

Ishani Chakrabartty

PERSONAL INFORMATION



Assistant Professor, Department of Applied Biology, School of Biological Sciences,
University of Science and Technology, Meghalaya - 793101
11, Pinaki Path, R.G. Baruah Road, Near Zoo Road Tiniali, Guwahati, Assam, India -
781003



+91 8724068765



ishani.kaushik@gmail.com

Link: https://www.researchgate.net/profile/Ishani_Chakrabartty2
<https://www.linkedin.com/in/ishai-chakrabartty-7ab89312a/>
<https://scholar.google.co.in/citations?user=XxjqoPoAAAAJ&hl=en>
<http://www.iamishani.blogspot.com>

EDUCATION

2014–2019: PhD in Biosciences and Bioengineering at Indian Institute of Technology Guwahati, India

- **Thesis title:** Investigation on the vibrational and antimicrobial potential of (E)-labda-8(17), 12-diene-15, 16-dial from *Alpinia nigra* (Gaertn.) B.L. Burt
- **Coursework score :** CGPA 9.33/10
- Supervised two Mtech students successfully.

2012-2014: Master of Science (M.Sc.) in Biotechnology at Tezpur Central University, Assam, India

- Study emphasis : Molecular biology and biotechnology and its related subjects like analytical techniques, immunology, virology, protein biochemistry and genetics
- Second rank holder in the MBBT Department
- Overall score : CGPA 8.8/10

2009-2012: Bachelor of Science (B.Sc.) in Zoology at Miranda House, Delhi University, Delhi, India

- Study emphasis: Zoology (Hons.) with specialization in Reproductive biology
- Experienced with animal dissection
- Minors: Botany and Chemistry.
- 1st rank holder in the Zoology Department for 3 years consecutively
- Overall score : 76.09%

RESEARCH EXPERIENCE

July 2014 –July 2019: Research fellow at Indian Institute of Technology Guwahati, Assam, India

- **Natural products:** Isolation and characterization of natural compounds by organic

- solvent extraction from medicinal plants, microbiological screening of natural products, microemulsion preparation
- Handling different instruments like flow cytometer, fluorescence microscopy, soxhlet apparatus etc.
- Other analytical techniques: HPLC, FTIR, Raman spectroscopy and HRMS

Jan-May 2014: Research Student at Tezpur Central University, Assam, India

- **Thesis title:** Deciphering the mechanism of anti-bacterial potential of “green synthesized” Ag nanoparticles
- Supervisor: Dr. Nima D. Nmasa
- Learnt nanotechnology, microbiology and spectroscopic tools of characterization as major components

June-July 2013: Summer Intern at SCIR-NEIST, Jorhat, Assam, India

- **Project title:** Isolation of microbes from soil and screening for candidal activity
- Supervisor: Dr. T. Bora, Former Head, Department of Biotechnology, CSIR-NEIST

TEACHER, VOLUNTEER, WORK AND LEADERSHIP EXPERIENCE

9/20-Present, Teacher and Mentor at Department of Applied Biology, USTM

- Currently working as an Assistant Professor, Dept. of Applied Biology, School of Biological Sciences, USTM
- Teaching courses like Genetics, Recombinant DNA technology
- Overall mentoring of students and molding them in a good way

8/19-8/20, Teacher and Administrator at Department of Science, PAFGC

- Served as Head of Department, Dept. of Science, PAFGC, Mangalore University
- Teaching courses like Human Physiology, Food Packaging, Analytical techniques, General Microbiology, Brewing and Fermentation Technology and IPR to B.Sc. (FT and FND) students
- Responsible for the maintenance of proper discipline and decorum of the college
- Organized annual college events like Food fest, College day and Sports day
- Conducted small association events like Sexual harassment and Women Empowerment, Drug abuse etc.

8/14 – 7/19, Teaching Associate at Department of BSBE, IIT Guwahati

- Represented the department and lab on Research Conclave (Institute Open Day).
- Delivered presentations and conducted laboratory demonstrations for Masters students
- Worked as a volunteer in the organizing of AdMAT (2014), FABACTCS (2016) and 3rd Research Conclave (2017), Sensitization workshop on Technological Empowerment of Women (2017), Indo-US Flow Cytometry Workshop (2019)

07/14 – 06/16, Lab Maintenance at Applied Biodiversity Lab

- Responsible for proper induction of new summer interns in the lab.
- Coordinate the lab funds and maintenance.

