

# Contents

<b>Preface.....</b>	<b>vii</b>
<b>1 Introduction to Foodborne Pathogens .....</b>	<b>1</b>
Introduction.....	1
What is a Pathogen?.....	4
What are the Attributes of Pathogenicity? .....	4
Sources of Foodborne Pathogens .....	6
Meats, Ground Meat, and Organ Meats .....	6
Vacuum Packaged Meats .....	7
Poultry.....	7
Seafoods .....	7
Fruits and Vegetables .....	8
Dairy Products .....	8
Delicatessen Foods.....	9
Foodborne Pathogen Statistics and Socioeconomic Impact .....	9
Why High Incidence of Foodborne Outbreaks? .....	11
Surveillance and Reporting.....	12
Changes in the Agricultural Practices and the Food Manufacturing .....	12
Changes in Consumer Habits.....	14
Increased At-Risk Populations.....	14
Improved Detection Methods and Tracking of Pathogens.....	14
Emerging Pathogens with Improved Survivability in Stressed Conditions.....	15
Summary .....	15
Further Readings .....	16
<b>2 Biology of Microbes Associated with Food .....</b>	<b>17</b>
Introduction.....	17
Bacteria .....	17
Gram-Positive Bacteria .....	19
Cell Wall and Peptidoglycan.....	19
Teichoic Acid and Lipoteichoic Acid .....	21
Cytoplasmic Membrane .....	21

Gram-Negative Bacteria.....	21
Outer Membrane .....	21
Peptidoglycan.....	22
Periplasmic Space .....	23
Protein Secretion Systems.....	23
Accessory Structures in Gram-Positive and Gram-Negative Bacteria.....	23
Endospore Formation.....	24
Diseases Caused by Viruses.....	26
Introduction.....	26
Significance of Viral Infection .....	28
Sources and Transmission.....	28
Virus Classification/Taxonomy .....	28
Structure .....	28
Adenovirus.....	29
Astrovirus.....	29
Rotavirus .....	29
Polio .....	30
Hepatitis A Virus.....	30
Norovirus .....	32
Bird-Flu Virus .....	33
Bovine Spongiform Encephalopathy .....	35
Prevention and Control of Foodborne Viruses.....	36
Diseases Caused by Parasites.....	37
Characteristics.....	37
Protozoa .....	37
Flat Worm (Tapeworm).....	41
Round Worm .....	42
Diseases Caused by Mycotoxins.....	42
Characteristics.....	42
Aflatoxin .....	44
Ochratoxin.....	45
Fumonosins .....	45
Tricothecenes .....	45
Patulin .....	46
Penicillic Acid.....	46
Zearalenone .....	46
Citrinin .....	46
Alternaria Toxin .....	46
Ergot Alkaloids .....	46
Prevention and Control of Mycotoxins .....	47
Diseases Caused by Seafood Toxins .....	47
Ciguatera Toxin.....	47
Scombroid Toxin.....	47
Saxitoxin .....	48
Summary.....	48
Further Readings .....	49

<b>3 Host Defense Against Foodborne Pathogens .....</b>	<b>51</b>
Introduction .....	51
Innate Immune Response .....	51
Adaptive Immune Response .....	52
Innate Immunity of Intestinal Tract .....	53
Skin .....	53
Mucus Membrane .....	53
Goblet Cells and Mucus .....	54
Antimicrobial Peptides .....	55
Resident Microbiota .....	56
Toll-Like Receptors .....	58
Other Components of Innate Immunity .....	59
Adaptive Immunity .....	60
Characteristics of Adaptive Immune Response .....	60
Phases of Immune Response .....	61
Tissues and Cells of Immune System .....	61
Tissues .....	61
Cells of Immune System .....	63
Cytokines .....	68
Cytokines in Natural Immunity .....	70
B-Lymphocytes .....	71
Classes of Immunoglobulins .....	73
Diversity of Antibodies .....	73
Antibody Production .....	74
Function of Antibody .....	75
Antigen .....	76
Types of Antigens .....	76
Epitope or Antigenic Determinant .....	76
Hapten .....	77
Antigen–Antibody Reaction .....	77
The Major Histocompatibility Complex .....	77
Structure of MHC .....	77
Antigen Presenting Cells .....	78
MHC-Restricted Antigen Processing and Presentation .....	80
The Complement System .....	81
The Classical Pathway .....	81
Alternative Pathway .....	83
Function of Complement .....	84
Control of Complement Activation .....	84
Immunity to Microbes .....	85
Extracellular Bacteria .....	85
Innate Immunity .....	86
Adaptive Immune Response .....	86
Evasion of Immune System by Extracellular Bacteria .....	86
Intracellular Bacteria .....	87
Innate Immunity .....	87
Adaptive Immunity .....	87
Evasion of Immune System .....	88

