

Antioxidant Activity Of Endophytic Fungi Isolated From

This book is a printed edition of the Special Issue "Fungal Endophytes in Plants" that was published in JoF

This book reviews the latest developments in our understanding of microbial endophytes and their potential applications in enhancing productivity and disease protection. It covers all the latest discoveries regarding endophytes, their interactions with plants and application in agricultural productivity and protection. Our understanding of endophytes has increased exponentially in recent decades. These microbes, such as fungi, bacteria, and actinobacteria, establish a symbiotic or parasitic association with plants. A better understanding of endophytic microorganisms may help to elucidate their functions and potential role in developing sustainable systems of crop production and improved protection against biotic stresses. Endophytes play a vital role in plant growth and health promotion. Endophytic bacteria are of agrobiological interest because they create host-endophyte relationships, which can open exciting prospects for newer biotechnological applications.

Endophytes have also proven to be a beneficial and sustainable alternative to agrochemicals due to their role in the biocontrol of pests and diseases. Further, endophytes are essential to the production of several secondary metabolites in grasses, in the process of gummosis in trees, and the production of useful metabolites such as alkaloids, pestaloside, cryptocandin, enfumafungin, subglutinols, etc. for the host plant. They are also involved in the production of enzymes, biosurfactants, biocontrol agents and plant growth promoters. As such, it is imperative that we explore these products' industrial applications in the fields of biotechnology, pharmacy and agriculture. This volume will offers a valuable guidance for botanists, microbiologists, biotechnologists, molecular biologists, environmentalists, policymakers, conservationists, and those working for the protection of plant species of agricultural and medicinal importance.

White biotechnology is industrial biotechnology dealing with various biotech products through applications of microbes. The main application of white biotechnology is commercial production of various useful organic substances, such as acetic acid, citric acid, acetone, glycerine, etc., and antibiotics like penicillin, streptomycin, mitomycin, etc., and value added product through the use of microorganisms especially fungi and bacteria. The value-added products included bioactive compounds, secondary metabolites, pigments and industrially important enzymes for potential applications in agriculture, pharmaceuticals, medicine and allied sectors for human welfare. In the 21st century, techniques were developed to harness fungi to protect human health (through antibiotics, antimicrobial, immunosuppressive agents, value-added products etc.), which led to industrial scale production of enzymes, alkaloids, detergents, acids, biosurfactants. The first large-scale industrial applications of modern biotechnology have been made in the areas of food and animal feed production (agricultural/green biotechnology) and pharmaceuticals (medical/red biotechnology). In contrast, the production of bio-active compounds through fermentation or enzymatic conversion is known industrial or white biotechnology. The beneficial fungal strains may play important role in agriculture, industry and the medical sectors. The beneficial fungi play a significance role in plant growth promotion, and soil fertility using both, direct (solubilization of phosphorus, potassium and zinc; production of indole acetic acid, gibberellic acid, cytokinin and siderophores) and indirect (production of hydrolytic enzymes, siderophores, ammonia, hydrogen cyanides and antibiotics) mechanisms of plant growth promotion for sustainable agriculture. The fungal strains and their products (enzymes, bio-active compounds and secondary metabolites) are very useful for industry. The discovery of antibiotics

is a milestone in the development of white biotechnology. Since then, white biotechnology has steadily developed and now plays a key role in several industrial sectors, providing both high valued nutraceuticals and pharmaceutical products. The fungal strains and bio-active compounds also play important role in the environmental cleaning. This volume covers the latest research developments related to value-added products in white biotechnology through fungi.

Microbes are ubiquitous in nature. Among microbes, fungal communities play an important role in agriculture, the environment, and medicine. Vast fungal diversity has been found in plant systems. The fungi associated with any plant system are in the form of epiphytic, endophytic, and rhizospheric fungi. These associated fungi play important roles in plant growth, crop yield, and soil health. The rhizospheric fungi present in rhizospheric zones have a sufficient amount of nutrients released by plant root systems in the form of root exudates for growth, development, and activities of microbes. Endophytic fungi enter in host plants mainly through wounds that naturally occur as a result of plant growth, or develop through root hairs and at epidermal junctions. The phyllospheric fungi may survive or proliferate on leaves, depending on the extent of influences of material in leaf diffuseness or exudates. The diverse group of fungal communities is a key component of soil-plant systems, where they are engaged in an intense network of interactions in the rhizospheric, endophytic, and phyllospheric areas, and they have emerged as an important and promising tool for sustainable agriculture. These fungal communities help to promote plant growth directly or indirectly by mechanisms for plant growth-promoting (PGP) attributes. These PGP fungi can be used as biofertilizers, bioinoculants, and biocontrol agents in place of chemical fertilizers and pesticides in an environmentally and eco-friendly manner. This book covers the current knowledge of plant-associated fungi and their potential biotechnological applications in agriculture and allied sectors. This book should be useful to scientists, researchers, and students of microbiology, biotechnology, agriculture, molecular biology, environmental biology, and related subjects.

