

## Antimicrobial and Cytotoxic Activities of Endophytic Fungi Isolated from *Artemisia annua* L

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### ABSTRACT

This study was aimed to investigate antimicrobial and cytotoxic effects of endophytic fungi isolated from *A. annua* L. The ethyl acetate extracts were obtained by liquid-liquid partition of fermentation broth of endophytes followed by evaporation. Antimicrobial assay was determined by disc diffusion method. Cytotoxicity assay was conducted against T47D, WiDr and Vero using MTT assay. Data generated were used to determine  $IC_{50}$ . While DP2 extract did not show any inhibition against all tested bacteria, DP6 extract at 200  $\mu$ g inhibited the growth of *B. subtilis*, *P. aeruginosa* and *S. dyspi* with the highest inhibition against *B. subtilis*. Similarly, E2 extract inhibited the growth of *B. subtilis*, *E. coli* and *S. dyspi*, with the highest inhibition against *B. subtilis*. The three extracts (DP2, DP6 and E2) were found to be cytotoxic against T47D and WiDr with E2 extract to be the most cytotoxic. These compounds were more selective against T47D cell line with  $IC_{50}$  of 91.7, 74.8 and 12.0  $\mu$ g/mL, respectively. The  $IC_{50}$  against Vero cell line are 444.4, 140.3 and 87.7  $\mu$ g/mL, respectively.

### INTRODUCTION

Natural products are sources of bioactive compounds potential to be developed as pharmaceutical agents. Endophytic microbes are one group of microorganisms capable of producing active metabolites which then attract the attention of scientists since the finding of paclitaxel which can be generated by a fungus colonizes Himalayan yew tree, *Pestalotiopsis microspora* (Tan and Zou, 2001). Endophytic microbes reside in living plant tissues without causing damage to the host. They colonize in plant tissues such as in leave, stem, root and seed and have been recognized to produce bioactive metabolites potentially having medicinal values such as alkaloids, terpenoids, polyketides, phenylpropanoids, aliphatic compounds, and peptides (Pinheiro *et al.*, 2013; Mousa *et al.*, 2013; Zheng *et al.*, 2013; de Souza *et al.*, 2011). *Artemisia annua* L., is a plant which grow on tropical countries and known to produce artemisinin with a range of concentration of 0.01-1.1 % (Alam *et al.*, 2010). Artemisinin is a famous drug against malaria, one of most deadly infections in tropical countries. This compound and its derivatives have been reported to have such

anticancer activities with various mechanism of actions as cell cycle arrest, apoptosis, inhibition of angiogenesis, inhibition of Wnt/ $\beta$ -catenin pathway and disruption of cell migration (Fireston *et al.*, 2009; Krishna *et al.*, 2008; Li, 2007; Zhou, 2007). However, the low level of production of artemisinins from the *A. annua*, limits its exploration directly from the plants for commercialization. Other methods are developed to find bioactive compounds from *A. annua*. Drimartol A, a sesquiterpenocoumarin has been isolated from *A. annua* hairy root culture and this compound was reported to have anticancer activity (Zhai and Zhong, 2010). Endophytes of *A. annua* are also a source of microorganisms potential to be developed for production of bioactive compounds. Twenty one of 39 endophytes of *A. annua*, have been isolated and reported to have antifungal activities (Liu *et al.*, 2001). Artemisinin, the antimalarial drug has been reported to be produced by endophytic actinobacteria *Pseudonocardia* sp (Li *et al.*, 2012). Many studies reported the ability of antimicrobial compounds to function as anticancer agents and anthracyclines are an example of a well-known antibiotics used as anticancer drugs (Mordente *et al.*, 2012). In this study we investigated the antimicrobial and cytotoxic activities of compounds produced by endophytes of *A. Annua* collected from National Centre for Research and Development of Medicinal Plants and Traditional Medicine, Tawangmangu, Indonesia.

