CURRICULUM VITAE

Madhuree Kumari, PhD
Department of Biochemistry,
Indian Institute of Science, C V Raman Ave,
Bengaluru-560 012 (Karnataka), India
Mobile: +91-9535241073
E-mail: madhuree88@gmail.com, madhureek@iisc.ac.in

Profile Summary

A highly motivated, team oriented scientist with strong scientific background in Plant-pathogen interactions, biotic-stress amelioration, microbial bioprospecting and their mechanistic analysis using omics approach.

Research Experience

CSIR-Pool Scientist **01/03/2019-Present**

Department of Biochemistry, Indian Institute of Science, Bengaluru, India

- Excellent knowledge in natural products, isolation and characterization of active principles and their nano-formulations
- Explore and assess various principals from small molecules to biologicals to control bacterial diseases (*in vitro* and greenhouse experiments)
- Omics based discovery approach to identify biological molecules
- End-to-end Quality management: ensure and maintain optimal (input vs output) scientific quality and standards in experimentation, analysis, and interpretation.
- Demonstrated experience in data collection, data analysis, first draft writing, editing, reviewing, co-ordinating and completion of the manuscript publication
- Demonstrated experience in communication skills, co-ordinating cross-functional teams, adjusting content of the articles as required and project management
- Mentored two PhD student and 10 dissertation students

D S Kothari Post-Doctoral Fellow **01/03/2016-28/-02/2019**

Department of Biochemistry, Indian Institute of Science, Bengaluru, India.

- Excellent knowledge of phytochemicals, natural product drug development based on Ayurveda and sustainable delivery by microbial bioprospecting
- Excellent interpersonal, team working, communication, presentation, mitigation and influencing skills
- Analysis and interpretation of experimental data, present conclusions in detailed reports and presentation

Educational Qualifications

1. **Doctor of Philosophy (Ph. D.)** in Life Sciences (awarded on 16-09-2015 in **Academy of Scientific & Innovative Research, CSIR-NBRI)**

Thesis title: Characterization of nanoparticles biosynthesized by *Trichoderma* spp. and their utility in agriculture

- **Proteomic and metabolomics analysis during plant-pathogen-nanoparticles interactions**
- **Knowledge of crop protection and plant nutrition**
- **Worked on plant gene regulation and hormone signalling**

2. **Master of Science (M. Sc.) in Biotechnology (2010)**. Banasthali University, Banasthali, Rajasthan. 79%.

Scientific Skills

Natural products and omics approach	**In vitro and whole plant assays**	**Microbiological techniques**	**Statistical analysis/Writing tools**
▪ Isolation and identification of active ingredient	▪ Biochemical analysis (enzymatic and non-enzymatic markers for biotic stress)	▪ Maintenance of bacterial and fungal culture, plant tissue culture and field trials	▪ MS-PowerPoint, Biorender, MS office
▪ HPLC, GCMS, 2D-gel electrophoresis	▪ Hormone and VOCs analysis by HPLC and GCMS	▪ FACS, RT-PCR and confocal assay	▪ Design expert software
▪ UV-Vis spectroscopy, FTIR spectroscopy	▪ Plant growth parameter and disease index	▪ Proteomics, Metabolomics and mechanistic assay	▪ Origin software, ▪ Graphpad prism
▪ Thin layer chromatography, silica-gel chromatography	▪ Photosynthesis efficiency	▪ antimicrobial activity, wound healing assay	▪ SPSS
▪ MALDI-TOF-ToF result interpretation, protein identifiation	▪ culturable and non-culturable soil microbial population (Bacteria, fungi)	▪ Drug and Ointment preparation	

Research Publications

More than 38 international research articles, reviews, book chapter and books (**Cumulative impact factor-125**)

Academic Achievements

1. DST-AWSAR Award-2020 for communicating scientific activities to a broader audience.
2. DBT travel grant 2019.
3. CSIR-Scientist Pool award 2019.
4. D S Kothari Post-Doc Fellowship by UGC in Department of Biochemistry, Indian Institute of Science, Bangalore, India.
5. SERB National Post-Doc Fellowship by DST in Department of Biochemistry, Indian Institute of Science, Bangalore, India.
6. NET JRF- December-2009 (Rank 0159) conducted by CSIR-UGC against Roll No. 319058.