Present Status and Future Challenges

Microbial Secondary Metabolites Biochemistry and Applications

Microbiome Stimulants for Crops

Bioprospecting for biomolecules

Plants as a Source of Natural Antioxidants

Microbiome Stimulants for Crops: Mechanisms and Applications provides the latest developments in the real-world development and application of these crop management alternatives in a cost-effective, yield protective way. Sections address questions of research, development and application, with insights into recent legislative efforts in Europe and the United States. The book includes valuable information regarding mechanisms and the practical information needed to support the growing microbial inoculant and biostimulant industry, thus helping focus scientific research in new directions. Provides methods for finding and testing endophytic and growth promotional microbes Explains the mechanisms of microbes and other biostimulant function in promoting plant

growth Evaluates methods for treatments of plants with microbes and microbiome stimulants Identifies areas for new research

This pioneering book focuses on Neotropical endophytic fungi, providing a comprehensive overview of their diversity, ecology, and biotechnological applications in medicine, agriculture, and industry. Despite their rich diversity, the endophytic fungi associated with plants of Central and South American biomes remain largely unknown. The book addresses that knowledge gap by offering insights into Neotropic endophytic fungal community.

Found in every plant species, the diversity of endophytic micro-organisms can be extremely high within different plant organs and tissue types. In trees, their ecological roles with respect to host tree can vary from latent pathogens or saprophytes to neutral commensalists and mutualists. Given their high diversity, and their bio-active nature, endophytes are currently being associated with a role in tree health against insect herbivores and fungal pathogens, as well as improving tree properties in phytoremediation. Meanwhile there is increasing interest in the potential of some tree endophytes as new sources of drug compounds. The first book on tree endophytes in several years, and containing contributions from leading authors in the field, this book provides an important reference text for professional researchers and advanced students.

New and Future Developments in Microbial Biotechnology and Bioengineering: Microbial Secondary Metabolites Biochemistry and Applications examines the areas of biotechnology and chemical engineering, covering aspects of plants, bacteria and machines, and using microbes as factories. The book is aimed at undergraduates, post-graduates and researchers studying microbial secondary metabolites, and is an invaluable reference source for biochemical engineers working in biotechnology, manipulating microbes, and developing new uses for bacteria and fungi. The applications of secondary metabolites in biotechnology, pharmaceuticals, diagnostics and medical device development are also extensively covered. The book integrates the aforementioned frontline branches into an interdisciplinary research work to satisfy those working in biotechnology, chemical engineering, alternative fuel development, diagnostics and pharmaceuticals. Chapters related to important research work on applications of microbial secondary metabolites are written by specialists in the various disciplines from the international community. Compiles the latest developments in the area of microbial secondary metabolites Authored by the top international researchers in this area Includes information related to nearly all areas of a microbial secondary metabolites system

Advances in Nanomaterials in Biomedicine

Endophytes

Agriculturally Important Fungi for Sustainable Agriculture

Biotechnology of Bioactive Compounds

Industrially Important Fungi for Sustainable Development

Volume 2: Perspective for Value-Added Products and Environments

Fungi are an essential, fascinating and biotechnologically useful group of organisms with an incredible biotechnological potential for industrial exploitation. Knowledge of the world's fungal diversity and its use is still incomplete and fragmented. There are many opportunities to accelerate the process of filling knowledge gaps in these areas. The worldwide interest of the current era is to increase the tendency to use natural substances instead of synthetic ones. The increasing urge in society for natural ingredients has compelled biotechnologists to explore novel bioresources which can be exploited in industrial sector. Fungi, due to their unique attributes and broad range of their biological activities hold great promises for their application in biotechnology and industry. Fungi are an efficient source of antioxidants, enzymes, pigments, and many other secondary metabolites. The large scale production of fungal pigments and their utility provides natural coloration without creating harmful effects on entering the environment, a safer alternative use to synthetic colorants. The fungal enzymes can be exploited in wide range of industries such as food, detergent, paper, and also for removal toxic waste. This book will serve as valuable source of information as well as will provide new directions to researchers to conduct novel research in field of mycology. Volume 2 of "Industrially Important Fungi for Sustainable Development" provides an overview to understanding bioprospecting of fungal biomolecules and their industrial application for future sustainability. It encompasses current advanced knowledge of fungal communities and their potential biotechnological applications in industry and allied sectors. The book will be useful to scientists, researchers, and students of microbiology, biotechnology, agriculture, molecular biology, and environmental biology.

New techniques; Ecology of epiphytic fungi; Endophytic leaf fungi; Plant-pathogenic and saprophytic prokaryotes; Biological control on aerial plant surfaces.