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# Antimicrobial And Cytotoxic Activities Of Endophytic

**Iqbal Ahmad, Shamim Ahmad, Kendra  
P. Rumbaugh**



## **Antimicrobial And Cytotoxic Activities Of Endophytic:**

**New and Future Developments in Microbial Biotechnology and Bioengineering** Joginder Singh Panwar, Praveen Gehlot, 2020-08-19 *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

*Biotechnological Utilization of Mangrove Resources* Jayanta Kumar Patra, Rashmi Ranjan Mishra, Hrudayanath Thatoi, 2020-04-17 Mangroves are typically tropical coastal ecosystems found in the inter tidal zones of river deltas and back water areas They represent highly dynamic and fragile ecosystems yet they are the most productive and biologically diversified habitats of various life forms including plants animals and microorganisms Mangroves are a resource of many different products including microorganisms that harbor a diverse group of industrially important enzymes antibiotics therapeutic proteins and vaccines timber resistant to rot and insects and medicinal plants Divided into three main parts *Biotechnological Utilization of Mangrove Resources* first provides a broad introduction into mangrove ecology Subsequent chapters discuss the biodiversity of mangroves including the diverse nature of the organisms within the mangroves themselves The final part pays special attention to biotechnological utilization of mangroves Topics such as antimicrobial activity of mangrove derived products anti oxidant activity of mangrove derived products and pharmaceutical applications are covered in detail *Biotechnological Utilization of Mangrove Resources* brings the latest research and technologies in mangrove biology into one platform providing readers with an up to date view on the area This would serve as an excellent reference book for researchers and students in the field of marine biology especially interested in mangrove ecosystems Highlights the diversity of different life forms in the mangrove ecosystem including the importance of mangroves and mangrove derived products Focuses on biotechnological utilization of mangrove resources such as antimicrobial and antioxidant properties of microorganisms and industrial and pharmaceutical applications Discusses the different modern tools and techniques used for the study of mangrove resources

*Microbial Technology for Health and Environment* Pankaj Kumar Arora, 2020-03-21 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 is a causal factor for bio magnification of heavy metals into our food cycle In the

last decade several methodologies have been adopted to clean the wastewaters and 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 microbial degradation 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 it focuses on the status quo in industrial wastewater treatment and its biodegradation The book is intended for researchers in the field of industrial wastewater students of environmental sciences and practitioners in water pollution abatement *Antibacterial Drug Discovery to Combat MDR* Iqbal Ahmad,Shamim Ahmad,Kendra P.

Rumbaugh,2019-11-09 This book compiles the latest information in the field of antibacterial discovery especially with regard to the looming threat of multi drug resistance The respective chapters highlight the discovery of new antibacterial and anti infective compounds derived from microbes plants and other natural sources The potential applications of nanotechnology to the fields of antibacterial discovery and drug delivery are also discussed and one section of the book is dedicated to the use of computational tools and metagenomics in antibiotic drug discovery Techniques for efficient drug delivery are also covered The book provides a comprehensive overview of the progress made in both antibacterial discovery and delivery making it a valuable resource for academic researchers as well as those working in the pharmaceutical industry **Medicinal Plants**

**and Fungi: Recent Advances in Research and Development** Dinesh Chandra Agrawal,Hsin-Sheng Tsay,Lie-Fen Shyur,Yang-Chang Wu,Sheng-Yang Wang,2017-11-03 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 *Natural Bioactives from the Endophytes of Medicinal Plants* Vineet Meshram,Kamlesh Kumar Shukla,Mahiti Gupta,Nadeem Akhtar,2025-03-13 Endophytes from medicinal plants have garnered global attention due to

their remarkable capacity to produce unique phytochemicals pharmaceuticals and promising lead compounds This book explores cutting edge advancements in endophytic fungi research encompassing a comprehensive exploration of their biodiversity ecological dynamics mechanisms of interaction and adaptive strategies The book offers valuable insights into the therapeutic potential agricultural applications environmental impacts and commercial prospects of these fascinating organisms While the contemporary books are limited to either taxonomic ecological or practical discussions this book presents a systematic compilation of biology and biotechnological applications of endophytic fungi from medicinal plants Key Features Comprehensive exploration of the diversity ecology and interactions of endophytes derived from medicinal plants found in their natural habitats Highlights the potential of endophytes derived as prolific producers of novel pharmaceutical and lead compounds Showcases the practical applications of endophytes in plant development and sustainable agriculture practices Includes contribution from researchers and academicians having vast experience in the field This book is a collection of informative illustrations strategically integrated throughout the content to facilitate the understanding of concepts and aid in smooth transitions between topics Given the vast and diverse nature of the discipline this book serves as an invaluable reference resource for students and researchers in various fields including mycology microbiology biotechnology pharmacology botany ecology agronomy and molecular biology Additionally professionals in environmental conservation and policymakers dedicated to preserving biodiversity of medicinal plants will find this book to be a valuable asset in their work