7. GATE 2010 (Life Sciences) examination with 94.2 percentile
8. Best publication award for year 2014-2015 in CSIR-NBRI for the paper published in Bioresource technology.
9. Best publication award for year 2017-2018 in CSIR-NBRI for the paper published in ACS-Applied Materials and Interface
10. CBSE merit certificate in 2005

Google Scholar Link: https://scholar.google.com/citations?user=hDITrboAAAAJ&hl=en
Reserachgate Link: **https://www.researchgate.net/profile/Madhuree-Kumari**
Linkedin : https://www.linkedin.com/in/madhuree-kumari-phd-78942733/

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 274 (2022) 121098

Contents lists available at ScienceDirect

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

journal homepage: www.elsevier.com/locate/saa

Usnic acid induced changes in biomolecules and their association with apoptosis in squamous carcinoma (A-431) cells: A flow cytometry, FTIR and DLS spectroscopic study

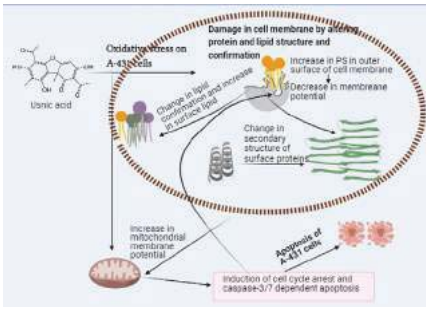
Madhuree Kumari *, Siya Kamat, C. Jayabaskaran *

Department of Biochemistry, Indian Institute of Science, Bangalore 560012, India

HIGHLIGHTS

- Usnic acid showed concentration and time dependent cytotoxicity in A-431 cells.
- Structural changes in secondary structure of proteins from α helix to β sheets was induced by usnic acid.
- It induced cell cycle arrest and externalization of phophatidylserine to the outer membrane leading to apoptosis.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 30 December 2021
Received in revised form 25 February 2022
Accepted 26 February 2022
Available online 2 March 2022

Keywords:
Apoptosis
FTIR
Zeta potential
Natural product
Secondary structure

ABSTRACT

Many natural products induce apoptotic cell death in cancer cells, though studies on their interactions with macromolecules are limited. For the first time, this study demonstrated the cytotoxic potential of usnic acid (UA) against squamous carcinoma (A-431) cells and the associated changes in cell surface proteins, lipids and DNA by attenuated total reflection- fourier transform infrared spectroscopy (ATR-FTIR) and dynamic light scattering (DLS) spectroscopic studies. The IC_{50} for UA was 98.9 μM after treatment of A-431 cells for 48 h, while the IC_{50} reduced to 39.2 μM after 72 h of incubation time. UA induced oxidative stress in treated cells as confirmed by DCFHDA flow cytometry assay, depletion in reduced glutathione and increase in lipid peroxidation. The oxidative stress resulted in conformation change in amide I, amide II protein bands and DNA as observed by ATR-FTIR in UA treated A-431 cells. Shift in secondary structures of proteins from α helix to β sheets and structural changes in DNA was observed in UA treated A-431 cells. An increase in the band intensity of phospholipids, increased distribution of lipid and change in membrane potential was noted in UA treated cells, which was confirmed by externalization of phosphatidylserine to the outer membrane by annexin V-FITC/PI assay. Increase in mitochondrial membrane potential, cell cycle arrest at G0/G1 phase by flow cytometry and activation of caspase-3/7 dependent proteins confirmed the UA induced apoptosis in treated A-431 cells. FTIR and DLS spectroscopy confirmed the changes in biomolecules after UA treatment, which were associated with apoptosis, as observed by flow cytometry.

