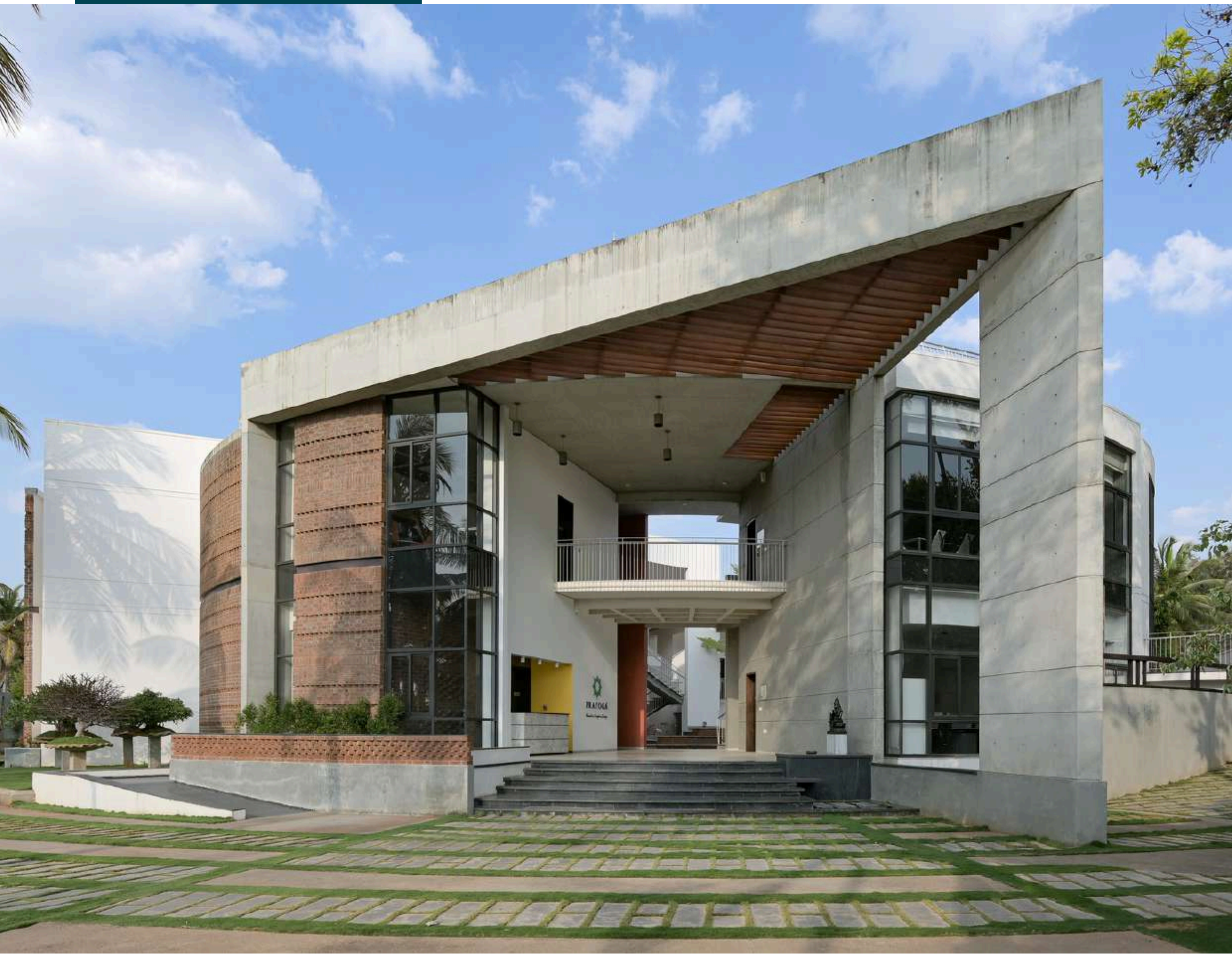
PORTFOLIO

PRAYOGA™
Research to Transform Learning



ANVESHANA

RESEARCH PROJECTS
2024

Nurturing Researchers for Tomorrow

ANVESHANA

Nurturing Tomorrow's Researchers

With education being primarily coursework-based, students excel in environments where learning outcomes are known or certain. We need to provide opportunities and support students in acquiring the competencies necessary to become world-class researchers. This broadens their scope for exploration and fosters a culture of discovery within the educational framework.

The Anveshana program nurtures the next generation of researchers for the country. High School Students (grades 9-12) passionate about a career in science are encouraged to apply to this unique student-researcher program.

Students participate in research projects guided by senior researchers at Prayoga. They are introduced the process and products of science research, developing competencies necessary to become world-class researchers. This broadens their scope for exploration and fosters a culture of discovery within the educational framework.

Research builds capabilities to deal with unknown outcomes and the attitudes to deal with uncertain paths in acquiring knowledge.

Under the guidance of experienced researchers, students researchers of the Anveshana program are encouraged to conduct innovative scientific research under five areas of thematic research

Green Chemistry

Advanced and Functional Materials

Earth Sciences

Wellness

Food & Agriculture

For Prayoga, Anveshana is an Education Research Project. How does science research impact learning outcomes? Do the skills learnt during the research process affect students' attitudes toward science as a whole?