Pathogenicity and Drug Resistance of Human Pathogens Saif Hameed,Zeeshan Fatima,2020-01-23

The book comprehensively discusses the mechanisms of pathogenesis and drug resistance current diagnostics landscape of four key human pathogens bacterial fungal protozoans and viral which are the causes of major infectious diseases It also assesses the emerging technologies for the detection and quantification of these pathogens Further it discusses the novel opportunities to fight against these infectious diseases and to identify pertinent drug targets with novel methodologies It also reviews the current and future insights into the control elimination and eradication of these infectious diseases Importantly the book discusses the epidemiological characteristics and various challenges in combating Ebola and Influenza diseases Finally the book highlights the growing role of nanotechnology and bioinformatics resources for combating the infectious diseases In summary the book provides the mechanistic insight of the pathogenicity drug resistance therapeutic strategies and identification of the novel drug targets of Mycobacterium tuberculosis Plasmodium Candida Hepatitis C and emerging viral infections

**Endophytes** Ravindra H. Patil,Vijay L. Maheshwari,2021-03-25

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

neutraceutical immunomodulatory etc Other prospects of entophytic 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

**Actinobacteria in Special and Extreme Habitats: Diversity, Function Roles and Environmental Adaptations** Sheng Qin, Wen-Jun Li, Syed G. Dastager, Wael N. Hozzein, 2016-11-09

Actinobacteria are highly diverse prokaryotes that are ubiquitous in soil freshwater and marine ecosystems Although various studies have focused on the ecology of this phylum data are still scant on the diversity abundance and ecology of actinobacteria endemic to special and extreme environments such as gut plant alkaline saline soil deep sea sediments hot springs and other habitats Actinobacteria are well known producers of a vast array of secondary metabolites many of which have useful applications in medicine and agriculture Furthermore actinobacteria also have diverse functions in different environments apart from antibiotic production For example actinobacteria are reported to contribute to the break down and recycling of organic compounds They play a significant role in fixation of nitrogen improvement plant growth biodegradation bioremediation and environmental protection Therefore understanding the actinobacterial diversity and distribution in such special environments is important in deciphering the ecological roles of these microorganisms and for biotechnological bioprospecting Recent advances in cultivation DNA sequencing technologies and omics metagenomics metaproteomics etc methods have greatly contributed to the rapid advancement of our understanding of microbial diversity function and they interactions with environment Furthermore comparative genomic studies can provide overall information about actinobacterial speciation evolution metabolism and environment adaptation mechanisms This research topic comprising reviews and original articles highlights the recent advances regarding the unexpectedly diverse rare group of actinobacteria with special selective isolation methods or culture independent methods as well as their biological activities ecophysiological function and mechanisms from diverse special and extreme environments

**Bioactive Compounds in Mangroves and their Associates** Hosakatte Niranjana Murthy, 2025-09-29 This reference work offers a comprehensive overview of the

chemistry and bioactivity of mangrove ecosystems focusing on their specialized metabolites and biological activities Through this volume readers will discover the novel secondary metabolites from mangrove flora and their potential applications in various fields The chapters cover a wide range of topics including the phytochemistry and biological activities of specific mangrove species such as *Acanthus ilicifolius* *Avicennia marina* and *Rhizophora mucronata* The chapter authors present an expert analysis of the bioactive compounds found in these species exploring their pharmacological and toxicological properties Particular attention is given to the anticancer activities of certain compounds as well as the role of mangrove associated bacteria and fungi in health management and bioremediation Readers will also encounter discussions on the synthesis of nanomaterials from mangroves and their antimicrobial properties This book is an essential resource for researchers scholars and practitioners in the fields of botany pharmacology and environmental science It invites readers to think through critical questions about the ecological and medicinal significance of mangroves offering diverse perspectives from expert contributors