1. Introduction

Skin cancer is one of the most prevalent forms of cancer, accounting for more than 30% of total cases diagnosed worldwide

* Corresponding authors.
E-mail addresses: madhureek@iisc.ac.in (M. Kumari), cjb@iisc.ac.in (C. Jayabaskaran).

https://doi.org/10.1016/j.saa.2022.121098
1386-1425/

ACS AGRICULTURAL SCIENCE & TECHNOLOGY

pubs.acs.org/acsagscitech Article

Comparative Study of the Development and Characterization of Ecofriendly Oil and Water Nanoemulsions for Improving Antifungal Activity

Shipra Pandey,[#] Ved Prakash Giri,[#] Madhuree Kumari, Ashutosh Tripathi, Sateesh Chandra Gupta, and Aradhana Mishra*

Cite This: https://doi.org/10.1021/acsagscitech.1c00141 Read Online

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ABSTRACT: Present work aimed to synthesize peppermint and eucalyptus oil-based nanoemulsions by a high-energy sonication process having potent antifungal activity. Tween 80 was used as the most suitable emulsifier by increasing interaction and stability of the system. A relative study was done among eucalyptus oil (ENE) and peppermint oil (PNE) nanoemulsions. PNE had a smaller droplet size (20−40 nm) than ENE (60−100 nm). Because of the smaller droplet size, higher surface area, lower surface tension, and presence of antimicrobial metabolites, PNE exhibited a higher antifungal efficacy as compared to ENE. 1% PNE showed complete inhibition of four fungal phytopathogens, while ENE showed partial inhibition. Stability of ENE was also a limiting factor along with increasing droplet size and resulted in decreased antimicrobial activity. Conclusively, peppermint oil-based nanoemulsion (PNE) proved to be a most promising antimicrobial agent against fungal pathogens; it can be used for sustainable disease management in crop plants.

KEYWORDS: *peppermint oil, eucalyptus oil, nanoemulsion, sustainable solution, antifungal activity, stability*

1. INTRODUCTION

In recent years, the use of chemical pesticides in agriculture practices has raised serious issues in terms of progression toward resistant microbes and environmental contamination.[1,2] To resolve these problems, nanotechnology has attained great importance in agriculture due to its controlled drug release and targeted and higher efficacy against pathogens.[3−5] In the agri-sector, various risks are associated with the application of engineered nanomaterials as nanopesticides during interaction with plants and soil.[6,7] Nanoemulsion, an innovative and greener facet of nanotechnology, has been explored widely in drug delivery systems, food, cosmetics, and pharmaceutical industries in recent decades.[8−11] Nanoemulsions are colloidal nanodispersions of oil and water being thermodynamically stabilized by an interfacial layer of surfactant/cosurfactant with a higher solubilization capacity and kinetic stability as compared to unstable emulsions and suspensions.[12] Essential oils have been reported earlier for their proficient antimicrobial activity against phytopathogens,[13,14] but their efficiency has been limited due to the low solubility with water, strong odor, less stability, and the higher amount required for the application of antimicrobial activity.[15,16] A paradigm shifted toward nanoemulsions over the bulk form because of their higher stability and hydrophilic nature.[17,18]

To formulate a stable nanoemulsion with smaller droplets, a selection of components and their concentrations are determining factors. A formulated nanoemulsion can be evaluated for its potency by characterizing physicochemical and biological properties. Characterization of a nanomaterial is a preliminary step for the confirmation of synthesized nanoemulsion; viz, size, shape, and physical properties play a very decisive step to determine the potency of synthesized nanoemulsions against phytopathogens. Bioactive metabolites of oils are accountable for promising antifungal activity against phytopathogens.[19,20] Moreover, physical and chemical properties also contribute to higher antimicrobial activity that can be improved by the intervention of nanoemulsion synthesis. Though various properties decide the fate of nanomaterials as antimicrobials, the most important parameter is its droplet size. A smaller droplet size is considered as an eminent characteristic for the higher antimicrobial property over bulk size,[21,22] although the size of the nanoemulsion droplet depends on the surfactant, mode of synthesis, and stability of the nanoemulsion formulation.[23,24] Surface charges, interfacial tension, and wettability are also the determining factor for stability of the formulation along with smaller droplet size.[17,25,26] The stability of the nanoemulsion is considered a critical evaluating factor for long-term effectiveness of nanoemulsion, and surfactants play a major role in stabilizing the system by preventing a destabilization phenomenon, *viz.*, Ostwald ripening.[27] Therefore, the compatibility and concentration of components present in nanoformulation can define the properties of nanoemulsion. Peppermint and eucalyptus oils

