



Review

Regulating Death and Disease: Exploring the Roles of Metacaspases in Plants and Fungi

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Abstract: Identified over twenty years ago and distantly related to animal caspases are a group of cysteine proteases known as metacaspases. Throughout the years, much like caspase roles in metazoans, metacaspases have been shown to be involved in regulating cellular death in non-metazoan organisms. Yet, continued research on metacaspases describes these proteins as intricate and multifunctional, displaying striking diversity on distinct biological functions. In this review, we intend to describe the recent advances in our understanding of the divergence of metacaspase functionality in plants and fungi. We will dissect the duality of metacaspase activity in the context of plant-pathogen interactions, providing a unique lens from which to characterize metacaspases in the development, immunity, and stress responses of plants, and the development and virulence of fungi. Furthermore, we explore the evolutionary trajectory of fungal metacaspases to delineate their structure and function. Bridging the gap between metacaspase roles in immunity and pathogenicity of plant-pathogen interactions can enable more effective and targeted phytopathogen control efforts to increase production of globally important food crops. Therefore, the exploitation and manipulation of metacaspases in plants or fungi represent new potential avenues for developing mitigation strategies against plant pathogens.

Keywords: metacaspases; programmed cell death; plant immunity; plant pathogens; pathogenicity; fungal pathogens



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1. Introduction

Plant pathogens are responsible for devastating agricultural losses across a wide array of crops, exacerbating the burden of global food insecurity [1]. Successful plant pathogens must bypass plant defenses while plants must employ a vast range of controlled defense mechanisms to subvert potential pathogenicity [2,3]. This complex interaction entails utilizing a variety of mechanisms, such as pathogen effector proteins and host resistance genes [4]. Intriguingly, a common denominator observed in these plant-pathogen interactions is the implementation and regulation of cellular death. Plant immune responses rely on precise and regulated cell death to impede pathogen invasion while ensuring the protection of the surrounding host cells [5]. Conversely, cell death is an important aspect in the maintenance of pathogen fitness, as it enables the pathogen to effectively cause disease and circumvent defense strategies executed by the plant host [6].

Initially, the regulation of cell death was only known in metazoan organisms. It was found that programmed cell death (PCD), the precise removal of unwanted cells following specific signals, in animals was coordinated by caspases [7,8]. Caspases are proteins found within the family of cysteine proteases. Their name is derived from their composition and amino acid specificity: cysteine aspartic-specific proteases [9]. Given the highly regulated network involved in PCD, caspases are initially synthesized as zymogens, or inactive enzymes. Caspases consist of a prodomain located at the N-terminus, followed by the p20

Regulating Death

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Regulating Death:

Regulating the Body Austin Sarat, Susanna Lee, 2025-08-05 How legal regulation of the body is practiced and justified
Regulating the Body examines the practice of legal regulation of the body and how it has been justified The essays in this anthology trace the ideological moral and religious arguments for increasing the reach of regulation and authorizing punishment for infractions Bringing together leading scholars in the law and humanities this volume examines the practices and discourses used to regulate the body concentrating on scenarios where ethical and legal inconsistencies abound The regulations examined herein range from the sale of gametes parental rights over children's genetic information debates about masking discourse regarding vaccines and abortion anti transgender legislation and the control of inmates bodies on death row These are situated within a cultural and political environment that values regulation and punishment over our long standing constitutional protections At a time where rhetoric around regulation of the body is becoming increasingly incendiary Regulating the Body reveals worsening legal hypocrisies and unmasks the threats to both personal autonomy and the claims of law itself *Cell Death Regulation in Health and Disease - Part C*, 2020-04-30 Cell Death Regulation in Health and Disease Part C Volume 353 in the International Review of Cell and Molecular Biology series reviews and details current advances in cell and molecular biology The IRCMB series maintains the highest standard by publishing timely topics authored by prominent cell and molecular biologists with this release covering Developmental and seasonal regulation of neural cell death in birds Post translational modifications in cell death regulation The role of cell death in tissue regeneration and fibrosis Crosstalk between the apoptosis and autophagy signaling pathways IP3 receptor signal integration in cell death and survival decisions and more **Deaths After Police Contact** David Baker, 2016-10-18 This book investigates death after police contact in England and Wales in the twenty first century It examines how regulatory bodies construct accountability in such cases Cases of death after police contact have the potential to cause deep unease in society They highlight the unique role of the police in being legitimately able to use force whilst at the same time being expected to preserve life People who are from Black or Minority Ethnic backgrounds or have mental health issues or are dependent on substances are disproportionately more likely to die in these cases and this emphasises the sensitive nature of many of these deaths to society Deaths after Police Contact examines police legitimacy and the legitimacy of police regulators in these cases The book argues that accountability is produced by a relatively arbitrary system of regulation that investigates such deaths as individual cases rather than attempting to learn lessons from annual trends and patterns that might prevent future deaths It will be of great interest to scholars and upper level students of policing and criminal justice Turkey's Necropolitical Laboratory Banu Bargu, 2019-10-08 Building on critical and contemporary theory these essays address the multiple ways in which the Turkish regime controls its citizens through physical destruction structural violence and exposure The 12 case studies include counterinsurgency warfare enforced disappearances cemeteries monuments prisons courts and