Immunity to Virus .....	88
Innate Immunity .....	88
Adaptive Immunity .....	89
Evasion of Immune System by Viruses .....	89
Immunity to Parasites .....	89
Innate Immunity .....	90
Adaptive Immunity .....	90
Evasion of Immune System .....	90
Summary .....	90
Further Readings .....	91
 <b>4 General Mechanism of Pathogenesis for Foodborne Pathogens.....</b>	 <b>93</b>
Introduction .....	93
Foodborne Infection .....	93
Infectious Dose .....	94
Colonization and Adhesion Factors .....	94
Invasion and Intracellular Residence .....	97
Iron Acquisition .....	100
Motility and Chemotaxis.....	100
Evasion of Immune System .....	100
Intoxication .....	101
Toxicoinfection .....	101
Toxins.....	101
Endotoxin.....	106
Genetic Regulation and Secretion Systems for Virulence Factors .....	108
Pathogenicity Islands .....	108
Protein Secretion System .....	108
Regulation of Virulence Genes .....	110
Summary .....	111
Further Readings .....	111
 <b>5 Animal and Cell Culture Models to Study Foodborne Pathogen Interaction.....</b>	 <b>113</b>
Introduction .....	113
Animal Model .....	113
Organ Culture.....	114
Ligated-Ileal Loop Assay.....	115
Embryonated-Egg Assay .....	115
Cultured Cell Lines .....	115
Measurement of Virulence .....	118
Animal Model .....	118
Cell Culture Model .....	118
Measurement of Specific Steps in Colonization and Invasion.....	121
Animal Model .....	121
Cell Culture Models .....	122
Summary .....	122
Further Readings .....	123

<b>6    <i>Staphylococcus aureus</i></b>	<b>125</b>
Introduction	125
Classification	125
Morphology	126
Cultural and Biochemical Characteristics	126
Virulence Factors	127
Food Association and Toxin Production	128
Enterotoxins	128
Molecular Regulation of Virulence Gene Expression	129
Mechanism of Pathogenesis	130
Symptoms	131
Prevention and Control	132
Detection	132
Culture Methods	132
Cytotoxicity-Based Assays	132
Nucleic Acid-Based Methods	132
Immunoassays	133
Other Rapid Methods	133
Summary	133
Further Readings	134
 <b>7    <i>Bacillus cereus</i> and <i>Bacillus anthracis</i></b>	 <b>135</b>
Introduction	135
Biology	135
Classification	136
Foods Involved	137
Toxins and Enzymes	137
Emetic Toxin	138
Enterotoxins	139
Hemolysins	140
Regulation of Toxins	140
Pathogenesis	140
Emetic Toxin	141
Diarrheagenic Toxin	141
Prevention and Control	141
Detection	142
Conventional Methods	142
Animal and Cell Culture Method	143
PCR	143
Antibody-Based Assay	144
<i>Bacillus anthracis</i>	144
Biology	144
Virulence Factors	144
Pathogenesis	146
Treatment and Prevention	146
Detection of <i>B. anthracis</i>	146
Summary	147
Further Readings	147