Received: June 7, 2021
Revised: August 29, 2021
Accepted: October 2, 2021

frontiers in Marine Science

ORIGINAL RESEARCH
published: 06 February 2020
doi: 10.3389/fmars.2020.00031

Endophytic Fungi of Marine Alga From Konkan Coast, India—A Rich Source of Bioactive Material

*Siya Kamat, Madhuree Kumari, Sidhartha Taritla and C. Jayabaskaran**

Department of Biochemistry, Indian Institute of Science, Bangalore, India

Endophytes are an unexploited source of pharmacologically relevant compounds owing to their species richness and diversity. In this study, a total of 26 endophytic fungi were isolated and identified from 10 marine algal samples collected from the Konkan coast, Goa, India. Eighteen of the fungal isolates belonged to phylum Ascomycota while one belonged to phylum Basidiomycota based on ITS sequencing. Further, the genus *Aspergillus* sp. was the most common and abundant endophyte found in the sampled algal species. A significant antibacterial activity against five pathogenic bacteria was exhibited by the extracts of fungal isolates AG1.1, AG1.1 (G) and VG2.6 (agar diffusion assay). The extracts of fungal endophytes VB1.1, PG1.2 and VG2.6 demonstrated good antioxidant activity (DPPH scavenging assay). Further, cytotoxicity of all the endophytic extracts on human cancer cell lines was determined by MTT and resazurin assay. The crude extract of *Aspergillus unguis* (AG 1.2) showed the highest cytotoxic potential on cervical cancer (HeLa), breast cancer (MCF-7), lung cancer (A549), and skin cancer (A431) cell lines in a concentration dependent manner. Moreover, Gas Chromatography-Mass Spectroscopy analysis of the extract of *A. unguis* (AG 1.2) confirmed the presence of several bioactive metabolites including azelaic acid, azetidine, and furopyrans. The extract of *A. unguis* (AG 1.2) demonstrated G1 phase cell cycle arrest, reactive oxygen species (ROS)-dependent MMP loss and apoptosis-dependent cell death in A431 cells. The algae-derived fungal endophytes of Konkan coast are a rich source of novel pharmaceutically active compounds as indicated by this work.

Keywords: Konkan coast, fungal endophyte, diversity, cytotoxicity, apoptosis

OPEN ACCESS

Edited by:
Chiara Lauritano, Stazione Zoologica Anton Dohrn, Italy

Reviewed by:
Perumal Karthick, Sea6 Energy Pvt Ltd, India
Ramasamy Ramasubburayan, Manonmaniam Sundaranar University, India

****Correspondence:***
C. Jayabaskaran
cjb@iisc.ac.in

Specialty section:
This article was submitted to Marine Biotechnology, a section of the journal Frontiers in Marine Science

Received: *05 November 2019*
Accepted: *20 January 2020*
Published: *06 February 2020*

Citation:
Kamat S, Kumari M, Taritla S and Jayabaskaran C (2020) Endophytic Fungi of Marine Alga From Konkan Coast, India—A Rich Source of Bioactive Material. Front. Mar. Sci. 7:31. doi: 10.3389/fmars.2020.00031

INTRODUCTION

For centuries treatment of a wide spectrum of maladies depended on natural sources (Mann, 2002; Marris, 2006). In the modern medicine, many effective lead molecules have come out of experimental research on natural products which include complex extracts or isolated compounds from plants, marine organisms, bacteria, and fungi (Lauritano et al., 2016). Due to the wide range of climatic and topological conditions, India offers a variety of flora and fauna, ranked to be one of the richest in the world (Nagarajan, 2014). The Indian coastline extends over 8,000 km with rich marine habitats, not just restricted to the sea but also in the intertidal rocky, sandy and muddy shores, mangroves, algae and coral reefs.