the army Novel Plant Molecules Regulating the Interaction with Pathogenic and Beneficial Fungi Silvia Proietti,Ivan Baccelli,Richard Hickman,Antonio Leon-Reyes,Laura Bertini,2021-03-26 **Scripting Death** Mara Buchbinder,2021-04-27

How the legalization of assisted dying is changing our lives Over the past five years medical aid in dying also known as assisted suicide has expanded rapidly in the United States and is now legally available to one in five Americans This growing social and political movement heralds the possibility of a new era of choice in dying Yet very little is publicly known about how medical aid in dying laws affect ordinary citizens once they are put into practice Sociological studies of new health policies have repeatedly demonstrated that the realities often fall short of advocacy visions raising questions about how much choice and control aid in dying actually affords Scripting Death chronicles two years of ethnographic research documenting the implementation of Vermont s 2013 Patient Choice and Control at End of Life Act Author Mara Buchbinder weaves together stories collected from patients caregivers health care providers activists and legislators to illustrate how they navigate aid in dying as a new medical frontier in the aftermath of legalization Scripting Death explains how medical aid in dying works what motivates people to pursue it and ultimately why upholding the right to die is very different from ensuring access to this life ending procedure This unprecedented in depth account uses the case of assisted death as an entry point into ongoing cultural conversations about the changing landscape of death and dying in the United States **Harvard Law Review: Volume 130, Number 7 - May 2017** Harvard Law Review,2017-05-10 **Regulating the End of Life** Sue Westwood,2021-09-09 Regulating the End of Life Death Rights is a collection of cutting edge chapters on assisted dying and euthanasia written by leading authors in the field Providing an overview of current regulation on assisted dying and euthanasia both in the UK and internationally this book also addresses the associated debates on ethical moral and rights issues It considers whether just as there is a right to life there should also be a right to death especially in the context of unbearable human suffering The unintended consequences of prohibitions on assisted dying and euthanasia are explored and the argument put forward that knowing one can choose when and how one dies can be life extending rather than life limiting Key critiques from feminist and disability studies are addressed The overarching theme of the collection is that death is an embodied right which we should be entitled to exercise with appropriate safeguards as and when we choose Making a novel contribution to the debate on assisted dying this interdisciplinary book will appeal to those with relevant interests in law socio legal studies applied ethics medical ethics politics philosophy and sociology The Neurology of Religion Alasdair Coles,Joanna Collicutt,Joanna Collicutt McGrath,2019-11-07 Examines what can be learnt about the brain mechanisms underlying religious practice from studying people with neurological disorders **Mitochondria and the Future of Medicine** Lee Know,2018-02-19 From infertility to aging to cancer and neurological disease Dr Lee Know will teach you that mitochondria play a central role in much that we care about in health and disease Stephanie Seneff senior research scientist MIT and author of Toxic Legacy With information for patients and practitioners on optimizing mitochondrial function for

