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Oxygen Sensing : Responses and Adaption to Hypoxia ...

Reviewing research on the molecular basis of oxygen homeostasis, this text describes the changes in intracellular signalling and gene expression that lead to physiological responses to hypoxia in unicellular, invertebrate, and mammalian species. It examines O2 sensing systems in bacteria and archaea and demonstrates interrelationships among cell pr

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Abstract. This review focuses on the molecular stratagems utilized by bacteria, yeast, and mammals in their adaptation to hypoxia. Among this broad range of organisms, changes in oxygen tension appear to be sensed by heme proteins, with subsequent transfer of electrons along a signal transduction pathway which may depend on reactive oxygen species. These heme-based sensors are generally two-domain proteins.

Oxygen sensing and molecular adaptation to hypoxia

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During that time, his lab and Ratcliffe's lab independently found that the oxygen-sensing mechanism is present in all bodily tissues rather than only in the kidney, where EPO is produced. Kaelin and his lab then found that the protein VHL, named after the inherited syndrome von Hippel-Lindau's disease, was involved in controlling responses to hypoxia.

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Sep 13, 2020 low oxygen stress in plants oxygen sensing and adaptive responses to hypoxia plant cell monographs Posted By James MichenerMedia Publishing TEXT ID f98a0c99 Online PDF Ebook Epub Library oxygen sensing mechanisms are important for organisms to adapt their survival strategy when faced with low oxygen conditions these survival strategies are morphological physiological and biochemical

The underlying theme of this book is the biology of oxygen. The 22 chapters cover aspects of molecular, cellular, and integrative physiological functions. A fundamental evolutionary feature of the oxygen-consuming organism is that it developed a oxygen-sensing mechanism as apart of feedback control at the levels of molecules, organelles, organs, and systems. Oxygen sensing is partic ularly expressed in certain specific cells and tissues like peripheral chemore ceptors, erythroprotein-producing cells, and vascular smooth muscle. Apart of the book is focused on the current issues of this basic question of chemosen sing. Mitrochondria as the major site for cellular oxygen consumption is a nat ural candidate for cellular oxygen sensitivity and adaptation. A section deals with this question. A perennial question concerns chronic environment al oxy gen and the organism's response and adaptation to it. This theme runs through several chapters. Because comparative physiology often provides insight into the mechanisms of environment al adaptation, a chapter on respiration of high altitude birds has been incorporated. Obviously this book gives only glimpses of the immense field of oxygen biology. The book grew out of two meetings where these subjects were discussed. These meetings were sponsored by the American Physiological Society and the Federation of American Societies for Experimental Biology. We are grateful to the FASEB Program Committee and APS publication committee for their sup port. We owe much to Ms. Anne Miller for her editorial assistance. S. L. Philadelphia N. S . C. Cleveland R. S. F.

The appearance of photosynthetic organisms about 3 billion years ago increased the partial pressure of oxygen (PO2) in the atmosphere and enabled the evolution of organisms that use glucose and oxygen to produce ATP by oxidative phosphorylation. Hypoxia is commonly defined as the reduced availability of oxygen in the tissues produced by different causes, which include reduction of atmospheric PO2 as in high altitude, and secondary to pathological conditions such as sleep breathing and pulmonary disorders, anemia, and cardiovascular alterations leading to inadequate transport, delivery, and exchange of oxygen between capillaries and cells. Nowadays, it has been shown that hypoxia plays an important role in the genesis of several human pathologies including cardiovascular, renal, myocardial and cerebral diseases in fetal, young and adult life. Several mechanisms have evolved to maintain oxygen homeostasis. Certainly, all cells respond and adapt to hypoxia, but only a few of them can detect hypoxia and initiate a cascade of signals intended to produce a functional systemic response. In mammals, oxygen detection mechanisms have been extensively studied in erythropoietin-producing cells, chromaffin cells, bulbar and cortical neurons, pulmonary neuroepithelial cells, smooth muscle cells of pulmonary arteries, and chemoreceptor cells. While the precise mechanism underpinning oxygen, sensing is not completely known several molecular entities have been proposed as possible oxygen sensors (i.e. Hem proteins, ion channels, NADPH oxidase, mitochondrial cytochrome oxidase). Remarkably, cellular adaptation to hypoxia is mediated by the master oxygen-sensitive transcription factor, hypoxia-inducible factor-1, which can induce up-regulation of different genes to cope the cellular effects related to a decrease in oxygen levels. Short-term responses to hypoxia included mainly chemoreceptor-mediated reflex ventilatory and hemodynamic adaptations to manage the low oxygen concentration while more prolonged exposures to hypoxia can elicit more sustained physiological responses including switch from aerobic to anaerobic metabolism, vascularization, and enhancement of blood O2 carrying capacity. The focus of this research topic is to provide an up-to-date vision on the current knowledge on oxygen sensing mechanism, physiological responses to acute or chronic hypoxia and cellular/tissue/organ adaptations to hypoxic environment.

