredients 124, 125
identification of 28
incidence 85
major food incidents 24, 26, 27
natural habitat 90
pasteurisation and 132
in ready-to-eat foods 80
symptoms of contamination 89
thermal resistance 131
listeriosis 67, 87
living standards 48–9
local language materials 21
lot identification 207–9
low-income countries 42

m
mad cow disease 97
maintenance chemicals 144
maintenance 190, 198–206, 286–8
maize, ethanol production from 47
management commitment 29, 182–3
map to food safety maturity 303
Maple Leaf Foods 298
marine foodborne toxins 101
market stall 385–6
master sanitation schedule (MSS) 200–1
material test records 286
mathematical modelling 122–3
mechanical refrigeration 4
mechanical traps 205
media 36
megareg 9
melamine 25, 52, 53, 66, 105
mercury 103
metal contamination, control of 146–7
metal detection 426
methane 47
Mexico
food trade 40
labour cost in 42
microbial growth
effects of various factors on 116–17
prevention of 129, 137–40
freezing 138–9
hot-holding 139
modified atmosphere 139–40
refrigeration 137–8
vacuum packaging 139–40
requirements 181
microbiological criteria 54
microbiological hazards. See biological hazards
microorganisms
destruction of 130–7
non-thermal processes 135–7
thermal processes 130–4
Middle East respiratory syndrome (MERS) 95–6
milk
pasteurisation of 131
Salmonella contamination 4
milk products, contamination of 23
Index 455

milk supply chain development project, Bangladesh 346–8
mobile foodservice 385–6
modified atmosphere 139–40
moisture control 142–3
morbidity 84–6
multinational corporations (MNCs) 317, 329
Mycobacterium avium subsp. paratuberculosis 94
Mycobacterium tuberculosis 131
mycotoxins 53, 100–1, 125

n
National Advisory Committee on Microbiological Criteria for Foods 8
National Aeronautics and Space Administration (NASA) 5
National Antimicrobial Resistance Monitoring System (NARMS) 55
National Conference on Food Protection 7
National Research Council 8
newly industrialized economies (NIEs), labour cost in 42
nisin 115
non spore-forming bacterial pathogens 92–4
nongovernmental organisations 440
non-thermal processes 135–7
chemical disinfectants 135
filtration 135
high hydrostatic pressure 136–7
ionising radiation 136
pulsed electric fields 137
ultraviolet light 135–6
norovirus 95
North American, food trade 40