greater health and longevity Why do we age Why does cancer develop What s the connection between heart failure and Alzheimer s disease or infertility and hearing loss Can we extend lifespan and if so how What is the Exercise Paradox Why do antioxidant supplements sometimes do more harm than good Many will be amazed to learn that all these questions and many more can be answered by a single point of discussion mitochondria and bioenergetics In *Mitochondria and the Future of Medicine* Naturopathic Doctor Lee Know tells the epic story of mitochondria the widely misunderstood and often overlooked powerhouses of our cells The legendary saga began over two billion years ago when one bacterium entered another without being digested which would evolve to create the first mitochondrion Since then for life to exist beyond single celled bacteria it s the mitochondria that have been responsible for this life giving energy By understanding how our mitochondria work in fact it is possible to add years to our lives and life to our years Current research however has revealed a dark side many seemingly disconnected degenerative diseases have tangled roots in dysfunctional mitochondria However modern research has also endowed us with the knowledge on how to optimize its function which is of critical importance to our health and longevity Dr Know offers cutting edge information on supplementation and lifestyle changes for mitochondrial optimization and how to implement their use successfully including CoQ10 D Ribose Cannabinoids Ketogenic dietary therapy and more *Mitochondria and the Future of Medicine* is an invaluable resource for practitioners interested in mitochondrial medicine and the true roots of chronic illness and disease as well as anyone interested in optimizing their health Dr Lee Know does a brilliant job shedding light on this once ignored organelle and shows us how to care for our most important metabolic system Dr Nasha Winters co author of *The Metabolic Approach to Cancer* *The Politics of Emotion* Nuria

Silleras-Fernandez, 2024-02-15 *The Politics of Emotion* explores the intersection of powerful emotional states love melancholy grief and madness with gender and political power on the Iberian Peninsula from the Middle Ages to the early modern period Using an array of sources literary texts medical treatises and archival documents Nuria Silleras Fernandez focuses on three royal women Isabel of Portugal 1428 1496 queen consort of Castile Isabel of Aragon 1470 1498 queen consort of Portugal and Juana of Castile 1479 1555 queen of Castile and its empire Each of these women was perceived by their contemporaries as having gone mad as a result of excessive grief and all three were related to Isabel the Catholic 1451 1504 queen of Castile and a woman lauded in her time as a paragon of reason Through the lives and experiences of these royal women and the observations judgments and machinations of their families entourage and circles of writers chroniclers courtiers moralists and physicians in their orbits Silleras Fernandez addresses critical questions about how royal women in Iberia were expected to behave the affective standards to which they were held and how perceptions about their emotional states influenced the way they were able to exercise power More broadly *The Politics of Emotion* details how the court cultures in medieval and early modern Castile and Portugal contributed to the development of new notions of emotional excess and mental illness

Unraveling the Molecular Mechanisms of Cytokine Signaling in Regulating Inflammatory Diseases Wai Po Chong, Jian

Zheng,Huawei Mao,2025-04-09 Chronic and dysregulated inflammation play a significant role in the pathogenesis of autoimmune diseases and inflammatory diseases Despite the prevalence and impact of these diseases the molecular mechanisms underlying cytokine regulation in these inflammatory diseases remain poorly understood This special issue aims to address this knowledge gap by discovering the intricate network of cytokine signaling pathways in immunoregulation during inflammatory diseases By unraveling these molecular mechanisms we can gain valuable insights into the dysregulation of cytokines in immune responses This deeper understanding will enable us to identify specific molecules signaling pathways and cellular interactions that contribute to disease progression Such knowledge is crucial for the development of targeted therapeutic interventions that can restore immune balance and mitigate the detrimental effects of inflammation Moreover the elucidation of these molecular mechanisms may also provide opportunities for the discovery of novel therapeutic targets By understanding the key molecules or pathways that drive the dysregulation of cytokine signaling pathways researchers can develop innovative approaches to modulate or manipulate these targets ultimately leading to the development of more effective treatments for autoimmune and inflammatory diseases