**Fungal Resources for Sustainable Economy** Ishwar Singh,Vijay Rani Rajpal,Shrishail S. Navi,2023-04-07 This edited book provides a comprehensive account of the new developments in various facets of fungal biology related to the impact and application of fungi on the sustainable economy The book consists of 24 chapters distributed under five sections written by active researchers and academicians from India and abroad The five sections of the book are 1 Fungi in Sustainable Economy 2 Fungal Resources Current and Potential Industrial Applications 3 Fungal Resources Current and Potential Agricultural Applications 4 Fungi and their Secondary metabolites Implications and 5 Fungi Burden to health and Indoor Environment The book explores the utility of fungi as food enzymes organic compounds nutraceuticals pharmaceuticals and agricultural productivity promoter It also highlights the negative fungal impacts on food production health and environment The book is useful to postgraduate students studying mycology plant pathology crop protection agricultural sciences and plant sciences In addition scientists involved in biological and agricultural research crop management and various industries that manufacture or utilize fungal products on a small to large scale shall also find the book helpful

Endophytic Association: What, Why and How Maulin P. Shah,Deepanwita Deka,2022-11-01 Endophytic Association What Why and How focuses on the endophytic association of plants how they have originated inside the host their importance and how they are beneficial for the environment as well as humans The book discusses how using endophytic microbes in agricultural fields can be enriched without impacting environment negatively and how they can be utilized for pharmaceutical purposes including bioremediation It includes advanced and up to date information as well as future directions for young researchers and scientists who are working in the field of agriculture pharmaceuticals bio nanotechnology and bioremediation of environmental contaminants for environmental protection and sustainable development Details the underlying mechanisms of endophyte host association and their signaling mechanisms Describes numerous successful field studies on the different applications of nanoparticles produced by endophytes bio nanotechnology

for sustainable development Presents recent advances and challenges in endophyte associated bio remediation research and applications for human health Provides information on bioactive compounds produced by endophytes for pharmaceutical purposes

**Recent Advancement in White Biotechnology Through Fungi** Ajar Nath Yadav,Sangram Singh,Shashank Mishra,Arti Gupta,2019-04-24 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

**Advances in Endophytic Fungal Research** Bhim Pratap Singh,2019-02-12 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

**Nanobiotechnology in Diagnosis, Drug Delivery and Treatment** Mahendra Rai, Mehdi Razzaghi-Abyaneh, Avinash P. Ingle, 2020-11-17 Presents nanobiotechnology in drug delivery and disease management Featuring contributions from noted experts in the field this book highlights recent advances in the nano based drug delivery systems It also covers the diagnosis and role of various nanomaterials in the management of infectious diseases and non infectious disorders such as cancers and other malignancies and their role in future medicine Nanobiotechnology in Diagnosis Drug Delivery and Treatment starts by introducing how nanotechnology has revolutionized drug delivery diagnosis and treatments of diseases It then focuses on the role of various nanocomposites in diagnosis drug delivery and treatment of diseases like cancer Alzheimer s disease diabetes and many others Next it discusses the application of a variety of nanomaterials in the diagnosis and management of gastrointestinal tract disorders The book explains the concept of nanotheranostics in detail and its role in effective monitoring of drug response targeted drug delivery enhanced drug accumulation in the target tissues sustained as well as triggered release of drugs and reduction in adverse effects Other chapters cover aptamer incorporated nanoparticle systems magnetic nanoparticles theranostics and vaccines toxicological concerns of nanomaterials used in nanomedicine and more Provides a concise overview of state of the art nanomaterials and their application like drug delivery in infectious diseases and non infectious disorders Highlights recent advances in the nano based drug delivery systems and role of various nanomaterials Introduces nano based sensors which detect various pathogens Covers the use of nanodevices in diagnostics and theranostics

**Nanobiotechnology in Diagnosis Drug Delivery and Treatment** is an ideal book for researchers and scientists working in various disciplines such as microbiology biotechnology nanotechnology pharmaceutical biotechnology pharmacology pharmaceutics and nanomedicine

*Microbial Endophytes and Plant Growth* Manoj Kumar Solanki, Mukesh Kumar Yadav, Bhim Pratap Singh, Vijai Kumar Gupta, 2022-11-19 *Microbial Endophytes and Plant Growth* Beneficial Interactions and Applications explains how modern molecular tools can unlock the plant s microbial network building the bridge between plant and environment Chapters describe the usefulness of the endophytic microbiome of different crops including cereals vegetables and horticulture and delve into the latest research surrounding the applications of plant microbe interactions in improving plant growth Other topics discussed include root endophytes and their role in plant fitness seed associated endophytes and their functions and microbial endophytes and nanotechnology This is a one stop resource for scientists wanting access to the latest research in plant microbiology The book also provides advanced techniques for using multi omics approaches to study plant microbe interactions providing readers with a practical approach Outlines multi omics approaches

to study plant endophytes interactions Describes the efficacy of endophytes to combat biotic and abiotic factors Defines the prominent role of endophytic microbes to improve plant growth      **Microbial Endophytes** Ajay Kumar,E.K.