o
ocean shipping, relative efficiency of 48
ochratoxin 100, 125
oil reserves 45
One World One Health project 57
open questions 291
operational prerequisites 210–12
opportunist pathogens 87
organic acids 111–14
organisational characteristics 325
organisational culture 302–3, 302
out-of-place cleaning 202
overpopulation 47
owner-led restaurants, cafes, and snack bars 381–3
oxidation–reduction potential 115–16
p
packaging design 197–8
packing manufacturer 336–7
Panisello pyramids 185
para red 52
parabens 112
paralytic shellfish poisoning 101
parasitic infections 85
parasitic worms 99
Partnership for Food Safety Education 355
PAS 220:2008 293
pasteurisation 130–3
Pasteurized Milk Ordinance (PMO) 7, 130
Pathogen Modelling Program 123
pathogens 43
antibiotic-resistant 55
changes in distribution of 65
emerging 64–5
patulin 100
peak oil production 45
peanut allergies (case study) 366–9
peanut butter, contamination of 71
Penicillium spp. 100, 114
periodic review 287
perishable foods 3
persistent organic pollutants (POPs) 102–3
personal hygiene 190, 206–7, 295, 359–60
personnel practices 145
pest control 146, 203–5
bird control 204
chemicals 204
insect control 205
procedures 204–5
rodent control 205
pesticides 51, 103, 356
Petrifilm 351
pH 110–11
pheromone traps 205b
physical hazards 105–6. See also
  biological hazards; chemical hazards
consumer food safety 356
hazard analysis 241
injuries associated with 106
overview 66
process control of 145–7
  detection techniques 147
  exclusion techniques 145–6
  removal techniques 146–7
sources of foreign material 105–6
Pillsbury Company 5–8, 61
plan-do-check-act (PDCA) cycle 151, 163,
  164f
plastic contamination, control of 145
policy making 78–80
  end product testing 79
  food safety objectives 78
  hazard analysis vs. risk assessment 79–80
polychlorinated biphenyls 103
popsicles manufacturer 334–6
population 47, 78, 388
pop-up facilities 385–6
porcine epidemic diarrhoea virus 96
potato chips, contamination of 23t
poultry 31, 40t
predictive microbiology 122–3
prepared meals (case study) 417–37
  envisaged consumer misuse 418
HACCP control chart 436–7t
HACCP modules 420f
  combining and mixing component meals 425f
  cooking/cooling 424f
  decant/batch
    weigh-in/pre-preparation 422f
  goods receipt 421f
  materials storage 421f
  packaging/decant/unwrap 423f
  secondary and tertiary packaging 426f
  storage and dispatch 427f
HACCP plan 417
HACCP review 419
HACCP team 417
hazard analysis 428–35
hazard analysis procedure 419
intended consumer use 418
prerequisites 418–19
product description 418
scope 417
terms of reference 417
prerequisite programmes 156, 187–214
consumer awareness 207–9
decision tree 212f
definition 188–9
establishment 192–207
  design and layout 192–3
  equipment 193
  facilities 194
  maintenance 198–206
  personal hygiene 206–7
  sanitation 198–206
  gap assessment 176–82
HACCP and 11, 28, 29, 70
HACCP plan 18
necessity for 11
operational control 194–8
  of food hazards 194–6
  prerequisite elements 194f
operational prerequisites 210–12
overview 187–8
primary production 189–90, 190–2b
product information 207–9
risk evaluation 179–80
training 209–10
transportation 207
validation 212–13
verification 212–13
preservative factors 116–18
preservatives 111–15
  carbon dioxide 115
  essential oils 115
  nisin 115
  organic acids 111–14
  sodium nitrite 114–15
  sulphur compounds 114
pressure groups 36–7
preventive controls (PCs) in the home 360
primary production prerequisite programmes 189–90
prions 96–8
prioritisation quadrant diagram 184f
process control 129–47
  of chemical hazards 143–4
    allergen control 143–4
    cleaning chemicals 144
    maintenance chemicals 144
    sanitation chemicals 144
    white powder control 144
  of microbiological hazards 130–43
    destruction of microorganisms 130–7
    prevention of contamination 140–3
    prevention of microbial growth 137–40
  of physical hazards 145–7
    detection techniques 147
    exclusion techniques 145–6
    removal techniques 146–7
process design and control 129–47
process development 287
process flow diagrams 28
process operation module 177f
processed food trade 42t
product characteristics 325
product design 195
product development 287
product information 207–9
product quality 317
product safety 107–27
  experimental design and analysis 118–23
    accelerated shelf life testing 121–2
    challenge testing 118–21
    mathematical modelling 122–3
    predictive microbiology 122–3
    theory vs. reality 123
ingredients 123–6
intrinsic control factors 28, 107–18
  chemical food preservatives 111–15
  oxidation–reduction potential 115–16
  pH 110–11
  preservative factors 116–18
  water activity 108–10
  unintended use 126–7
product safety assessment (PSA) 215–24
  example of 219–23
process 217–18
process flow diagram 221–3, 222f
product development team 216
research staff 216
team 216–17
timing of 217
training 218–19
product test records 286
product testing 52
product/process description 232–3
production characteristics 325
professional associations 34–5, 441
propionic acid 111–12
Proteus spp. 101
protozoan parasites 98
Pseudomonas fluorescens 131t
Pseudomonas spp. 123
Pseudonitzchia 101
public health, protection of 15
publications, misleading 22
public–private partnerships (PPPs) 57–8, 440
puffer fish poisoning 101
pulsed electric fields 137
pulsed field gel electrophoresis (PGFE) 55
PulseNet 55
q
quality control 16–17
Quality Egg 327
  case study 325–6
quality management systems 158