PUBLICATIONS, SEMINARS, WORKSHOPS AND POSTERS

Journal Publications:

- **Chakrabartty I***, Kalita NK, Boruah P, Katiyar V, Hakeem K, Rangan L* (2020) Physico-rheological characterization of organically derived seed samples from *Alpinia nigra*, an ethnic medical plant of North East India; **Industrial Crops and Products**, 152 (112560), doi.org/10.1016/j.indcrop.2020.112560 (*Corresponding author; Impact factor 4.8)
- Baruah PK[#], **Chakrabartty I[#]**, Mahanta DS, Rangan L, Sharma AK, Khare A* (2020) Efficacy of cellulose paper treated with Cu and Ag oxide nanoparticles synthesized via pulse laser ablation in distilled water in the annihilation of bacteria from contaminated water; **Review of Scientific Instruments**, 91 (034105), [doi. 10.1063/1.5144495](https://doi.org/10.1063/1.5144495) ([#]Equal contribution) (Impact factor 1.58)
- **Chakrabartty I**, Vijayasekhar A, Rangan L* (2019) Therapeutic potential of labdane diterpene from *Alpinia nigra*: Detailed hemato-compatibility and antimicrobial studies; **Natural Product Research**, [doi.10.1080/14786419.2019.1610756](https://doi.org/10.1080/14786419.2019.1610756) (Impact factor 1.98)
- Basak S, **Chakrabartty I**, Hedao V, Shelke RG, Rangan L* (2018) Assessment of genetic variation among wild *Alpinia nigra* (Zingiberaceae) population: Genome mining and molecular marker approach; **Molecular Biology Reports**, 46 (1), 177-189 (Impact factor 2.1)
- **Chakrabartty I**, Baruah PK, Panda AN, Khare A, Rangan L* (2018) Hybrid formulation of Cu nanoparticles and labdane diterpene from *Alpinia nigra*: a vibrational spectroscopic study; **Journal of Applied Spectroscopy**, 85 (5), 983-990 (Impact factor 0.8)
- **Chakrabartty I***, Rangan L* (2020) Phytochemical and biopharmaceutical importance of *Alpinia nigra* and its bioactive compound, labdane diterpene : A Review; **Saudi Journal of Biological Sciences (Under Review)**
- **Chakrabartty I***, Hakeem KR* (2020) Green nanomaterials for energy conversion applications – A Review; **Renewable and Sustainable Energy Reviews (Under Review)**
- Khan J[#], Al Asoom LI[#], Khan M[#], **Chakrabartty I[#]**, Dandoti S[#] (2020) Evolution of RNA viruses from SARS to Covid-19 and the diagnostic techniques – A review; **International Journal of Infectious Diseases (Under Review)** ([#]Equal contribution)
- Khan M, **Chakrabartty I**, Hussain Q* (2020) Recent insights into rapidly emerging RNA viruses: A threat to mankind; **Translational Medicine and Infectious Diseases (Under Review)**

Full paper proceedings:

- Baruah PK, Raman MA, **Chakrabartty I**, Rangan L, Sharma AK and Khare A (2018) Antibacterial effect of silk treated with Ag and Cu nanoparticles synthesized by pulsed laser ablation in distilled water; **AIP Conference Proceedings 1953**; [doi: 10.1063/1.5032399](https://doi.org/10.1063/1.5032399)
- Rangan L*, Tushar, Basak S, **Chakrabartty I**, Ghosh S, Das A, Kumar M, Sadokpam S, Vijayasekar A, Hedao VS, Kumar V and Ramachandran S (2018) Maintaining Biodiversity in North-east India: Ethno-medicinal usage of Zingiberaceae; **BVA Proceedings (In Press)**

Book chapter:

- Baruah PK, Nath A, **Chakrabartty I**, Singh A, Das A, Rangan L, Sharma AK and Khare A (2019) Surface enhance Raman scattering and antibacterial capability of pulsed laser ablated metal/metal oxide nanoparticles **In: Advances in Science and Technology**; 1: 140-144
- Mushtaq W, Shakeel A, Fazili MA, **Chakrabartty I**, Sevindik M (2020) Pros and Cons of Nanotechnology. In: Hakeem K., Pirzadah T. (eds) **Nanobiotechnology in Agriculture**. Nanotechnology in the Life Sciences. Springer, Cham; 207-222
- Chakrabartty I (2020) Plant based nanoparticles and their applications. In Hakeem K. (ed) **Nanotechnology: Applications in Biological Sciences**. Springer (Accepted)

Conferences:

- **Chakrabartty I**, Kalita NK, Katiyar V, Rangan L* (2019) Physico-rheological characterization of organically derived seed samples from *Alpinia nigra*; **Indian Plant Science Congress (IPSC'19)**, 23rd – 25th January 2019, pp 116
- Sadokpam S, **Chakrabartty I**, Rangan L* (2019) Anti-bacterial susceptibility assessment of microemulsion formulation of labdane from *Alpinia nigra*; **Indian Plant Science Congress (IPSC'19)**, 23rd – 25th January 2019, pp 108
- **Chakrabartty I*** and Rangan L (2018) *Alpinia nigra*: The unexplored ore of Zingiberaceae for future therapeutics; **Indo-Japan Bilateral Symposium for Future Perspectives of Bioresource Utilization in North East India (IJBS'17)**, 1st-4th February 2018, IIT Guwahati, pp 68 (Oral presentation) (Awarded best oral presentation)
- **Chakrabartty I**, Panda AN, Khare A and Rangan L* (2017) FT-IR, FT-Raman, NMR and SERS studies of labdane diterpene from *Alpinia nigra*; **National Workshop on Fluorescence and Raman Spectroscopy (FCS)**, 17th – 21st December 2017, IIT Guwahati, pp 123
- **Chakrabartty I** and Rangan L* (2017) Understanding the unique inhibitory potential of (E)- labda – 8 (17), 12 – diene – 15, 16 – dial, a bioactive compound from *Alpinia nigra*, on the growth kinetics of *Candida albicans*; **Bioprocessing India**, 9th – 11th December 2017, IIT Guwahati, pp 84
- **Chakrabartty I**, Vijayasekhar A. and Rangan L* (2017) Viability assessment of bacteria under the treatment of (E)-labda-8(17), 12-diene-15, 16-dial, a bioactive compound from the seeds of *Alpinia nigra*; **Translational Research on Natural Products for Therapeutic Uses (TRNPTU)**, 21st November 2017, IASST Guwahati, pp 13 (Awarded best poster)
- Sadokpam S, **Chakrabartty I** and Rangan L* (2017) Formulation strategies and anti-candidal assessment of a labdane-type diterpene from *Alpinia nigra*; **Translational Research on Natural Products for Therapeutic Uses (TRNPTU)**, 21st November 2017, IASST Guwahati, pp 24
- **Chakrabartty I**, Khare A, Panda AN and Rangan L* (2017) Vibrational spectroscopic studies of bioactive labdane diterpene from seeds of *Alpinia nigra* in conjugation with Cu nanoparticles; **International Conference on "Sophisticated Instruments in Modern Research" (ICSIMR)**, 30th June-1st July 2017, IIT Guwahati, pp 98

- **Chakrabartty I** and Rangan L* (2017) (E)-labda-8(17), 12-diene-15,16 dial from *Alpinia nigra*: Is it a potential agent against *Candida albicans*?; **3rd Research Conclave**, 16th-19th March 2017, IIT Guwahati, pp 106 (**Department winner in best poster category**)
- Vijayshekhar A, **Chakrabartty I**, Khare A and Rangan L* (2017) Effect of labdane diterpene dialdehyde –a bioactive compound from the seeds of *Alpinia nigra*, on erythrocytes; **3rd Research Conclave**, 16th- 19th March 2017, IIT Guwahati, pp 96
- **Chakrabartty I**, Khare A and Rangan L* (2016) Investigating the inhibitory effect and possible mode of action of (E)-Labda-8(17), 12-diene-15,16-dial from *Alpinia nigra* on *Candida albicans*; **International Conference on Current Trends in Biotechnology (ICCB) organized by BRSI**, 8th – 10th December 2016, VIT Vellore, pp 344
- **Chakrabartty I** and Rangan L* (2016) Isolation, identification and flow cytometric investigation of DNA leakage from *Candida albicans* upon treatment with (E)-labda-8(17), 12-diene- 15, 16- dial from *Alpinia nigra*; **9th Annual TCS Event and Flow cytometry workshop on flow applications in basic, applied and clinical biology (FABACTCS)**, 3rd – 5th November 2016, IIT Guwahati, pp 60
- **Chakrabartty I**, Khare A, Panda AN and Rangan L* (2016) Raman spectroscopic studies of labdane diterpene, a bioactive compound from the seeds of *Alpinia nigra*; **22nd Indian Society for Chemists and Biologists (ISCB 2016) International Conference**, 6th-8th February 2016, Uka Tarsadia University, Surat, pp 150

Seminars:

- Women In Science Congress organized by US Embassy at US Embassy, New Delhi (September 2011)
- 9th Annual TCS Event and Flow cytometry workshop on flow applications in basic, applied and clinical biology, by Department of Biosciences and Bioengineering, IIT Guwahati and Dr. B. Borooah Cancer Institute, Guwahati at IIT Guwahati (November 2016)
- Sensitization Workshop on Technological Empowerment of Women, by Department of Biosciences and Bioengineering, IIT Guwahati at IIT Guwahati (November 2017)
- Preventing Sexual Harassment in Educational Institutions, by Centre for Women's Studies, Mangalore University at Mangalore University (February 2020)
- Cyber Awareness: Strategies for Safeguarding Ourselves from Cybercrimes and Cyber attacks, by IQAC, New Prince Shri Bhavani Arts and Science College at Tamil Nadu (Webinar; July 2020)
- COVID-19 Awareness Programme, NSS of SPW Degree and PG College at Tirupati (National Webinar; July 2020)
- COVID-19- Coping with the pandemic and challenges in an outbreak at IQAC, D R College, Golaghat, Assam (International Webinar; July 2020)
- Therapeutic Potentials of Spices and Herbs in Relation to COVID-19 at Besant Women's College at Mangalore (National Webinar; July 2020)
- Expanding Language World for Learners at SDM College of Business Management at Mangalore (National Webinar; August 2020)
- Entrepreneurship and You – Opportunities and Challenges at Talent Research Foundation at Mangalore (National Webinar; August 2020)

Workshops:

- Gene Polymorphism organized by DBT Star College Project at DS Kothari Centre for Research and Innovation in Science Education, Miranda House, University Of Delhi (June 2011)
- Application of Bioinformatics Tools in Biological Sciences at College of Veterinary

Science, Assam Agricultural University, Guwahati (January 2014)

- Cell Culture Techniques at Tezpur University, Assam (April 2014)
- Advanced Techniques in Cell and Molecular Biology, by Department of Biotechnology, IIT Guwahati at IIT Guwahati (June 2014)
- Flow Cytometry Data Analysis, by Department of Biotechnology, IIT Guwahati at IIT Guwahati (February 2015)
- *ACS on Campus*, IIT Guwahati (2016)
- Indo – Japan Workshop on *Translational Agriculture – Avenues for International Cooperation*, IIT Guwahati
- Workshop on *ZE5 & Droplet Digital PCR – QX200*, IIT Guwahati (2017)
- Workshop on *Research Methodology* in Reflux, IIT Guwahati (2018)
- 20th Indo-US Flow Cytometry Symposium cum Workshop on *Applications of Flow Cytometry in Biotechnology*, IIT Guwahati (2019)
- 2-Day Online Workshop on *Aligning Yourself to Publishing Process*, Research Academy on Campus, Elsevier (2020)
- 1-week Online Certificate Course on *Digital Teaching Techniques*, ICT Academy (2020)

IPR Workshops:

- Capacity Building in Effective Management of Intellectual Property Rights (IPRs) in Biotechnology by Universities and Research Institutes in Assam, by Biotech Consortium India Limited (BCIL), New Delhi at College of Veterinary Science, Assam Agricultural University, Guwahati (November 2014)
- Protection of Traditional Product Names in the North East Region using Geographical indications. Its importance in enhancing business and promoting Regional Art and Craft, by Ministry of Commerce and Industry, Department of Industrial Policy Promotion, GI Registry, Chennai, Govt. of India at NEDFi Auditorium, Guwahati (February 2015)
- Intellectual Property Rights, by IPR Cell, R&D Section, IIT Guwahati at IIT Guwahati (November 2016)
- Intellectual Property Rights- hands on training on patent search, by Research Conclave 2017, IIT Guwahati at IIT Guwahati (March 2017)

SCHOLARSHIPS AND AWARDS

- Awarded **Best Science Story** by **AWSAR-DST**, Govt. of India, **2019**
- Awarded **Best Blogger of the Year** 2019-20 by **GISR Foundation**
- Awarded **Best Oral Presentation Award** at IJBS' 17 (Indo-Japan), IIT Guwahati, **2018**
- Awarded **Best Poster Award** at TRNPTU, IASST Guwahati, **2017**
- Awarded **Departmental Winner** in the **Best Poster** Category at 3rd Research Conclave, IIT Guwahati, **2017**

- Cracked regional level competitive exam, **State Level Eligibility Test (SLET) in Life Sciences, 2014** which makes one eligible for lecturership in the field of life sciences in North-East India
- Cracked national level competitive exam, **Graduate Aptitude Test in Engineering (GATE in Life Sciences), 2014** - This is awarded by the MHRD, India for a duration of 5 years after enrollment in PhD
- Awarded **Academic Prize-2011** and **Academic Prize-2012** for academic year **2011-2012** and **2012-2013** respectively, by **Miranda House, University of Delhi**, for securing *highest marks in Part I & II and Part I, II & III* Examination in **B.Sc (Hons.) Zoology**
- Awarded **Anundoram Borooah Award** for academic year 2007-08 by **Planning & Development Department, Government of Assam**, for excellent academic performance in securing *First Division with Distinction Marks in HIGH SCHOOL LEAVING CERTIFICATE* Examination, 2007