The roles of microbes in agriculture, industry and environment have been the point of interest since long time for their potential exploitation. Although only a fraction of microbial diversity was accessed by microbiologists earlier for harnessing them owing to limited techniques available. The molecular techniques have opened new vistas to access the wide field of the unexplored microbes and their exploitation for useful genes and novel metabolites. Sincere efforts have been made in biotechnology using microbes leading to improve our life with respect to agriculture and people health. This comprehensive volume covers different aspects of microbial biotechnology and its management in sustainable agriculture for food security and improved human health. The book comprises four sections: Endophytes and Mycorrhizae, Microbial Diversity and Plant Protection,

Microbial Functions and Biotechnology, and Microbes and the Environment, which contain 53 chapters. The book examines the aspects on endophytes and mycorrhizae, bioactive compounds, growth promoting microorganisms, disease management with emphasis on biocontrol, genetics of disease resistance, microbial enzymes, advances in potential of microbes and their industrial as well as pharmaceutical applications. In addition, the use of botanicals, and the etiology and management of medicinal and aromatic plants in the post harvest management have been reviewed in greater depth for the benefit of teaching and research community. The biotechnological developments using microbe potential have enabled us combat the environment and human health problems worldwide in ecofriendly manner. We are sure that this volume will be highly useful to all those concerned with fungi, bacteria, viruses and their biology, including environmental and public health officers and professionals in the field of interest. The volume is an exhaustive coverage of almost all the aspects of microbial biology and biotechnology.

New and Future Developments in Microbial Biotechnology and Bioengineering: Recent Advances in Application of Fungi and Fungal Metabolites: Applications in Healthcare presents an account of recent development and applied aspects of fungi and its metabolites in the healthcare sector. Chapters are written by eminent researchers, emphasizing the incredible role of fungi and its metabolites in the field of medicine. This book offers reference material to all mycologists working on the exploration and usage of medicinal aspects of fungi and fungal metabolites. Introduces the aspects and advances of fungi and fungal metabolites in healthcare Includes a description of traditional uses and modern practices on how to harness the potential of fungi and its metabolites in healthcare applications Provides details surrounding the use of fungi and its metabolites in medical purposes Describes potential manifold prospects of fungi and fungal metabolites
Volume 1

Natural Antioxidants and Biocides from Wild Medicinal Plants

Endophytes of Forest Trees

Fungal Endophytes in Plants

Potential Source of Compounds of Commercial and Therapeutic Applications

Diversity, Characterization and Biocontrol

This volume sheds new light on the immense potential of medicinal plants for human health from different technological aspects. It presents new research on bioactive compounds in medicinal plants that provide health benefits, including those that have proven especially effective in treating and managing diabetes mellitus and hypertension. It looks at the medicinal properties, antioxidant capacity, and antimicrobial activity of plants and provides scientific evidence on the use of medicinal plants in the treatment of certain diseases. Many of the plants described in the chapters are easily accessible and are believed to be effective with fewer side effects

in comparison to modern drugs in the treatment of different diseases.

This book provides an up-to-date treatment of antioxidant and biocidal compounds mainly from Latin American plants. New antimicrobials, insecticides and antioxidants are compiled in a single source for the first time based on the research and knowledge of several internationally renowned research groups. This book is organized in three sections: Part I provides a general overview and perspectives on antioxidant, medicinal and biocidal plant compounds; Part II provides information on plant antioxidants isolated from a wide range of species; and Part III describes insecticidal, antimicrobial and other biocidal activities based on peptides, phytoecdysteroids, alkaloids, polyphenols, terpenoids and other allelochemicals.

The purpose of this research was to isolate bioactive compounds from endophytic fungi isolated from *Lagerstroemia speciosa* Linn. leaves. Fungal isolate K_BK5 was selected for bioactive compounds due to this isolate produced active compounds against *Bacillus subtilis* ATCC 6633. Based on morphology, the fungal isolate K_BK5 was identified as *Mycelia sterilia*. Based on nucleotide sequencing of ITS region, it was closely related to Fungal endophyte MS6 IS133. In this study we investigated for secondary metabolites of fungal isolate K_BK5. Chromatographic techniques and crystallization method were used to purify bioactive compounds from Sabouraud's dextrose culture broth and mycelia. Two compounds and two mixtures were isolated and identified. The structures of these compounds were elucidated using their physical and chemical properties, spectral data and x-ray crystallographic analysis and comparison with literatures. Three compounds were triglyceride (mixture 1), deoaustrocortirubin (mixture 2), austrocortinin (compound 1) and

1,4,6,7,9-Pentahydroxy-2-methoxy-7-methy-5,6,7,8,8a,9-hexahydroanthracene-10(10aH)-one (compound 2). The pure compound and mixture were tested for antioxidant activity. Deoxyaustrocortirubin and austrocortinin showed high potential of antioxidant activity with EC₅₀ 30.17 and 23.91 respectively. Deoaustrocortirubin inhibits *B. subtilis* with the MIC value of 250 microgram/ml.

