

**ADVANCES IN  
APPLIED MICROBIOLOGY**

**VOLUME 67**



# CONTENTS

## Contributors

xi

## 1. Phage Evolution and Ecology

Stephen T. Abedon

I. Introduction	2
II. Bacteriophage Types	4
III. Phage Ecology	6
A. Phage organismal and population ecology	8
B. Phage community ecology	8
C. Phage ecosystem ecology	8
IV. Phage Evolutionary Biology	9
A. Microevolution versus macroevolution	9
B. Fitness and natural selection	11
C. Mutation	13
D. Genetic drift	18
E. Migration (Intragression)	18
F. Recombination	19
V. Phage Evolutionary Ecology	21
A. Life history evolution	21
B. Adsorption	22
C. Infection, prereproductive period	24
D. Infection, reproductive period	25
E. Burst	26
VI. Phage Genome Evolution	27
A. Horizontal gene transfer	27
B. Genomics and mosaicism	29
C. “All the world’s a phage”	34
VII. Concluding Remarks	35
References	35

## 2. Nucleoid-Associated Proteins and Bacterial Physiology

Charles J. Dorman

I. Introduction	48
II. The Multifunctional Fis Protein	50

III. The Fis Protein and Bacterial Physiology	51
IV. The Characteristic Expression Pattern of Fis	52
V. Fis and the Global Transcription Pattern	55
VI. The H-NS Protein, a Universal Repressor	56
VII. Proteins HU and IHF	57
VIII. RpoS as a Regulatory Target of NAPs	58
IX. Perspective	59
Acknowledgments	59
References	59

### **3. Biodegradation of Pharmaceutical and Personal Care Products**

Jeanne Kagle, Abigail W. Porter, Robert W. Murdoch,  
Giomar Rivera-Cancel, and Anthony G. Hay

I. Introduction	66
II. What are PPCPs?	67
III. Human Interactions With PPCPs	68
IV. Biological Transformation of PPCPs During Wastewater Treatment	76
V. Biological Transformation of PPCPs in the Environment	85
VI. Growth on PPCPs	88
VII. Pathways for the Degradation of Selected PPCPs	91
A. Octylphenol degradation by <i>Sphingomonas</i> sp. strain PWE1	91
B. Ibuprofen degradation by <i>Sphingomonas</i> sp. strain Ibu-2	94
C. Deet degradation by <i>P. putida</i> DTB	96
VIII. Conclusions	98
References	99

### **4. Bioremediation of Cyanotoxins**

Christine Edwards and Linda A. Lawton

I. Introduction	110
II. Hepatotoxic Peptides—Microcystins and Nodularins	111
A. Persistence and biodegradation	112
B. Biodegrading bacteria	115
C. Characterization of MC-LR degradation pathway	117
D. Exploitation of microcystin-degrading bacteria	120
III. Other Toxins	122
A. Saxitoxins	122
B. Cylindrospermopsin	123
C. Anatoxin-a	125
IV. Conclusions	125
References	126

## **5. Virulence in *Cryptococcus* Species**

Hansong Ma and Robin C. May

I. <i>Cryptococcus</i> and Cryptococcosis	132
A. <i>C. neoformans</i>	135
B. <i>C. gattii</i>	136
C. Other species	138
D. Cryptococcosis	138
E. Genome sequencing project	142
II. Virulence Factors	143
A. Capsule	143
B. Melanin	146
C. Ability to grow at physiological temperature	146
D. Degradative enzymes	147
E. Mating type	148
F. Phenotypic switching	149
G. The origin and maintenance of virulence factors	150
III. Signaling Pathways Regulating Pathogenicity	152
A. cAMP-PKA	152
B. MAP kinase pathway	153
C. Ras pathway and the $\text{Ca}^{2+}$ -calcineurin pathway	154
IV. <i>Cryptococcus</i> and the Host Response	155
A. Immunocompromised host	155
B. Immunocompetent host	161
C. Conclusion	165
V. Current Understanding on How <i>Cryptococcus</i> Crosses the Blood–Brain Barrier	165
VI. Animal Models	167
VII. Perspectives	169
References	170

## **6. Molecular Networks in the Fungal Pathogen *Candida albicans***

Rebecca A. Hall, Fabien Cottier, and Fritz A. Mühlischlegel

I. Introduction	192
II. Ras1 Interrelated Networks	193
A. Mitogen-activated protein kinase signaling	193
B. Cyclic AMP-dependent PKA pathway	196
III. Carbon Dioxide Sensing	199
A. Adenylyl cyclase (Cyr1) senses environmental $\text{CO}_2$	199
B. $\text{CO}_2$ sensing: A role for carbonic anhydrase	200
IV. Quorum Sensing and its Effects on <i>C. albicans</i> Morphology	200
A. Farnesol exerts its effects through cAMP signaling cascades	201

B. Tup1p is involved in quorum sensing in <i>C. albicans</i>	203
C. Transcriptional analysis of quorum sensing in <i>C. albicans</i>	203
V. pH Regulation of Cell Morphology	204
VI. Other Pathways Affecting Morphology	205
VII. Conclusions	206
Acknowledgments	207
References	207

## **7. Temperature Sensors of Eubacteria**

Wolfgang Schumann

I. Introduction	214
II. Thermosensors	215
A. Nucleoid modulators	215
B. RNA	216
C. Proteins	217
III. Responses to Sudden Changes in the Growth Temperature	218
A. The high temperature response	221
B. The heat shock response	221
C. The low temperature response	222
D. The cold shock response	223
IV. Sensors of the HTR	223
A. Nucleoid modulators as thermosensor	224
B. RNA as thermosensor	228
C. Proteins as thermosensor	231
V. Sensors of the HSR	233
A. Molecular chaperones as thermosensors	233
B. Proteases as thermosensors	236
VI. Sensors of the LTR	237
A. RNA as thermosensor	237
B. Proteins as thermosensors	239
VII. Sensors of the CSR	241
A. RNA as sensor	242
B. Proteins as sensor	243
VIII. The Thermotactic Response	243
Acknowledgment	245
References	245

## **8. Deciphering Bacterial Flagellar Gene Regulatory Networks in the Genomic Era**

Todd G. Smith and Timothy R. Hoover

I. Introduction	258
II. Master Regulators	261

A. FlhDC	262
B. CtrA	264
C. VisNR	266
D. $\sigma^{54}$ -dependent master regulators	267
E. Other master regulators	271
III. RpoN ( $\sigma^{54}$ ) Regulators	274
A. FlbD	274
B. FleR/FlrC	278
C. FlgR	279
D. FleT	280
IV. FliA ( $\sigma^{28}$ ) and FlgM	280
A. SigD and other systems	282
V. Conclusions	284
References	284

## **9. Genetic Tools to Study Gene Expression During Bacterial Pathogen Infection**

Ansel Hsiao and Jun Zhu

I. Introduction	298
II. <i>In Vivo</i> Expression Technology	299
A. Selection by selection for complementation of auxotrophy in <i>Salmonella</i>	300
B. Antibiotic-based IVET selection for <i>ivi</i> genes	301
C. Recombinase-mediated IVET and analysis of <i>Vibrio cholerae</i> gene regulation	302
III. DFI: <i>S. typhimurium</i> Genes Induced By Low-ph and Intracellular Growth Conditions <i>In Vitro</i> and <i>In Vivo</i>	306
IV. Repression of An Anti-Colonization Factor in <i>V. cholerae</i>	308
V. Conclusion and Future Prospects	311
Acknowledgment	312
References	312

<i>Index</i>	315
<i>Contents of Previous Volumes</i>	323
<i>Color Plate Section</i>	