Marine natural products have been the focus of global research owing to their species richness and diversity (Calisto et al., 2019). Marine life is fundamentally robust and tolerant to extreme

frontiers in Microbiology

ORIGINAL RESEARCH
published: 03 August 2018
doi: 10.3389/fmicb.2018.01777

Antiproliferative and Antioxidative Bioactive Compounds in Extracts of Marine-Derived Endophytic Fungus *Talaromyces purpureogenus*

*Madhuree Kumari, Sidhartha Taritla, Ankur Sharma and C. Jayabaskaran**

Department of Biochemistry, Indian Institute of Science, Bangalore, India

Endophytic fungi are now recognized as sources of pharmacologically beneficial, novel bioactive compounds. This study was carried out to evaluate antiproliferative and antioxidative potential of a seaweed endophytic fungus *Talaromyces purpureogenus.* Extracts with different solvents of the fungus grown on different liquid media were assayed for the antiproliferative and antioxidative activities. Tested 6 cancer cell lines, the highest antiproliferative activity was observed in ethyl acetate extract of total culture grown in Potato Dextrose Broth for 28 days in a dose-dependent manner. The highest antioxidative activity was observed in hexane extract of fungal culture grown in Malt Extract Broth for 21 days. Analyzed for secondary metabolites, the extract revealed the presence of phenolics, alkaloids, flavonoids, steroids and terpenoids. Further, Gas Chromatography Mass Spectroscopy (GCMS) analysis of the extract revealed the presence of several compounds including 3-nitropropanoic acid, 4H-pyran-4-one 5-hydroxy-2-(hydroxymethyl), hexadecanoic acid, and octadecanoic acid, known to be cytotoxic or antioxidative. Among different cell lines tested, HeLa cells were the most vulnerable to the treatment of the fungal extract with an IC_{50} value of 101 ± 1 μg/mL. The extract showed no significant cytotoxicity to the normal human embryonic kidney cell line (HEK 293 T) in the MTT assay. The ethyl acetate extract induced membrane damage and mitochondrial depolarization and thereby apoptosis and cytotoxicity in HeLa cells. The study marks marine-derived endophytes as potential sources for discovery of novel drugs.

Keywords: endophytes, *Talaromyces*, anticancer, antioxidative, parameter optimization, apoptosis

OPEN ACCESS

Edited by:
Farhat Afrin,
Taibah University, Saudi Arabia

Reviewed by:
Marian Brestic,
Slovak University of Agriculture, Slovakia
Katarzyna Turnau,
Jagiellonian University, Poland
Bin Wu,
Zhejiang University, China

****Correspondence:***
C. Jayabaskaran
cjb@iisc.ac.in

Specialty section:
This article was submitted to Antimicrobials, Resistance and Chemotherapy, a section of the journal Frontiers in Microbiology

Received: *28 April 2018*
Accepted: *16 July 2018*
Published: *03 August 2018*

Citation:
Kumari M, Taritla S, Sharma A and Jayabaskaran C (2018) Antiproliferative and Antioxidative Bioactive Compounds in Extracts of Marine-Derived Endophytic Fungus Talaromyces purpureogenus. Front. Microbiol. 9:1777. doi: 10.3389/fmicb.2018.01777

INTRODUCTION

Natural product research has occupied a prominent position in pharmaceutical industries and agriculture for development of high-value products for use in human healthcare, nutrition and therapeutics (Kusari et al., 2014; Gupta and Tuohy, 2015; Gill et al., 2016; Fei Law et al., 2017; Masand et al., 2018). Natural product chemistry has also played a vital role in providing better substitutes for existing drugs (Kusari et al., 2014; Kosanić et al., 2016), especially in dreaded diseases like cancer, a major cause of morbidity and mortality in developing and developed countries alike (Mallath et al., 2014; Kilcullen et al., 2016). Taxol® is a classic example of natural complex diterpenoids which has gained the status of a blockbuster anticancer drug. *Smallanthus sonchifolius*