quality, food 315–16, 317
quick-service restaurants 376–9
  challenges in 376–7
  ongoing control in 378–9, 378–9b
r
railroad, relative efficiency of 48t
Raleigh, Walter 39
raw materials, consumer safety 357–8
raw meat 31
real-time monitoring 17
recall procedures 198
record-keeping 257
records 198
red meat 40t
Red Tractor 315, 316, 319, 329
case study 320, 321–4b
refrigerated transportation 3
refrigeration 137–8, 358
mechanical 4
refusals 50t
Register of Professional Food Auditors and Mentors 57
regulatory developments, USA 11–12
regulatory obligations 17
removal techniques 146–7
renewable energy 46–7
resource management 175–83
resources 439–42
academic institutions 441
consulting organisations 442
governmental organisations 439–40
intergovernmental organisations 439
laboratories 442
misconceptions 19
nongovernmental organisations 440
professional associations 441
public–private partnerships (PPPs) 440
shared training and education 61
trade associations 440–1
use of 17
restaurants
owner-led 381–3
quick-service 376–9
retailers 34
retailing 49
review 287
rice 40t
risk
definition 328
mitigation at farm level 327–9
risk assessment 79–80, 329
robotics 67
rodent control 205b
rodenticides 356
roles and responsibilities 32–7
academia 35
advocacy and pressure groups 36–7
consumers 35–6
foodservice establishments 34
government 33
industry 33
influencers and experts 37
media 36
retailers 34
trade and professional associations 34–5
rotovirus 95t
roundworms 99t
Russia, food trade 40t
Rwanda dairy development projects 342–6
context 342
insights and lessons learned 345–6
project work and accomplishments 343
yogurt and fermented milk processor 343–4
accomplishments 344
project work 343–4
5 safe product/process design 155–6
Safe Supply of Affordable Food Everywhere Inc. 57
*Salmonella agona* 23t
*Salmonella enterica* 86
*Salmonella enteritidis* 23t, 93, 132–3, 325–6
egg contamination 325
*Salmonella montevideo* 24t
*Salmonella senftenberg* 131t
*Salmonella St. Paul* 24–25t
*Salmonella typhimurium* 25t
*Salmonella spp.* 43, 61, 92–3, 356
contamination 4, 9, 298
growth limits 91t
growth temperature 138t
hazard analysis 28
in high-risk food ingredients 124, 125t
incidence 85t
major food incidents 23t
natural habitat 90t
number of outbreaks 85t
performance standards 10t
symptoms of contamination 88t
thermal resistance 131t
salmonellosis 87
salted eggs 131t
sanitary design 142, 199b
sanitation 142, 178–9, 198–206, 359–60
chemicals 144, 202b
efficacy of 178–9
manager 203b
risk evaluation 178
schedules and procedures 200–1b
tools and equipment 201b
scombroid poisoning 101
crapie 97
separation 359–60
shellfish poisoning 101
Shigella spp. 85t, 88t, 90t, 91t, 94
snack bars 381–3
sodium nitrite 114–15
sorbic acid 111–12
South Africa, food trade 40t
South America, food trade 40t
South Korea, food trade 40t
soybeans 40t
Space Food Sticks 6, 6f
spices, contamination of 24t
spoilage 84
spore-forming bacterial pathogens 91–2
spray-dried egg albumen, pasteurisation of 131t
Sri Lanka hygiene and management systems
development projects 332–41
coconut processor 339–40
dairy (ice-cream processor) 337–9
dairy-based curd and popsicles manufacturer 334–6
environmental management plans 332–4
packing manufacturer 336–7
quality and GMP training 340–1
staphylococcal poisoning 86
Staphylococcus aureus 43, 94, 356
growth limits 91t
growth temperature 138t
in high-risk food ingredients 124, 125t
symptoms of contamination 88t
thermal resistance 131t
toxin 23t
star ratings 383–5
sterilisation 133–5
canning processes 134
dry-heat processes 134
UHT processes 134
storage 190
strategies 55–8
auditor competency 57
food waste reduction 58
global food safety audit standards 56
global food traceability systems 57
government communications systems 55–6
labelling 58
public–private partnerships 57–8
Sudan red 24t, 52
sudden acute respiratory syndrome (SARS) 95–6
sulphur compounds 114
supplier audits and approval 59–60
supplier quality assurance (SQA) 179–82
supply chain 298–300, 299f, 300–2, 301t, 387
governance 326–7
model 30f, 159f
supply quality assurance (SQA) 31
sustainability programmes 158
Sustainable Development Goals (SDGs) 351
Taco Bell 377–8b
ongoing control in 378–9b
tactical level responses 58–61. See also
food safety management
approved supplier lists 59–60
business continuity planning 60
emerging issues 61
shared training and education resources 61
supplier audits and approval 59–60
technology sharing 60–1
Taenia saginata 99t
Taenia solium 99t
tapeworms 99t
technologies 387–8
technology advancements 67–8
technology sharing 60–1
temple of food and safety 32f
Tesco 56
tetrodotoxin 101
thermal processes 130–4
  pasteurisation 130–3
  sterilisation 133–4
third-party consultants 21
Total Productive Maintenance (TMP) 159
Total Quality Management (TMQ) 158
toxic dose 88
Toxoplasma gondii 98
trade associations 34–5, 440–1
training
  additions to prerequisite programmes 70
  breakthrough learning 168–9, 168b
  cleaning programmes 203b
  desired outcomes 167
  food safety training 166–7
  HACCP implementation 259–61
  HACCP maintenance 288
  learning pyramid 168, 168f
  overview sessions 167
  in prerequisite programmes 209–10
  product safety assessment 218–19
  PRP 203b
  resources 61
  of workforce 71–2, 73f
transmissible spongiform encephalopathy (TSE) 96, 97
transportation 207
  labelling and 196
  modes, efficiency of 48t
  in primary production 190
Trichinella spiralis 99t
trichinellosis 85t
trucking, relative efficiency of 48t