Radhakrishnan,2020-03-05 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      **Industrially Important Fungi for Sustainable Development** Ahmed M. Abdel-Azeem,Ajar Nath

Yadav,Neelam Yadav,Minaxi Sharma,2021-12-02 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      Neotropical Endophytic Fungi Luiz Henrique Rosa,2021-04-14 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 Industrial Applications of Soil Microbes: Volume 3 Ashutosh Gupta,Shampi Jain,Neeraj Verma,2024-04-25 This volume is a compilation of reviews on the industrial usage of soil microorganisms The contents include 16 brief reviews on different soil microbe assisted industrial processes Readers will be updated about recent applications of soil bacteria fungi and algae in sectors such as agriculture biotechnology environmental management The reviews also cover special topics like sustainable agriculture biodiversity ecology and intellectual property rights of patented strains giving a broad perspective on industrial applications of soil microbes Volume 3 emphasizes various soil microorganisms including cyanobacteria and mycorrhiza The 16 chapters cover the ecological significance of mycorrhiza to and their role in sustainable agriculture microbial interactions with nematodes microbes as biocontrol agents and the use of endophytes in agriculture Chapters also shed light on industrial aspects and microbial biotransformation providing a comprehensive view of sustainable agricultural practices Special topics such as the microbial carotenoids are also included

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## **Table of Contents Antimicrobial And Cytotoxic Activities Of Endophytic**

1. Understanding the eBook Antimicrobial And Cytotoxic Activities Of Endophytic
  - The Rise of Digital Reading Antimicrobial And Cytotoxic Activities Of Endophytic
  - Advantages of eBooks Over Traditional Books
2. Identifying Antimicrobial And Cytotoxic Activities Of Endophytic
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Antimicrobial And Cytotoxic Activities Of Endophytic
  - User-Friendly Interface
4. Exploring eBook Recommendations from Antimicrobial And Cytotoxic Activities Of Endophytic
  - Personalized Recommendations
  - Antimicrobial And Cytotoxic Activities Of Endophytic User Reviews and Ratings
  - Antimicrobial And Cytotoxic Activities Of Endophytic and Bestseller Lists
5. Accessing Antimicrobial And Cytotoxic Activities Of Endophytic Free and Paid eBooks
  - Antimicrobial And Cytotoxic Activities Of Endophytic Public Domain eBooks
  - Antimicrobial And Cytotoxic Activities Of Endophytic eBook Subscription Services
  - Antimicrobial And Cytotoxic Activities Of Endophytic Budget-Friendly Options

6. Navigating Antimicrobial And Cytotoxic Activities Of Endophytic eBook Formats
  - ePub, PDF, MOBI, and More
  - Antimicrobial And Cytotoxic Activities Of Endophytic Compatibility with Devices
  - Antimicrobial And Cytotoxic Activities Of Endophytic Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Antimicrobial And Cytotoxic Activities Of Endophytic
  - Highlighting and Note-Taking Antimicrobial And Cytotoxic Activities Of Endophytic
  - Interactive Elements Antimicrobial And Cytotoxic Activities Of Endophytic
8. Staying Engaged with Antimicrobial And Cytotoxic Activities Of Endophytic
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Antimicrobial And Cytotoxic Activities Of Endophytic
9. Balancing eBooks and Physical Books Antimicrobial And Cytotoxic Activities Of Endophytic
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Antimicrobial And Cytotoxic Activities Of Endophytic
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Antimicrobial And Cytotoxic Activities Of Endophytic
  - Setting Reading Goals Antimicrobial And Cytotoxic Activities Of Endophytic
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Antimicrobial And Cytotoxic Activities Of Endophytic
  - Fact-Checking eBook Content of Antimicrobial And Cytotoxic Activities Of Endophytic
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

## **Antimicrobial And Cytotoxic Activities Of Endophytic Introduction**

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