Fungi Bio-prospects in Sustainable Agriculture: Fungal metabolites and Nano-technology is a three-volume series that has been designed to explore the huge potential of the many diverse applications of fungi to human life. The series unveils the latest developments and scientific advances in the study of the biodiversity of fungi, extremophilic fungi, and fungal secondary metabolites and enzymes, while also presenting cutting-edge molecular tools used to study fungi.

Readers will learn all about the recent progress and future potential applications of fungi in agriculture, environmental remediation, industry, food safety, medicine, and nanotechnology. Volume 3 provides a comprehensive account of fungal metabolites, including bioactive and host origin compounds, along with other biomolecules, and mycotoxins. This book includes the applications, limitations, and prospects of working with fungal secondary metabolites. The authors explore fungi in the myco-mediated synthesis of nanoparticles along with their biotechnological, industrial, and agricultural uses. This book also discusses advancements in medical mycology for the diagnosis and treatment of fungal infections. Furthermore, this book provides up-to-date and in-depth knowledge about the adoption of advanced CRISPR-Cas9 technology in fungi for gene editing. Covers the secondary metabolites of fungi including bioactive compounds, mycotoxins and other biomolecules. Provides insight into the fungal mediated biosynthesis of nanoparticles and its various applications in diverse fields. Describes advances in diagnosis and treatment of human fungal infections. Presents the latest information on applications of the CRISPR-Cas9 system in fungi.

Recent Advancement in White Biotechnology Through Fungi

Volume 3: Fungal Metabolites, Functional Genomics and Nano-technology

Functional Biology and Applications

Volume 2

Advances in Endophytic Fungal Research

Endophytic Fungi

In recent years there has been significant attention paid on the endophytic research by various groups working within this domain. Mutualistic endophytic microbes with an emphasis on the relatively understudied fungal endophytes are the focus of this special book. Plants are associated with micro-organisms: endophytic bacteria and fungi, which live inter- and intra-cellularly without inducing pathogenic symptoms, but have active biochemical and genetic interactions with their host. Endophytes play vital roles as plant growth promoters, biocontrol agents, biosurfactant producers, enzymes and secondary metabolite producers, as well as providing a new hidden repertoire of bioactive natural products with uses in pharmaceutical, agrochemical and other biotechnological applications. The increasing interest in endophytic research generates significant progress in our understanding of the host-endophyte relationship at molecular and genetic level. The bio-prospection of microbial endophytes has led to exciting possibilities for their biotechnological application as biocontrol agent, bioactive metabolites, and other useful traits. Apart from these virtues, the microbial endophytes may be adapted

to the complex metabolism of many desired molecules that can be of significant industrial applications. These microbes can be a useful alternative for sustainable solutions for ecological control of pests and diseases, and can reduce the burden of excess of chemical fertilizers for this purpose. This book is an attempt to review the recent development in the understanding of microbial endophytes and their potential biotechnological applications. This is a collection of literature authored by noted researchers having signatory status in endophytic research and summarizes the development achieved so far, and future prospects for further research in this fascinating area of research.

The large number of molecular protocols available creates a dilemma for those attempting to adopt the most appropriate for streamlined identification and detection of fungal pathogens of interest. *Molecular Detection of Human Fungal Pathogens* provides a reliable and comprehensive resource relating the molecular detection and identification of major human fungal pathogens. This volume contains expert contributions from international mycologists involved in fungal pathogen research and diagnosis. Following a similar format throughout, each chapter comprises: A brief review of the classification, epidemiology, clinical features, and diagnosis of one or a group of related fungal species An outline of clinical sample collection and preparation procedures A selection of representative stepwise molecular detection protocols A discussion on further research requirements for improving the diagnosis The book offers an indispensable tool for medical, veterinary, and industrial laboratory scientists working in the area of fungal determination. It also constitutes a convenient textbook for undergraduate and graduate students majoring in microbiology and is an essential guide for upcoming and experienced laboratory scientists wishing to acquire and polish their skills in molecular diagnosis of fungal diseases.

Molecular Aspects of Plant Beneficial Microbes in Agriculture explores their diverse interactions, including the pathogenic and symbiotic relationship which leads to either a decrease or increase in crop productivity. Focusing on these environmentally-friendly approaches, the book explores their potential in changing climatic conditions. It presents the exploration and regulation of beneficial microbes in offering sustainable and alternative solutions to the use of chemicals in agriculture. The beneficial microbes presented here are capable of contributing to nutrient balance, growth regulators, suppressing pathogens, orchestrating immune response and improving crop performance. The book also offers insights into the advancements in DNA technology and bioinformatic approaches which have provided in-depth knowledge about the molecular arsenal involved in mineral uptake, nitrogen fixation, growth promotion and biocontrol attributes. Covers the molecular attributes of biocontrol, PGPR and mycorrhizal associations involved in the three-way interaction between beneficial microbes-host-pathogen Explores the role of technological interventions in exploring molecular mechanisms Provides detailed and comprehensive insights about recent trends in the use of microbial genetic engineering for agricultural

application

Discusses the role of endophytes in food security, forestry and health. It outlines their general biology, spanning theory to practice.