OTHER INTERESTS

08/15 – Present, Social Worker

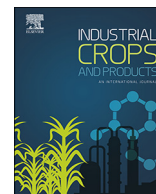
- Lifetime member of Biotech Research Society of India (BRSI)
- Member of International Natural Product Science Taskforce (INPST)
- Counselor in a North-East based NGO '**Xomidhan**' that thrives to help young people of NE India by providing career and educational guidance
- Freelance writer for a Pune based start-up "**Mirage Vialista**" (March 2019-July 2019)
- Writer on social issues in **The Assam Tribune**, a local English daily of Assam and an online forum called **Countercurrents.org**, **Voice of Margin** and **The Eleventh Column**
- Have an own blog called "**Ishani's Pen**" (www.iamishani.blogspot.com)
- Regular writer for a blog called "**Rise for India**" to generate awareness among masses in general and young people in particular towards the burning issues currently existing the Indian society; a very small yet firm step (till 2016)
- Associated with a non-religious organization called "**Who is Hussain?**" a group of like-minded individuals who work together to try their best to spread goodness in the society (till 2016)
- Participated in "Spit-free India Movement" to prevent the spread of COVID 19 (June-August 2020)

REFERENCES

1. Prof. Latha Rangan
Professor
Department of Biosciences and Bioengineering
Indian Institute of Technology Guwahati
Tel: +91 (361) 2582214
Fax: +91 (361) 2582249
Mail: lrangan@iitg.ac.in/ latha_rangan@yahoo.com
2. Dr. M. Abdul Mujeebu
College of Architecture and Planning
Imam Abdulrahman Bin Faisal University
PB No. 2397
31451 Dammam

Kingdom of Saudi Arabia
Tel: 00966-50574470
Mail: mamujeebu@gmail.com

3. Prof. Aiyagari Ramesh
Professor
Department of Biosciences and Bioengineering
Indian Institute of Technology Guwahati
Tel: +91 (361) 2582205
Mail: aramesh@iitg.ac.in/
4. Prof. Tanima Bose
Professor (Retd.)
Department of Zoology
Miranda House, Delhi University
Tel: +919871040959
Mail: bose.tanima@gmail.com



Physico-rheological characterization of organically derived seed samples from *Alpinia nigra* (Gaertn.) B.L. Burt, an ethnic medicinal plant of Northeast India

Ishani Chakrabartty^{a,b,*}, Naba Kumar Kalita^c, Pankaj Boruah^c, Vimal Katiyar^c, Khalid Rehman Hakeem^d, Latha Rangan^{a,*}

^a Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam, 781039, India

^b Department of Science, P. A. First Grade College (Affiliated to Mangalore University), Konaje, Mangalore, Karnataka, 574153, India

^c Centre of Excellence for Sustainable Polymers, Department of Chemical Engineering, Indian Institute of Technology Guwahati, Assam, 781039, India

^d Department of Biological Sciences, King Abdulaziz University, Jeddah, 21589, Saudi Arabia

ARTICLE INFO

Keywords:

Alpinia nigra
Contact angle
Diterpene
Seed extracts
Thermal stability
Viscosity

ABSTRACT

Alpinia nigra (Gaertn.) B.L. Burt is one of the most easily available culinary items as well as medicinal plants of Northeast (NE) India. Physico-rheological characterization of the colloidal seed extracts of *A. nigra* and an isolated compound molecule, labdane diterpene-(E)-labda-8 (17), 12-diene-15, 16-dial- is carried out in the current study. Ideally, studies on the rheological or physical properties (which are important for industrial application) of plant derived secondary metabolites are lacking. In this context, the present study has been taken up. The optimum seed-to-solvent ratio for maximum yield of seed extracts is found to be 1:6. Contact angle value indicates the hydrophobicity of these plant samples; labdane diterpene being the most hydrophobic. All the samples exhibit specific rotation and hence, optical behavior. The DSC results suggest the lack of crystallinity of the samples; the compound exhibits the characteristic behavior of diterpenes like drimenol, cninin etc. The plant extracts and compound show a high degree of thermal stability. The viscosity of the samples shows an increasing trend with concentration but a decreasing trend with temperature; labdane diterpene exhibits the highest viscosity at all temperatures. The results obtained provide interesting insight towards the application of the *A. nigra*-derived extracts in the food and pharmaceutical industries.