<b>8</b>	<b><i>Clostridium botulinum</i> and <i>Clostridium perfringens</i></b>	<b>149</b>
Introduction		149
Classification of <i>Clostridium</i> Species		149
<i>Clostridium botulinum</i>		149
Biology		149
Sources		150
Botulism		151
Mechanism of Pathogenesis		153
Symptoms		156
Prevention and Treatment		156
Detection		157
<i>Clostridium perfringens</i>		158
Biology		158
Sources		158
Toxins		158
Genetic Regulation of Virulence		160
Pathogenic Mechanism		160
Symptoms, Prevention, and Control		162
Detection		162
Summary		162
Further Readings		163
<b>9</b>	<b><i>Listeria monocytogenes</i></b>	<b>165</b>
Introduction		165
Classification		166
Biology		166
Flagella		167
Sources		168
Disease		168
Gastrointestinal Form		168
Systemic Listeriosis		169
Abortion and Neonatal Listeriosis		169
Mechanism of Pathogenesis		170
Intestinal Phase of Infection and Systemic Spread		170
Attachment and Entry		171
Internalin A		173
Internalin B		175
LAP		176
Autolysin Amidase		176
p60		176
Vip		177
Miscellaneous Adhesion Proteins		177
Lysis of Vacuole (Phagosome)		177
Listeriolysin		177
Phosphatidylinositol-Specific PLC		178
Intracellular Growth		178
Cell-to-Cell Spread		178
ActA		178
Phosphatidylcholine-Specific PLC		179

Regulation of Virulence Genes .....	179
Immunity to <i>Listeria monocytogenes</i> .....	180
Prevention and Control .....	180
Summary .....	181
Further Readings .....	182
<b>10 <i>Escherichia coli</i>.....</b>	<b>183</b>
Introduction.....	183
Sources .....	183
Classification.....	184
Serotypes.....	184
Virotypes .....	184
Enterotoxigenic <i>E. coli</i> .....	185
Virulence Factors and Pathogenesis.....	186
Enteropathogenic <i>E. coli</i> .....	188
Pathogenesis of EPEC.....	188
LEE and Regulation of Virulence Genes .....	190
Enterohemorrhagic <i>E. coli</i> .....	190
Biology.....	190
Food Association .....	191
EHEC Pathogenesis .....	191
Type III Secretion System and Delivery of Effector	
Proteins During EHEC Pathogenesis.....	193
Inflammation .....	195
Enterohemolysin .....	195
Other Virulence Factors .....	195
Regulation of Virulence Genes .....	196
Symptoms and Complications .....	196
Enteroaggregative <i>E. coli</i> .....	196
Characteristics.....	196
Adhesion Factors .....	196
Toxins.....	197
EAEC Pathogenesis .....	197
Symptoms and Diagnosis.....	197
Enteroinvasive <i>E. coli</i> .....	197
Characteristics.....	197
Disease and Symptoms .....	197
Diffusely Adhering <i>E. coli</i> .....	198
Animal and Cell Culture Model Used for Diagnosis of <i>E. coli</i> .....	198
Control and Prevention of <i>E. coli</i> -Mediated Diarrhea .....	198
Summary .....	199
Further Readings.....	200
<b>11 <i>Salmonella enterica</i>.....</b>	<b>201</b>
Introduction.....	201
Biology.....	201
Source and Transmission .....	202
Classification.....	202
Major Groups .....	203