Volume 2: Functional Annotation for Crop Protection

Techniques of Flavonoid Identification

Tropical Mycology

Endophytes: Crop Productivity and Protection

Mechanisms and Applications

Biology and Applications

This book discusses the latest developments in our understanding of microbial endophytes, their ecology, diversity and potential biotechnological applications. It covers all the latest advances concerning the endophytic interaction of microorganisms in a wide array of plants, reported on by experts from the entire globe. The diverse microbial community, which consists of archaeal, bacterial, fungal and protistic taxa, can be found in all plants. The endophytic lifecycle reveals how microorganisms play essential roles in plant growth, fitness and diversification. Diversity is an integral component of ecology. In soil ecology, below-ground interactions of plant and microorganisms are accomplished by endophytes, which reside in the plant's internal tissues. The microbial world in general and endophytes in particular represent a unique degree of genetic and functional (metabolic) diversity. Currently, significant attention is being paid to endophytic microorganisms as their repertoire of cells and metabolites hold immense potential with regard to biotechnological applications for sustainable development. The diversity of bacterial endophytes guarantees that there are endophytes capable of forming compatible associations with all agronomically important plants, including monocots and dicots. The study of endophytes' diverse nature in connection with biodiesel, medicinal and agriculturally important crops can lead to a better understanding of applicable facets. The topics in this dynamic field of study are so diverse and vast. This volume will benefit all botanists, microbiologists, ecologists, plant pathologists, physiologists, agronomists, molecular biologists, environmentalists, policymakers, conservationists and NGOs working to protect species and prevent the loss of biologically significant genetic material.

Endophytic fungi are important biotechnological tools because they produce many secondary metabolites. However, to access this important source of bioactive molecules, it is essential to explore the diversity of endophytic fungi and catalog their species richness in different ecosystems. This book reviews the diversity, characterisation and biocontrol of endophytic fungi.

Tropical mycology is attracting increasing interest, as the key role of fungi in tropical ecosystems and as pathogens becomes appreciated. This book describes the ecology, biology, economic dimensions and systematics of tropical Micromycetes and is the second of two complementary volumes (Volume 1 covers Macromycetes) developed from papers given at the British Mycological Society's symposium in Liverpool in April 2000.

This book provides insights into various aspects of medicinal plant-associated microbes, known to be a unique source of biological active compounds, including their biotechnological uses and their potential in pharmaceutical, agricultural and industrial applications. Featuring review papers and original research by leading experts in the field, it discusses medicinal plants and their interactions with the environment; medicinal plants as a source of biologically active compounds; medicinal plant-associated microbes (diversity and metabolites); their

pharmaceutical, agricultural and industrial applications as well as their potential applications as plant growth stimulators and biocontrol agents. As such the book offers a valuable, up-to-date overview of the current research on medicinal plants, their ecology, biochemistry associated biomes.

Volume 1: Fungal Diversity of Sustainable Agriculture

The Full Story of the Untapped Treasure

Microbial Technology for Health and Environment

Medicinal Plants and Fungi: Recent Advances in Research and Development

Bioactive Compounds of Medicinal Plants

Bioactive Compounds from Endophytic Fungi Isolated from *Lagerstroemia Speciosa* Linn

Microbial Endophytes: Functional Biology and Applications focuses on endophytic bacteria and fungi, including information on foundational endophytes and the latest advances in relevant genomics, proteomics and nanotechnological aspects. The book provides insights into the molecular aspects of plant endophytes and their interactions and applications, also exploring the potential commercialization of endophytic microorganisms and their use as bio fertilizers, in biocontrol, and as bioactive compounds for other sustainable applications. Coverage of important and emerging legal considerations relevant to those working to implement these important bacteria in production processes is also included. Presents discussion on entry, colonization and the distribution of endophytic microorganisms Explores the phyto immunological functions of endophytic microorganisms Provides genomic insights on plant endophyte interaction Identifies bio-commercial aspects of microbial endophytes for sustainable agriculture, including potential legal issues and IPR in microbial research

