Stress Response in Microbiology

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Preface

Every living organism must cope with environmental changes that may represent stress situations, including elevated temperature, chemical stress or oxidative injury. Cells respond to stress stimuli through coordinated changes in gene expression, leading to the synthesis of specialized molecules that counteract the deleterious environmental insults. Bacteria and eukaryotic microorganisms are very useful for studying the stress response and its regulation as they have developed systems to constantly monitor the changing environment. One group of organisms that is subjected to dramatic environmental challenges throughout their life cycle, including large changes in temperature, availability of nutrients and exposure to host immune defenses, is the pathogenic microorganisms. For pathogenic bacteria and parasites that are transmitted from the environment (or by invertebrate vectors) to mammalian hosts, sudden changes in pH, osmotic pressure and temperature occur. Additionally, inside the body, invading microorganisms soon encounter the innate and adaptive defenses. The pathogens, as a group, have evolved a variety of mechanisms to circumvent the otherwise lethal effects of these defenses. On the other hand, pathogenic microorganisms have integrated the stress response into their life cycles, in which stress signalling pathways and the self-same stress proteins play specific functions in the differentiation programme.

Stress Response in Microbiology comprises 17 excellent chapters, each one dedicated to a particular microorganism or group of microorganisms; most of the selected organisms represent important health threats for humans. With its coverage of a broad range of model organisms, the book gives a complete overview of the stress response in both prokaryotic and eukaryotic microorganisms, providing detailed information for researchers, as well as for teachers and students in the fields of microbiology and parasitology. The chapter authors, among the best in their respective fields, have done an excellent job of synthesizing data from numerous studies and making the book a well-referenced work. Thus, we hope that this work will serve as an informative resource for researchers and students at all levels.

The first chapter provides a complete description of the cell envelope stress responses and the stress-sensing regulatory systems, mainly in Gram-negative bacteria. Chapter 2 gives an overview on the stress responses in several pathogenic species of the genus *Streptococcus*; acid, oxidative and nutritional stresses are presented here in depth. Chapter 3 is devoted to oxidative and nitrosative defenses in pathogenic *Neisseria* species. In addition, the authors have included detailed information about biologically relevant oxidants and the chemical reactions involving oxidants in biological systems that are of considerable basic scientific interest. The relationship between stress response and virulence in the food-borne pathogen *Listeria monocytogenes* is the main focus of Chapter 4. Chapter 5 focuses on current knowledge and research activity about low-temperature adaptation of the spore former and human pathogen *Bacillus cereus*. Chapter 6 gives a complete overview of the main stress response mechanisms employed by *Salmonella* for survival in nutrient-limited conditions and during osmotic and acid stress exposure. In the next chapter, devoted to *Yersinia*, the authors

review the responses of this pathogen to heat and cold shocks, encounter with macrophages and macrophage-like conditions. Also, the extracytoplasmic stress responses are covered in detail in Chapter 7. Chapter 8 describes how the stress response systems are vitally important for the vibrios to successfully establish in the host. Chapter 9 describes the function of the major stress proteins within mycobacteria, paying special attention to the interaction between the bacterial heat shock proteins and the host's cell-mediated immune response. Chapter 10 focuses on the types of stresses that mycoplasmas encounter *in vivo*, such as heat shock, oxidative stress, osmolarity shifts, hormone exposure, iron deprivation and biofilm formation. In Chapter 11, the authors describe the different mechanisms used by model yeasts *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe*, as well as the pathogenic fungus *Candida albicans*, to sense and transduce stress signals to stress-activated protein kinases pathways in response to osmotic, heat and oxidative stresses. Among eukaryotic microorganisms, one group that is subjected to dramatic environmental changes throughout their complex life cycle are the parasitic protozoa, which are the focus of the remaining chapters. Chapter 12 summarizes the current knowledge about the responses of the malaria parasite *Plasmodium falciparum* to a variety of stresses: drug treatments, changes in temperature and elevation of oxidative stress. Chapter 13 summarizes the recent findings on the *Toxoplasma gondii* stress responses and the implication of these processes in the biology and pathogenesis of this parasite. The focus of Chapter 14 is the stress response in *Leishmania*, containing a comprehensive view on the implications of the stress response in parasite survival, in cytodifferentiation and in apoptotic processes. Chapter 15 reviews the components of the *Trypanosoma cruzi* stress response with emphasis on its relevance to the parasite biology and to Chagas' disease transmission, pathogenesis and treatment. In Chapter 16, the authors have compiled the most significant molecular and biological aspects related to the mechanisms and components of the stress response of *T. brucei* to adapt and survive in the bloodstream of mammals. The final chapter, devoted to *Entamoeba histolytica*, gives special emphasis to the oxidative and nitrosative stresses experienced by this protozoan parasite.

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Jose M. Requena

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