Pathogenic Mechanism .....	203
Gastroenteritis .....	203
Pathogenicity Islands .....	205
SPI-1 .....	205
SPI-2 .....	206
SPI-3 .....	206
SPI-4 .....	206
SPI-5 .....	206
SPI-6 .....	206
SPI-7 or Major Pathogenicity Island (MPI) .....	206
SPI-8 .....	206
SPI-9 .....	207
SPI-10 .....	207
Salmonella Genomic Island-1 (SGI-1) .....	207
High Pathogenicity Island (HPI) .....	207
Type III Secretion System .....	207
Adhesion and Colonization .....	207
Invasion and Intracellular Growth .....	208
Phagocytosis by M-Cells .....	208
Phagocytosis by Dendritic Cells .....	208
Induced Phagocytosis .....	209
Survival in Phagocytes .....	211
Regulation of Virulence Genes .....	211
RpoS Regulator .....	211
ATR Response .....	212
Treatment and Prevention of Gastroenteritis .....	212
Typhoid Fever .....	212
Detection .....	214
Summary .....	214
Further Readings .....	215
 <b>12 <i>Campylobacter</i> and <i>Arcobacter</i> .....</b>	<b>217</b>
<i>Campylobacter</i> .....	217
Introduction .....	217
Biology .....	218
Classification .....	219
Sources .....	219
Antibiotic Resistance .....	219
Disease .....	220
Mechanism of Pathogenesis .....	220
Regulation of Virulence Genes .....	222
Symptoms .....	222
<i>Arcobacter</i> .....	222
Prevention and Control .....	223
Detection of <i>Campylobacter</i> and <i>Arcobacter</i> .....	224
Summary .....	224
Further Readings .....	225



<b>13</b>	<b><i>Yersinia enterocolitica</i> and <i>Yersinia pestis</i></b>	<b>227</b>
Introduction		227
<i>Yersinia enterocolitica</i>		228
Biology		228
Classification		228
Sources		228
Virulence Factors		229
Chromosome-Linked Virulence Gene Products		229
Plasmid (pVY)-Linked Virulence Gene Products		231
Type III Secretion System		232
Pathogenic Mechanism		232
Symptoms		234
Prevention and Control		235
Detection		235
<i>Yersinia pestis</i>		236
Introduction		236
Biology		237
Pathogenesis		237
Treatment and Prevention		238
Detection of <i>Y. pestis</i>		238
Summary		238
Further Readings		239
<b>14</b>	<b><i>Vibrio cholerae</i>, <i>V. parahaemolyticus</i>,     <i>V. vulnificus</i></b>	<b>241</b>
Introduction		241
Classification		241
Biology		241
Source and Transmission		242
<i>Vibrio cholerae</i>		242
Introduction		242
Biology		242
Gastroenteritis		243
Pathogenic Mechanism		244
Cholera Toxin		244
Other Toxins		245
Immune Response to CT		246
<i>Vibrio parahaemolyticus</i>		246
Biology		246
Pathogenesis		247
Toxins		247
<i>Vibrio vulnificus</i>		248
Introduction		248
Pathogenic Mechanism		248
Acquisition of Iron		248
Flagella and Motility		249
Hemolysin		249
Metalloprotease		249

Septicemia.....	249
Wound Infection.....	250
Control and Prevention of Infection by <i>Vibrio</i> species .....	250
Detection of <i>Vibrio</i> species .....	251
Summary.....	251
Further Readings.....	252
 <b>15 <i>Shigella</i> species .....</b>	<b>253</b>
Introduction.....	253
Biology.....	253
Classification.....	254
Source and Transmission .....	254
Pathogenesis.....	254
Invasion .....	256
Intracellular Multiplication .....	259
Bacterial Movement: Inter- and Intracellular Spreading .....	259
Cell Death and Inflammation.....	260
Shiga Toxin and Hemolytic Uremic Syndrome .....	260
Regulation of Virulence Genes .....	261
Resistance Against Infection.....	261
Symptoms .....	262
Prevention and Control .....	262
Diagnosis and Detection .....	263
Animal and Cell Culture Models .....	263
Bacterial Culture Methods .....	263
Immunological Methods .....	263
Molecular Techniques .....	264
Summary.....	264
Further Readings .....	264
 <b>Glossary .....</b>	<b>267</b>
 <b>Index.....</b>	<b>269</b>



<http://www.springer.com/978-0-387-74536-7>

Foodborne Microbial Pathogens  
Mechanisms and Pathogenesis

Bhunia, A.

2008, XVIII, 276 p., Hardcover

ISBN: 978-0-387-74536-7