Bioactive compounds play a central role in high-value product development in the chemical industry. Bioactive compounds have been identified from diverse sources and their therapeutic benefits, nutritional value and protective effects in human and animal healthcare have underpinned their application as pharmaceuticals and functional food ingredients. The orderly study of biologically active products and the exploration of potential biological activities of these secondary metabolites, including their clinical applications, standardization, quality control, mode of action and potential biomolecular interactions, has emerged as one of the most exciting developments in modern natural medicine. **Biotechnology of Bioactive Compounds** describes the current stage of knowledge on the production of bioactive compounds from microbial, algal and vegetable sources. In addition, the molecular approach for screening bioactive compounds is also discussed, as well as examples of applications of these compounds on human health. The first half of the book comprises information on diverse sources of bioactive compounds, ranging from microorganisms and algae to plants and dietary foods. The second half of the book reviews synthetic approaches, as well as selected bioactivities and biotechnological and biomedical potential. The bioactive compounds profiled include compounds such as C-phycoyanins, glycosides, phytosterols and natural steroids. An overview of the usage of bioactive compounds as antioxidants and anti-inflammatory agents, anti-allergic

compounds and in stem cell research is also presented, along with an overview of the medicinal applications of plant-derived compounds. *Biotechnology of Bioactive Compounds* will be an informative text for undergraduate and graduate students of bio-medicinal chemistry who are keen to explore the potential of bioactive natural products. It also provides useful information for scientists working in various research fields where natural products have a primary role.

Volatiles and Metabolites of Microbes compiles the latest research and advancement in the field of volatiles, metabolites synthesized from the microbial strains such as actinomycetes, bacteria, cyanobacteria, and fungal species and their potential applications in the field of healthcare issue and sustainable agriculture. There is an urgent need to explore new and advanced biological methods for health industries and sustainable agriculture and to protect the environment from environmental pollution or contaminates, global warming, and also control the health of human beings from the side effects of various pharmaceuticals products. Focusing all these factors, *Volatiles and Metabolites of Microbes* explores new aspects of microorganism in terms of volatiles, enzymes, bioactive compounds synthesized from the microbes and their potential applications in the field of sustainable agriculture and health-related issues. Provides a broad aspect about volatiles, bioactive compounds, and secondary metabolites of microbes compiled in one cover. Gives the latest research and advancement in the field of volatiles, secondary metabolites, and bioactive compounds synthesized from the different microbial strains. Responds to new developments in the detection of the complex compound structures of volatiles. Offers insight to a very broad audience in Biotechnology, Applied Microbiology, Agronomy, and Pathology.

Biodiversity and Biomedicine: Our Future provides a new outlook on Earth's animal, plant, and fungi species as vital sources for human health treatments. While there are over 10 million various species on the planet, only 2 million have been discovered and named. This book identifies modern ways to incorporate Earth's species into biomedical practices and emphasizes the need for biodiversity conservation. Written by leading biodiversity and biomedical experts, the book begins with new insights on the benefits of biologically active compounds found in fungi and plants, including a chapter on the use of wild fruits as a treatment option. The book goes on to discuss the roles of animals, such as amphibians and reptiles, and how the threatened presence of these species must be reversed to conserve biodiversity. It also discusses marine organisms, including plants, animals, and microbes, as essential in contributing to human health. *Biodiversity and Biomedicine: Our Future* is a vital source for researchers and practitioners specializing in biodiversity and conservation studies. Students in natural medicine and biological conservation will also find this useful to learn of the world's most bio-rich communities and the molecular diversity of various species. Presents new developments in documenting and identifying species for biodiversity conservation and ethical considerations for biodiversity research. Examines biodiversity as an irreplaceable resource for biomedical breakthroughs using available species for medical research. Discusses challenges and opportunities for biodiversity protection and research in biosphere reserves.

Molecular Aspects of Plant Beneficial Microbes in Agriculture

Fungi Bio-prospects in Sustainable Agriculture, Environment and Nano-technology

Endophytes for a Growing World

Microbial Diversity and Biotechnology in Food Security

Neotropical Endophytic Fungi

Advances in Endophytic Research

A comprehensive overview of both traditional and current knowledge on the health effects of plant based antioxidants, this book reviews medicinal and aromatic plants from around the world. It covers the different sources of antioxidants including essential oils, algae and marine microorganisms, as well as the role of abiotic and biotic stresses, endophytes, transgenic approaches in scavenging ROS and antioxidant plants used in different therapeutic systems.

This book highlights the latest international research on different aspects of medicinal plants and fungi. Studies over the last decade have demonstrated that bioactive compounds isolated from medicinal fungi have promising antitumor, cardiovascular, immunomodulatory, anti-allergic, anti-diabetic, and hepatoprotective properties. In the light of these studies, the book includes chapters (mostly review articles) by eminent researchers from twelve countries across the globe working in different disciplines of medicinal plants and fungi. It discusses topics such as the prevention of major neurodegenerative and neurotoxic mechanisms by *Centella asiatica*; the medicinal properties and therapeutic applications of several mushrooms species found in different parts of the world; and fungal endophytes as a source of bioactive metabolites including anticancer and cardioprotective agents. There are also chapters on strategies for identifying bioactive secondary metabolites of fungal origin; the use of genomic information to explore the biotechnological potential of medicinal mushrooms; and solid state fermentation of agro-industrial and forestry residues for the production of medicinal mushrooms. It is a valuable resource for the researchers, professionals and students working in the area of medicinal plants and fungi.