1. Introduction

An economy based on biological resources provides hope to the developing countries for better sustainability. There is a worldwide awareness for the improvement of bioresource preservation and their sustainable utilization. Plants are one of the most important and beneficial natural resources. They have always attracted the attention of the scientific community due to their countless benefits to mankind in various areas like medicines, cosmetics, food etc. In addition, plants play the most important role in environmental clean up and add enormously to the beauty and aesthetic appeal of nature. The current century observes a paradigm shift of the bioprocess and pharmaceutical industry towards the use of plants as they open new avenues for product development, less processing cost, drug development and environmental impact; a huge amount of reduction in pollution can be achieved through the use of plant-derived biodegradable, eco-friendly

disposables. After all, consumption of plant based diets contribute to environmental sustainability (Fischer et al., 2012; Lacour et al., 2018). Thus, the advancement of green chemistry and biological studies provide a new network of inter-disciplinary research to ensure maximum benefit with the lowest possible risk to mankind (ACS, 2015; Harborne, 1998).

Like all other countries of Asia, the Indian subcontinent is endowed with natural beauty and resources. The luxurious forests of the country are rich in “green” wealth that house plants containing many bioactive compounds. The NE India has different climatic zones like tropical, sub-tropical, temperate and alpine; hence, this region flourishes in its flora and fauna, particularly in the growth of valuable medicinal plants (Shankar et al., 2017). Hippocrates had said, “Let food be thy medicine and medicine be thy food.” In the plant kingdom, the Zingiberaceae family seems to abide by Hippocrates’ vision, as it is well known for its medicinal as well as culinary properties. The NE region of India houses


* Corresponding authors at: Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam, 781039, India.

E-mail addresses: ishani.kaushik@gmail.com (I. Chakrabartty), lrangan@iitg.ac.in (L. Rangan).

Efficacy of cellulose paper treated with Cu and Ag oxide nanoparticles synthesized via pulsed laser ablation in distilled water in the annihilation of bacteria from contaminated water

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Prahlad K. Baruah , Ishani Chakrabartty, Dipta S. Mahanta, Latha Rangan, Ashwini K. Sharma, and Alika Khare



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Efficacy of cellulose paper treated with Cu and Ag oxide nanoparticles synthesized via pulsed laser ablation in distilled water in the annihilation of bacteria from contaminated water

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Prahlad K. Baruah,^{1,2,a)}  Ishani Chakrabarty,³ Dipta S. Mahanta,⁴ Latha Rangan,³ Ashwini K. Sharma,² and Alika Khare²

AFFILIATIONS

¹Department of Science, School of Technology, Pandit Deendayal Petroleum University, Gandhinagar, Gujarat 382007, India

²Department of Physics, Indian Institute of Technology Guwahati, Assam 781039, India

³Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam 781039, India

⁴Department of Physics, National Institute of Technology Meghalaya, Shillong 793003, India

^{a)}Author to whom correspondence should be addressed: prahladkb@gmail.com and prahlad.baruah@sot.pdpu.ac.in.

Telephone: (office) +91-79-23275392

ABSTRACT

In the present work, nanoparticles of copper and silver synthesized via pulsed laser ablation of the respective targets in distilled water are applied to cellulose filter paper to check their effectiveness in the annihilation of bacteria from contaminated water. The treatment of the filter paper with the nanoparticles is found to be an excellent way to get rid of two common bacteria, *Staphylococcus aureus* and *Escherichia coli*, from contaminated water. The spread plate method on agar, employed to test the antibacterial efficacy of the nanoparticle-treated papers, clearly shows the absence of bacterial growth upon coming into contact with the nanoparticles in the filter paper. These results were further substantiated by the growth kinetic study of the bacteria that exhibited slow growth of the bacteria that were exposed to the nanoparticles. The morphology of the bacteria that came into contact with the nanoparticles is found to be adversely affected by the nanoparticles. Both copper and silver nanoparticles show a similar extent of antibacterial activity.

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I. INTRODUCTION

The plasmonic properties of metal as well as its oxide nanoparticles (NPs) have been utilized in numerous applications including plasmon-based sensors, surface enhanced Raman scattering (SERS), metal enhanced fluorescence, photodegradation, flexible electronics, and color printing.^{1–12} Recently, the antibacterial properties of these NPs have paved the way for their successful implementation in treating bacterial infection.^{13–16} This aspect, associated with metallic NPs, has been keenly investigated in the last decade and has provided extremely interesting insights.¹⁷ The interest behind the increased use of NPs in antibacterial applications is particularly

due to the injudicious use of antibiotics, which is believed to be the reason behind the emergence of several drug-resistant bacterial strains.¹⁴ The exact mechanism of the antibacterial action of NPs has eluded scientists for a long time. However, the antibacterial activity of NPs is generally attributed to a few common factors.^{13,18} First, the change in the permeability of the bacterial membrane due to the accumulation of NPs leads to the uncontrolled exchange of cellular organelles, which disrupts the normal functioning of the cells. Second, the generation of oxidative species from the NPs leads to oxidative damage to cellular structures. Then, there is also a possibility of the NPs entering the cell and depleting the adenosine triphosphate (ATP) production