U
ultra-high temperature (UHT) 133, 134
ultraviolet light 135–6
uncertainty 319–20
unintended use 126–7
United States
  energy consumption in 46
  food trade 40t
  HACCP regulatory developments 11–12

V
vacuum packaging 139–40
validation 21, 255–6
  in PRP programmes 202b, 212–13
value as food attribute 202b, 212–13
variant Creutzfeldt–Jakob disease (vCJD) 97–8, 318
vegetable juice, imports 39
vegetable oils 40t
verification 29
  activities 286
  difficulties 21
  procedures 255–6
  in PRP programmes 202b, 212–13
  review of records 286
system audit 286
Vibrio parahaemolyticus 91t, 138t
Vibrio spp. 85t, 89t, 90t, 94
Vibrio vulnificus 65
viral pathogens 94–6
Volunteers for Economic Growth
  VEGA/BIZ+ programme 332, 337–9
vomitoxin 100
vulnerability 319

W
Walmart 56
waste management 205–6
water activity 108–10
water quality
  accomplishments 351–3
  challenges in low-income countries 350–1
  consumer safety 360
  water-testing challenge in low-income countries 351
water supply 44–5
wet cleaning 202b
wheat imports and exports 40t
white powder control 144
whole genome sequencing 55
wood contamination, control of 145
world-class food safety programme 151–86
continuous improvement of 160
corrective actions 183–5
definition of 153–5
elements of 152–3, 152f
essential management practices 157, 165–74
assignment of roles and responsibilities 166
continuous improvement programmes 173–4
documentation 173
management commitment 165–6
resource management 172–3
supplier/customer partnership 173
training and education 166–72
food safety culture 158
in global food supply chain 159–60
overview 151–2
preparation activities 175–83
food defence 182
food fraud prevention 182
food safety culture 182–3
gap assessment 176–83
HACCP programme restructuring 176
management commitment 182–3
project plan 175–6
supporting elements 157–8
system elements of 152–3, 152f
food defence 156–7
food fraud 156–7
HACCP 156
prerequisite programmes 156
safe product/process design 155–6
World Health Organization 55, 56
Guide to Healthy Food Markets, A 386
World Organization for Animal Health 75
World Trade Organisation 9, 56

Y
Yersinia enterocolitica 85t, 89t, 91t, 94, 138t
yogurt 343–4
contamination of 23t

Z
zearalenone 100, 125t
zero risk 20
zoonoses 98–9