The ability of cells to sense and respond to changes in oxygenation underlies a multitude of developmental, physiological, and pathological processes. This volume provides a comprehensive compendium of experimental approaches to the study of oxygen sensing in 48 chapters that are written by leaders in their fields.

The latest in a series of books from the International Hypoxia Symposia, this volume spans reviews on key topics in hypoxia, and abstracts from poster and oral presentations. The biannual International Hypoxia Symposia are dedicated to hosting the best basic scientific and clinical minds to focus on the integrative and translational biology of hypoxia. Long before 'translational medicine' was a catchphrase, the founders of the International Hypoxia Symposia brought together basic scientists, clinicians and physiologists to live, eat, ski, innovate and collaborate in the Canadian Rockies. This collection of reviews and abstracts is divided into six sections, each covering new and important work relevant to a broad range of researchers interested in how humans adjust to hypoxia, whether on the top of Mt. Everest or in the pulmonary or cardiology clinic at low altitude. The sections include: Epigenetic Variations in Hypoxia High Altitude Adaptation Hypoxia and Sleep Hypoxia and the Brain Molecular Oxygen Sensing Physiological Responses to Hypoxia

During the last ten years, knowledge about the multitude of adaptive responses of plants to low oxygen stress has grown immensely. The oxygen sensor mechanism has been discovered, the knowledge about the interaction network of gene expression is expanding and metabolic adaptations have been described in detail. Furthermore, morphological changes were investigated and the regulative mechanisms triggered by plant hormones or reactive oxygen species have been revealed. This book provides a broad overview of all these aspects of low oxygen stress in plants. It integrates knowledge from different disciplines such as molecular biology, biochemistry, ecophysiology and agricultural / horticultural sciences to comprehensively describe how plants cope with low oxygen stress and discuss its ecological and agronomical consequences. This book is written for plant scientists, biochemists and scientists in agriculture and ecophysiology.

In this volume of Cell and Molecular Responses to Stress articles provide up-to-date information on key areas of signal sensing (sensing of pain, heat, cold, light, infrared radiation), molecules involved in the intracellular transmission of these signals, metabolic responses to stress including changes in gene expression and production of specialized proteins that aid cell responses to factors including interrupted blood supply (ischemia), oxygen limitation (hypoxia/anoxia), freezing and dehydration, amino acid limitation, radiation and processing drugs. There are chapters which also provide insights into new technologies (such as cDNA arrays), analysis of metabolic control theory (a key method for analysing stress effects on cells), and examine how enzymes evolve in the face of stress.

Hypoxic stress is a consequence of the decrease in the oxygen reaching the tissues of the body. The coupling of energy with oxygen makes low tension oxygen sensing and adaptation very essential for survival. The intracellular partial pressure of oxygen is regularly measured by a family of hydroxylase enzymes named as prolyl hydroxylase domain containing proteins (PHD). Hypoxia Inducible Factor (HIF) is the transcription factor that controls the ability of the cell to balance between adaptation and cell death during hypoxia. During normoxia, HIF1[alpha] undergoes non-reversible hydroxylation in the presence of PHD2. The hydroxylated HIF1[alpha] interacts with von Hippel-Lindua tumor suppressor protein (pVHL) and is degraded by ubiquitination. During hypoxia, PHD2 is inhibited which results in HIF-1[alpa] stabilization. Stabilized HIF-1[alpha] enters the nucleus and heterodimerizes with Hypoxia Inducible Factor-1[beta] and the dimeric transcription factor HIF-1 is formed which binds to the response elements of the target genes. HIF-regulated target genes enable cells to induce an adaptive response by increasing glycolysis; angiogenesis etc. or undergo cell death by promoting apoptosis or necrosis. In this work, a Boolean network is generated whose state transitions realize the hypoxic stress response pathway. The simulated behavior of the Boolean network obtained is consistent with the experimental results from the already published pathway literatures. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/152506