Therapeutic potential of labdane diterpene isolated from *Alpinia nigra*: detailed hemato-compatibility and antimicrobial studies

Ishani Chakrabartty, Aswitha Vijayasekhar & Latha Rangan

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To link to this article: <https://doi.org/10.1080/14786419.2019.1610756>




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SHORT COMMUNICATION



Therapeutic potential of labdane diterpene isolated from *Alpinia nigra*: detailed hemato-compatibility and antimicrobial studies

Ishani Chakrabartty, Aswitha Vijayasekhar and Latha Rangan

Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam, 781039, India

ABSTRACT

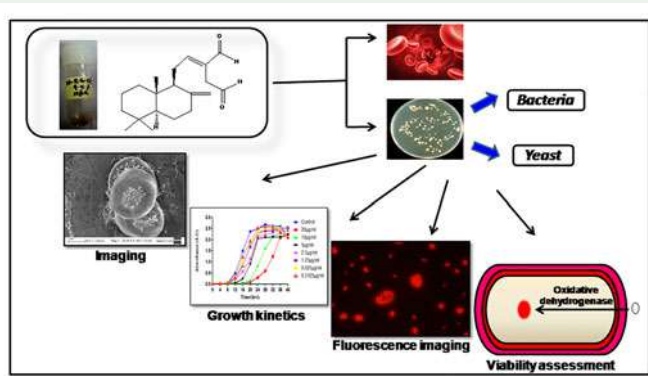
(E)-labda-8(17), 12-diene-15,16-dial has been isolated from the seeds of *Alpinia nigra* that is unsuitable for oral administration and evident from *in silico* studies. The present investigation therefore deals with understanding the effect of this compound on RBCs for intravenous administration. No prominent hemolytic effect of compound at a concentration of ≤ 0.4 mg/ml was found whereas higher concentrations perforated RBC membrane. The molecule showed remarkable inhibitory potential against Gram negative bacteria (concentration ≥ 0.025 mg/ml) causing cell lysis. In case of pathogenic yeast *Candida albicans* although growth was inhibited (concentration ≥ 0.0025 mg/ml), growth kinetic study revealed that the diterpene significantly delayed fungal growth (concentration 0.005–0.020 mg/ml) by preventing substrate uptake and was able to extend its lag phase in a dose-dependent manner. This study tries to unveil the mechanism of action of this diterpene on microorganisms with differential cell wall compositions.

ARTICLE HISTORY


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KEYWORDS

Alpinia nigra; *Candida albicans*; Gram negative bacteria; labdane diterpene; RBCs



CONTACT Latha Rangan  latha_rangan@yahoo.com/rangan@iitg.ac.in  Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Assam, India.

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HYBRID FORMULATION OF Cu NANOPARTICLES AND LABDANE DITERPENE FROM *Alpinia Nigra*: A VIBRATIONAL SPECTROSCOPIC STUDY

Ishani Chakrabartty, Prahlad Kumar Baruah, Aditya N. Panda,
Alika Khare,* and Latha Rangan*

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The vibrational characteristics of a labdane diterpene, (E)-labda-8(17),12-diene-15,16-dial, have been studied using FT-IR, FT-Raman and surface-enhanced Raman spectroscopy (SERS). A good yield of the compound has been sourced and isolated from the seeds of Alpinia nigra. Experimentally obtained vibrational modes of the compound obtained by IR and Raman were verified by theoretical calculations at density functional theory (DFT) level using Gaussian 09 software package. Copper nanoparticles have been used to enhance the inherently weak Raman signals of the compound. In the SERS spectra, intense enhancement (up to 10³ fold) was observed in the bands at lower wavenumbers, corresponding to the in-plane deformations, which indicated perpendicular orientation of the compound on the metal surface. However, some bands were weakened by the proximity of the metal surface. This interaction was assessed by IR and visualized by electron microscopy, revealing that Cu nanoparticles lie in the vicinity of the compound, which is responsible for the SERS phenomenon.

Keywords: Cu nanoparticles, labdane diterpene, surface-enhanced Raman spectroscopy, Fourier transform infrared spectroscopy.