ACS APPLIED MATERIALS & INTERFACES

Research Article

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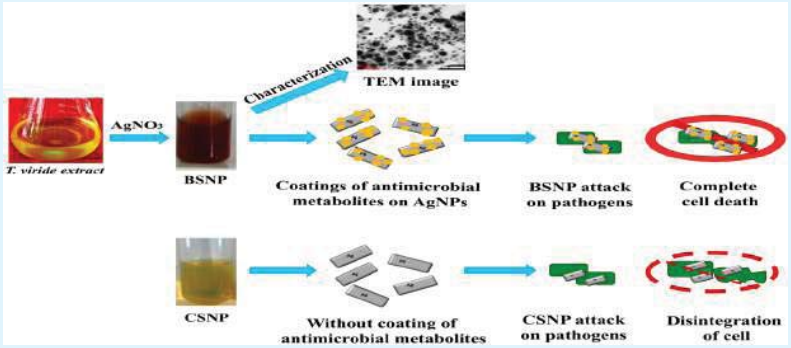
Enhanced Cellular Internalization: A Bactericidal Mechanism More Relative to Biogenic Nanoparticles than Chemical Counterparts

Madhuree Kumari,[†,#] Shatrunajay Shukla,[‡,#] Shipra Pandey,[†] Ved P. Giri,[†] Anil Bhatia,[†] Tusha Tripathi,[†] Poonam Kakkar,[‡] Chandra S. Nautiyal,[†] and Aradhana Mishra*[,†]

[†]CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow, 226 001, India

[‡]CSIR-Indian Institute of Toxicology Research, Vishvigyan Bhawan 31, Mahatma Gandhi Marg, Lucknow, 226 001, India

Supporting Information



ABSTRACT: Biogenic synthesis of silver nanoparticles for enhanced antimicrobial activity has gained a lot of momentum making it an urgent need to search for a suitable biocandidate which could be utilized for efficient capping and shaping of silver nanoparticles with enhanced bactericidal activity utilizing its secondary metabolites. Current work illustrates the enhancement of antimicrobial efficacy of silver nanoparticles by reducing and modifying their surface with antimicrobial metabolites of cell free filtrate of *Trichoderma viride* (MTCC 5661) in comparison to citrate stabilized silver nanoparticles. Nanoparticles were characterized by visual observations, UV−visible spectroscopy, zetasizer, and transmission electron microscopy (TEM). Synthesized particles were monodispersed, spherical in shape and 10−20 nm in size. Presence of metabolites on surface of biosynthesized silver nanoparticles was observed by gas chromatography−mass spectroscopy (GC-MS), energy dispersive X-ray analysis (EDAX), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR). The antimicrobial activity of both silver nanoparticles was tested against *Shigella sonnei*, *Pseudomonas aeruginosa* (Gram-negative) and *Staphylococcus aureus* (Gram-positive) by growth inhibition curve analysis and colony formation unit assay. Further, it was noted that internalization of biosynthesized nanoparticles inside the bacterial cell was much higher as compared to citrate stabilized particles which in turn lead to higher production of reactive oxygen species. Increase in oxidative stress caused severe damage to bacterial membrane enhancing further uptake of particles and revoking other pathways for bacterial disintegration resulting in complete and rapid death of pathogens as evidenced by fluorescein diacetate/propidium iodide dual staining and TEM. Thus, study reveals that biologically synthesized silver nanoarchitecture coated with antimicrobial metabolites of *T. viride* was more potent than their chemical counterpart in killing of pathogenic bacteria.

KEYWORDS: *green synthesis, Trichoderma viride, silver nanoparticles, bactericidal activity, nanoparticles characterization, bacterial disintegration*

1. INTRODUCTION

Pathogens have always been a cause of suffering to human beings by causing destruction of human health[1] resulting in a huge loss on social and economic front.[2] After they acquired resistance to multiple drugs, it has become more difficult to fight against the pathogenic agents.[3]

Silver has been known for its antimicrobial potential and widely used for food and water safety for ages.[4] Advancement in nanotechnology has created new possibilities to synthesize silver nanoparticles to enhance the potential of metal against pathogens.[3,5,6] Owing to the excellent antimicrobial activities of the particles against multidrug resistant microbes,[7,8] research has now been focused on to increase the antimicrobial potential and deciphering the mode of action involved.[9,10] A number of methods have been employed to enhance the antimicrobial potential of silver nanoparticles including modification in shape, size and change in surface corona by chemical modifications,[5,11,12] however biological means also bear equal potential

Received: December 2, 2016
Accepted: January 4, 2017
Published: January 4, 2017

DOI: 10.1021/acsami.6b15473
ACS Appl. Mater. Interfaces 2017, 9, 4519−4533