Development of the Nervous System Dan H. Sanes,Thomas A. Reh,William A. Harris,2000-06-07 Development of the Nervous System presents a broad outline of neural development principles as exemplified by key experiments and observations from past and recent times The text is organized along a development pathway from the induction of the neural primordium to the emergence of behavior It covers all the major topics including the patterning and growth of the nervous system neuronal determination axonal navigation and targeting synapse formation and plasticity and neuronal survival and death This new text reflects the complete modernization of the field achieved through the use of model organisms and the intensive application of molecular and genetic approaches Original artist rendered drawings combined with clear concise writing make Development of the Nervous System well suited to anyone approaching this complex field for the first time Key Features Provides a synopsis of concepts and experimental strategies Includes designs of critical experiments that are easy to understand Outlines the molecular and genetic bases for many developmental events Presents new information on the function of the developing central nervous system Richly illustrated with original drawings Treats the field as an experimental rather than a descriptive science Written at a level that is appropriate for undergraduates and beyond

Theory-Based Ecology Liz Pásztor,Zoltán Botta-Dukát,Gabriella Magyar,Tamás Czárán,Géza Meszéna,2016-06-30 Ecology is in a challenging state as a scientific discipline While some theoretical ecologists are attempting to build a definition of ecology from first principles many others are questioning even the feasibility of a general and universal theory At the same time it is increasingly important that ecology is accurately and functionally defined for a generation of researchers tackling escalating environmental problems in the face of doubt and disagreement The authors of Theory Based Ecology have written a textbook that presents a robust modern and mathematically sound theory of ecology maintaining a strong link between empirical data models and theory It is

firmly based in Darwinian thought since it was Darwin who first revealed the ecological principles of the origin of species and gave the evolution of diversity a process based mechanistic explanation The authors base their synthetic theory of Darwinian ecology on seven key principles exponential growth growth regulation inherited individual differences finiteness and stochasticity competitive exclusion robust coexistence and constraints and trade offs Within this solid conceptual framework they integrate classic and actual empirical knowledge from ecology and evolutionary biology clarifying methodological and mathematical detail in clear and helpful text boxes A wealth of illustrated examples pertaining to different organisational levels alleles clones and species helps to explain how the principles operate This is an invaluable resource for graduate level students as well as professional researchers in the fields of ecology genetics evolutionary ecology and mathematical biology

Pain of the Unborn United States. Congress. House. Committee on the Judiciary. Subcommittee on the Constitution,2005 **Regulation of Adult Stem Cells Fate and Function in Natural and Artificial Microenvironments** Pavel Makarevich,Andrei S. Chagin,Yu-Chen Hu,2023-01-06 **The Free Son** Independent Order Free Sons of Israel,1917 **Advances in Botanical Research** Jean-Claude Kader,Michel Delseny,2011-12-02 Advances in Botanical Research publishes in depth and up to date reviews on a wide range of topics in plant sciences The series features a wide range of reviews by recognized experts on all aspects of plant genetics biochemistry cell biology molecular biology physiology and ecology **Advances in Botanical Research** ,2011-10-28 Edited by Jean Claude Kader and Michel Delseny and supported by an international Editorial Board Advances in Botanical Research publishes in depth and up to date reviews on a wide range of topics in plant sciences Currently in its 50th volume the series features a wide range of reviews by recognized experts on all aspects of plant genetics biochemistry cell biology molecular biology physiology and ecology This eclectic volume features six reviews on cutting edge topics of interest to postgraduates and researchers alike Multidisciplinary reviews written from a broad range of scientific perspectives For over 40 years series has enjoyed a reputation for excellence Contributors internationally recognized authorities in their respective fields **Control of Cell Cycle and Cell Proliferation** Rossen Donev,2023-04-13 Control of Cell Cycle and Cell Proliferation Volume 135 in the Advances in Protein Chemistry and Structural Biology series presents chapters on a variety topics including Exploiting pivotal mechanisms behind the senescence like cell cycle arrest Viral infection on through Cell Cycle Regulation Analyzing drug resistant mutation in CDK4 gene and identification of potential inhibitors through structure based virtual screening approach Controlling cell proliferation by targeting CDK6 using drug repurposing approach The role of the nucleolus in regulating cell cycle Chromatin regulators in DNA replication and genome stability maintenance during S phase Role of macrophage in cancer cell progression and targeted immunotherapies and much more Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in the Advances in Protein Chemistry and Structural Biology series Includes the latest information on Control of Cell Cycle and Cell Proliferation

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