Plant endophytes are a potential source for the production of bioactive compounds that can fight against devastating diseases in both plants and humans. Among these endophytic microorganisms, endophytic fungi are one of the dominant group of microorganisms with a potential role in plant growth promotion and the discovery of noble bioactive natural products.

Endophytic fungi possess several bioactivities like anticancer, antimicrobial, insecticidal, plant growth stimulants, crop protection, phytoremediation, etc. Presence of modular biosynthetic genes clusters like PKS and NRPS in several endophytic fungi underscores the need to understand and explore such organisms. This volume presents and demonstrates the applied aspects of endophytic fungi. Practical applications of such endophytes are discussed in detail, including studies in pharmaceutical development and agricultural management of important microbial diseases. The beneficial effects that endophytic fungi provide to host plants—enhancing growth, increasing fitness, strengthening tolerance to abiotic and biotic stresses through secondary metabolites—are also discussed. The reader is provided with a comprehensive and detailed understanding of such relationships between endophytic fungi and their host.

This book illustrates the multiple roles of fungi in everyday life. Fungi are the large group of organisms with tremendous diversity and economic importance. Their ability to produce commercially efficient useful products makes them the vulnerable sustainable tool for the future generation. This book describes a systems approach and provides a means to share the latest developments and advances about the benefits of fungi including their wide application, traditional uses, modern practices, along with designing of strategies to harness their potential. The chapters are organized with data, providing information related to different sustainable aspects of fungi in agriculture, its cultivation and conservation strategies, industrial and environmental utilization, advanced bioconversion technologies and modern biotechnological interventions. Updated information and current opinion related to its application for sustainable agriculture, environment, and industries as futuristic tools have been presented and discussed in different chapters. The book also elucidates a comprehensive yet a representative description of the challenges associated with the sustained application of fungi to achieve the goals of sustainability.

Our Future

Microbiology of the Phyllosphere

Endophytes: Biology and Biotechnology

Medically Important Plant Biomes: Source of Secondary Metabolites

Microbial Endophytes

Fungi and their Role in Sustainable Development: Current Perspectives

This book describes the various therapeutic and commercial applications of compounds produced by endophytes.

Endophytes are microorganisms that reside in the living internal tissues of plants without showing any apparent symptom of their presence. During their life cycle, they establish a symbiotic or parasitic relationship with the host plant. The book discusses different kinds of compounds that these endophytes produce, and their potential properties such as antimicrobial, anti-oxidative, anti-inflammatory, anticancer, nutraceutical, immunomodulatory etc. Other prospects of endophytic biology such as fungi of wild and domesticated crop plants and their applications in sustainable agriculture have also been included. The book also provides details about various techniques used in endophyte research, metabolite detection and bioactivity-based assays to explore endophytes. Endophytes with phytohormones-producing potential and their role in plant –microbial interactions under stress are also discussed. The book also highlights novel strategies to tap into the hidden potential of endophytic fungi for the production of novel biomolecules using an integrated approach. These microorganisms have attracted a lot of scientific attention worldwide because of their huge potential for novel phytochemicals, pharmaceuticals and lead compounds. Hundreds of new novel endophytic fungi have been isolated, identified and systematically studied in last decade. However, this is the first of its kind, systematic compilation of potential biotechnological applications of endophytic compounds. Chapter contributions from groups across the globe make this book very up-to-date and informative. This book is very useful and interesting for students and researchers in the field of microbiology, plant sciences, mycology and pharmacology. It is also helpful for industry experts working on

developing novel compounds.

This reference work presents an authoritative review of endophytes and their applications to human welfare. Endophytes have become a class of interesting and curious microorganisms due to their intimate intra- and intercellular association with plants for competence, survival and reproduction. They can be bacteria or fungi, and they are usually non-pathogenic to their host. Endophytes have important applications in agriculture and industry, namely, they can help with plant growth, act as biocontrol agents and biosurfactant and secondary metabolite producers, and they are also rich sources of bioactive natural products. Novel and beneficial effects of endophytes are constantly emerging, and this book, divided into four sections, provides readers with the latest developments in this fast expanding field. In the first section, readers will discover the biology of the major groups of endophytes, followed by a summary of conventional and molecular tools for endophytes' identification in Section II. The production of high-value metabolites by endophytes will be explored in the third section of this book, and in the final section, readers will find several case studies, examples and prospects for endophytes' application in agriculture and industry. Written by leading international authors, this reference work will appeal to a wide readership, from students and researchers in the field of botany, biotechnology and agriculture to professionals interested in the production and applications of endophytic metabolites.