Fish form an extremely diverse group of vertebrates. At a conservative estimate at least 40% of the world's vertebrates are fish. On the one hand they are united by their adaptations to an aquatic environment and on the other they show a variety of adaptations to differing environmental conditions - often to extremes of temperature, salinity, oxygen level and water chemistry. They exhibit an array of behavioural and reproductive systems. Interesting in their own right, this suite of adaptive physiologies provides many model systems for both comparative vertebrate and human physiologists. This four volume encyclopedia covers the diversity of fish physiology in over 300 articles and provides entry level information for students and summary overviews for researchers alike. Broadly organised into four themes, articles cover Functional, Thematic, and Phylogenetic Physiology, and Fish Genomics Functional articles address the traditional aspects of fish physiology that are common to all areas of vertebrate physiology including: Reproduction, Respiration, Neural (Sensory, Central, Effector), Endocrinology, Renal, Cardiovascular, Acid-base Balance, Osmoregulation, Ionoregulation, Digestion, Metabolism, Locomotion, and so on. Thematic Physiology articles are carefully selected and fewer in number. They provide a level of integration that goes beyond the coverage in the Functional Physiology topics and include discussions of Toxicology, Air-breathing, Migrations, Temperature, Endothermy, etc. Phylogenetic Physiology articles bring together information that bridges the physiology of certain groupings of fishes where the knowledge base has a sufficient depth and breadth and include articles on Ancient Fishes, Tunas, Sharks, etc. Genomics articles describe the underlying genetic component of fish physiology and high light their suitability and use as model organisms for the study of disease, stress and physiological adaptations and reactions to external conditions. Winner of a 2011 PROSE Award Honorable Mention for Multivolume Science Reference from the Association of American Publishers The definitive encyclopedia for the field of fish physiology Three volumes which comprehensively cover the entire field in over 300 entries written by experts Detailed coverage of basic functional physiology of fishes, physiological themes in fish biology and comparative physiology amongst taxonomic Groups Describes the genomic bases of fish physiology and biology and the use of fish as model organisms in human physiological research Includes a glossary of terms

The book provides a comprehensive and up-to-date account of the information available on the morphological, physiological and evolutionary aspects of specialized cells distributed within the epithelia of the airways in the vertebrates. A lot of work has been done on the cell and molecular biology of these cells which are regarded as as oxygen recep

Bacteria in various habitats are subject to continuously changing environmental conditions, such as nutrient deprivation, heat and cold stress, UV radiation, oxidative stress, dessication, acid stress, nitrosative stress, cell envelope stress, heavy metal exposure, osmotic stress, and others. In order to survive, they have to respond to these conditions by adapting their physiology through sometimes drastic changes in gene expression. In addition they may adapt by changing their morphology, forming biofilms, fruiting bodies or spores, filaments, Viable But Not Culturable (VBNC) cells or moving away from stress compounds via chemotaxis. Changes in gene expression constitute the main component of the bacterial response to stress and environmental changes, and involve a myriad of different mechanisms, including (alternative) sigma factors, bi- or tri-component regulatory systems, small non-coding RNA's, chaperones, CHRIS-Cas systems, DNA repair, toxin-antitoxin systems, the stringent response, efflux pumps, alarmones, and modulation of the cell envelope or membranes, to name a few. Many regulatory elements are conserved in different bacteria; however there are endless variations on the theme and novel elements of gene regulation in bacteria inhabiting particular environments are constantly being discovered. Especially in (pathogenic) bacteria colonizing the human body a plethora of bacterial responses to innate stresses such as pH, reactive nitrogen and oxygen species and antibiotic stress are being described. An attempt is made to not only cover model systems but give a broad overview of the stress-responsive regulatory systems in a variety of bacteria, including medically important bacteria, where elucidation of certain aspects of these systems could lead to treatment strategies of the pathogens. Many of the regulatory systems being uncovered are specific, but there is also considerable "cross-talk" between different circuits. Stress and Environmental Regulation of Gene Expression and Adaptation in Bacteria is a comprehensive two-volume work bringing together both review and original research articles on key topics in stress and environmental control of gene expression in bacteria. Volume One contains key overview chapters, as well as content on one/two/three component regulatory systems and stress responses, sigma factors and stress responses, small non-coding RNAs and stress responses, toxin-antitoxin systems and stress responses, stringent response to stress, responses to UV irradiation, SOS and double stranded systems repair systems and stress, adaptation to both oxidative and osmotic stress, and desiccation tolerance and drought stress. Volume Two covers heat shock responses, chaperonins and stress, cold shock responses, adaptation to acid stress, nitrosative stress, and envelope stress, as well as iron homeostasis, metal resistance, quorum sensing, chemotaxis and biofilm formation, and viable but not culturable (VBNC) cells. Covering the full breadth of current stress and environmental control of gene expression studies and expanding it towards future advances in the field, these two volumes are a one-stop reference for (non) medical molecular geneticists interested in gene regulation under stress.