Introduction. Terpene derivatives, which are secondary metabolites sourced from plants, display a spectrum of biological activity, ranging from antipathogenic to antidiabetic and analgesic [1–6]. In addition, derivatives like sesquiterpene (e.g., cnicin) are known to induce myeloma cell death even in the presence of cytokines [7]. Studies on the structural and vibrational properties of analogous terpene derivatives could yield vital chemical clues to accentuate their biological potential [8]. IR spectroscopy is an excellent noninvasive, label-free, and vibrational analytical method that elucidates the general biochemical profile and specific functional groups of the compound under investigation. In addition, Raman spectroscopy has the added advantage of requiring a very small amount of sample for analysis with nearly no interference from water molecules [9, 10]. In fact, Raman spectroscopy has been used to study molecular associations and thermal vibrations in gases [11, 12]. Yet, the widespread use of Raman scattering has been curtailed by its inherently small signal intensity [13]. Subsequently, the intensity of Raman scattering has been greatly enhanced by positioning a Raman scatterer on or near a roughened metal surface [14]. This enhancement, known as surface enhanced Raman scattering (SERS), can be used to increase signal strength in any system handicapped by an intrinsically weak Raman signal [15].

Copper nanoparticles (Cu NPs) can be employed as SERS substrates since they exhibit surface plasmon resonance (SPR). The SERS is, in turn, responsible for significant enhancement in electromagnetic field, due to oscillations of incident light and the free movement of electrons in the NPs. The SPR property of Cu NPs is adopted in various optical enhancement applications, with the SERS function being one of its better known/accepted applications [16]. Further, the widespread utility of Cu NPs for SERS is accelerated by its low procurement cost, which has offset its inherent disadvantage of metal reactivity. These factors have encouraged researchers to study Cu NPs and optimize its applicability as a SERS substrate, despite the associated disadvantages. SERS is known to exhibit a high sensitivity for a wide range of bioactive compounds [17, 18]. It is a powerful tool to probe chemical interactions between the adsorbing molecules and the surface of metals like Cu, Au, Ag, etc. SERS is, therefore, capable of stimulating even a 10-fold amplification of the Raman signal from the adsorbed molecule [19–21]. However, it must be noted that SERS is a viable approach to adopt when only one or two biomolecules are of interest [10].

*To whom correspondence should be addressed.



Assessment of genetic variation among wild *Alpinia nigra* (Zingiberaceae) population: an approach based on molecular phylogeny

Supriyo Basak^{1,2} · Ishani Chakrabartty¹ · Vivek Hedao¹ · Rahul G. Shelke¹ · Latha Rangan¹

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Abstract

Genetic structure was evaluated among wild *Alpinia nigra* (Gaertn.) B.L. Burtt, populations. The information of genetic relatedness was developed using random amplified polymorphic DNA (RAPD), inter-simple sequence repeat (ISSR) and barcoding loci (plastid and mitochondrial). The order (high to low) of Shannon's information index (I) and Nei's gene diversity (h) from the populations was: "IIT Guwahati" > "Amingaon" > "Saraighat". Genetic diversity decreased and genetic differentiation increased among the three populations. We observed no isolation by distance thus lower amount of gene flow was observed. Narrow range of genetic distance among the three populations and appearance of two distinct clusters strengthened the geographical isolation in dendrogram and principal component analysis. No mutation among the three populations was observed for seven plastid loci and two mitochondrial tested suggesting the taxonomic homogeneity. The phylogeny based on nine barcoding loci supported our observation that individuals of IIT Guwahati were partially isolated from the outside populations. Our study will provide a backbone for developing strategies to resist habitat fragmentation of Zingiberaceous plants.

Keywords *Alpinia nigra* · Genetic diversity · DNA barcodes · Habitat fragmentation · ISSR marker · Population differentiation · RAPD marker

Abbreviations

<i>accD</i>	Acetyl-CoA carboxylase-D
<i>atpF–atpH</i>	ATP synthase subunit b–ATP synthase subunit c
<i>cob</i>	Apocytochrome b
<i>coxI</i>	Cytochrome oxidase subunit 1
ISSR	Inter simple sequence repeats
PCA	Principle component analysis
PIC	Polymorphic information content

PCR	Polymerase chain reaction
<i>psbK–psbI</i>	Photosystem II reaction center protein K–Photosystem II reaction center protein I
RAPD	Random amplified polymorphic DNA
<i>rbcL</i>	Ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit
<i>rpoCI</i>	RNA polymerase C
<i>rpoB</i>	RNA polymerase B
UPGMA	Unweighted pair group method with arithmetic mean.

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✉ Latha Rangan
latha_rangan@yahoo.com

¹ Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Guwahati 781 039, Assam, India

² Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, 650201 Kunming, China

Introduction

Genetic variation is considered to be a mode of adaptation to rapid environmental changes, which is a major cause of habitat fragmentation. The vulnerability of plants to genetic erosion may be determined from the genetic diversity. Due to habitat fragmentation, small sized plant populations get confined to a small fragment of the previously widespread habitat. This reduced population size has a negative impact upon the reproductive success and plant fitness because of