Endophytic Fungi: The Full Story of the Untapped Treasure covers the developments in endophytic fungal research from beginning to the end by the eminent researchers involved in the field. It sheds light on the endophytic fungal current research, challenges, and future possibilities, the trending recent topics in the plant-fungal endophytes' biodynamics for sustainable development of bioproducts and its applications are supported in large-scale biosynthesis of industrially and pharmaceutical important biomolecules. The highlights of Endophytic Fungi: The Full Story of the Untapped Treasure are the bioprospecting and applied aspects of endophytic fungi. Practical applications of such endophytes are discussed in detail. Further, it reviews recent strategies on alternative sustainable sources of medicines such as secondary metabolites of fungi instead of over collection of plants under prohibiting of biodiversity conventions. The uniqueness of the Endophytic Fungi is the inclusion of updated bioinformatics-based strategies and its importance in bioactive molecules produced by endophytic fungi. Endophytic Fungi addresses one of the most eminent issues in this field: "how to translate the potential that endophytic fungi hold in stable practical application." Covers major concepts of plant-fungi interaction, biodiversity of endophytic fungi from diverse and biotechnological applications for sustainable development Is extensively illustrated and clearly written, using easy-to-understand language, sharing the latest developments and potential of fungal products for various applications Sheds light on the endophytic fungal current research, challenges, and future possibilities Serves as a useful reference for policy makers

Fungi bio-prospects in sustainable agriculture, environment and nanotechnology is a three-volume series that has been designed to explore the huge potential of the many diverse applications of fungi to human life. The series unveils the latest developments and scientific advances in the study of the biodiversity of fungi, extremophilic fungi, and fungal secondary metabolites and enzymes, while also presenting cutting-edge molecular tools used to study fungi. Readers will learn all about the recent progress and future potential applications of fungi in agriculture, environmental remediation, industry,

food safety, medicine, and nanotechnology. Volume 1 will cover the biodiversity of fungi and the associated biopotential applications. This volume offers insights into both basic and advanced biotechnological applications in human welfare and sustainable agriculture. The chapters shed light on the different roles of fungi as a bio-fertilizer, a bio-control agent, and a component of microbial inoculants. They also focus on the various applications of fungi in bio-fuel production, nanotechnology, and in the management of abiotic stresses such as drought, salinity, and metal toxicity. Provides a deep understanding of fungi and summarizes fungi's various applications in the fields of microbiology and sustainable agriculture Describes the role of fungal inoculants as biocontrol agents, and in improved stress tolerance and growth of plants

Properties and Potential for Human Health

Recent Advances in Application of Fungi and Fungal Metabolites: Applications in Healthcare

New and Future Developments in Microbial Biotechnology and Bioengineering

Sources and Applications

Bacterial Endophytes for Sustainable Agriculture and Environmental Management

Biodiversity and Biomedicine

Bioactive Compounds from Endophytic Fungi Isolated from *Lagerstroemia Speciosa* Linn

This book is a comprehensive account of recent advances in the endophytic research. It covers recent perspective of endophytic research, diversity, bioprospecting of novel genes using high throughput molecular techniques, and most importantly application of endophytes in sustainable agriculture. Endophytic micro-organisms are mysterious living component associated mutually with plant roots and soil microorganisms. Endophytic bacteria have attracted considerable attention for their ability to promote plant growth through direct mechanisms or by producing growth-promoting agents. Endophytes also find use in biocontrol, medicine, agriculture and food industry. This is a useful reading for the student of agricultural microbiology and biotechnology.

Rampant industrialization has caused high levels of contamination by various toxic chemicals in our water bodies, which is a matter of concern in terms of ecosystems, as well as human and animal health. Polluted wastewater can contaminate drinking water and is also a cause of magnification of heavy metals into our food cycle. In the last decade, several methodologies have been adopted to clean the wastewater. Among these, microbial remediation has emerged as an effective technology. Several variants of microbial technologies have been developed for wastewater treatment and biodegradation specific to the industry, type of waste and toxicity of the chemicals. This book describes the recent advances in biodegradation and microbial remediation of various xenobiotic compounds in soil and wastewater. It also explains various modern microbial technologies for biodegradation and wastewater treatment. It covers various microbial technologies for wastewater treatment, biodegradation, bioremediation and solid waste management. Gathering contributions from leading international experts it focuses on the status quo in industrial wastewater treatment and biodegradation. The book is intended for researchers in the field of industrial wastewater, students of environmental sciences and professionals in pollution abatement.

"Advances in Nanomaterials in Biomedicine" provided a platform for more than 110 researchers from different countries to present their latest investigations in various fields of nanotechnology, new methods and nanomaterials intended for medical applications. Modern achievements in the field of nanoparticle-based diagnostics, drug delivery and the use of various nanomaterials in the treatment of diseases are presented.

articles. The published reviews provide a comprehensive analysis of the current information on the use of nanomedicine in the treatment of cancer and liver fibrosis, in the field of solid tissue engineering and in drug delivery systems.

Molecular Detection of Human Fungal Pathogens

Endophytes and Secondary Metabolites

Volatiles and Metabolites of Microbes

Diversity, Ecology, and Biotechnological Applications