The impact of research in developing competencies and performance is assessed through this initiative which will help us evolve a framework to develop and nurture the next generation researchers for the nation.

ANVESHANA

List of Projects

01 **ANV-PR-013**

Isolation and Screening of Bilirubin Oxidase-Producing Microbes from Rotten Wood Samples for Industrial Applications

02 **ANV-PR-014**

Investigating the Effects of Anacardic Acids on Intracellular Calcium Levels.

03 **ANV-PR-015**

Investigating and Raising Awareness of Chemical Hazards in Everyday Life

04 **ANV-PR-016**

Nature to Nanotech: Saponin-capped Green Nanoparticles for Environmental and Biomedical Applications

05 **ANV-PR-017**

Lake sedimentology and hydrogeology for efficient rainwater harvesting and artificial recharge in Bengaluru

06 **ANV-PR-018**

Mineral-Microbe Interaction: Exploring through Milk Fermentation Experiment in Pots Made of Different Minerals

07 **ANV-PR-019**

Tree leaves as a separator for graphene based supercapacitors.

08 **ANV-PR-020**

Engineering the cerium oxide nanoparticles with enhanced hydrophobicity

20 Projects Completed

8 Student Research Publications

61 Total Student Participants

2024

Isolation and Screening of Bilirubin Oxidase-Producing Microbes from Rotten Wood Samples for Industrial Applications

Mentors

Dr. Venkata Krishna B, Senior Researcher, Dept. of Biology
Mrs. Jayatha BC, Research Associate, Dept. of Biology

Students

Ms. Raichal, 12th Std, Guru Nanak India PU College, Bidar

Ms. Harshali Rathod, 12th Std, Guru Nanak India PU College, Bidar

Ms. Anushka Chandra, 9th Std, Sri Kumarans Children's Home, Bengaluru

Ms. Nandana Raghavendra, 10th std Mallya Aditi International School, Bengaluru

Overview

Bilirubin oxidase (BOX) is an enzyme with significant applications in medical diagnostics and environmental bioremediation. It is particularly useful in jaundice detection and the degradation of azo dyes. This enzyme was initially reported from the fungus Myrothecium verrucaria MT-1.

So, the present study aimed to isolate and screen bacteria and fungi for BOX production and improve BOX productivity in M. verrucaria through UV-induced mutations.

Outcomes

After screening bacteria and fungi isolated from different samples, we successfully isolated a fungal strain (Isolate F20) producing BOX from decayed wood samples. The production of BOX in M. verrucaria was enhanced through UV-induced mutation.

The enzyme obtained from Isolate F20 was partially purified and shown to degrade bilirubin. The project demonstrated the potential of UV-induced mutation to enhance BOX production, offering insights into microbial sources for BOX and their industrial applications.

Further investigations are needed to characterize the enzyme and optimize fermentation conditions.

Investigating the Effects of Anacardic Acids on Intracellular Calcium Levels

Mentors

Dr. K S Nagabhshana, Research Director

Ms. Shruthi Srinath Chakravarthy, Research Associate, Dept. of Biology

Supervisor

Prof. K Sandeep Prabhu, Head, Dept. of Veterinary and Biomedical Sciences, Penn State University, USA

Students

Ms. Vachana B Hiremath, 12th Std, Rashtrotthana Vidya Kendra, Bengaluru

Ms. Chirantana, 11th Std, Brigade Public School, Bengaluru

Ms. Gopika G, 10th Std, Guru Nanak Public School, Bidar

Overview

This study investigates the effects of anacardic acid, the chief component of the natural cashew nut shell liquid (CNSL), on intracellular calcium levels.

Calcium ions are crucial for cellular processes, including glucose transport and neuronal pathways. Understanding these effects is vital for diabetes and neurodegenerative diseases, as diabetes mellitus is linked to neuropathy, retinopathy, and nephropathy, with glucose uptake heavily regulated by calcium ions.

Outcomes

Anacardic acid was extracted and characterized using chromatographic and spectroscopic methods. HEK-293T cells cultured with varying anacardic acid concentrations in DMEM (Dulbecco's Modified Eagle's Medium) showed the highest viability at 1µM.

Cells treated with anacardic acid exhibited a significant decrease in glucose level in 25 hours compared to untreated cells, indicating potential biological activities of these naturals.

Investigating and Raising Awareness of Chemical Hazards in Everyday Life

Mentors

Dr. S Athavan Alias Anand, Senior Researcher, Dept. of Chemistry.

Ms. Asha C H, Research Associate, Dept. of Chemistry.

Students

Ms. Usha R, 10th Std, Sai Krushna Vidya Mandir

Ms. Nalini R, 9th Std, Sai Krushna Vidya Mandir

Mr. Aniketh V B, 10th Std, Rashtrotthana Vidya Kendra Banashankari

Overview

The project aimed to identify and characterize chemical hazards in thermal bill paper, driven by concerns over potential health and environmental risks associated with these widely used materials.

Understanding these risks is crucial for developing safer alternatives and informing regulatory measures to protect public health and the environment.

Outcomes

Chemical compounds were extracted from thermal bill paper and characterized using High Resolution Mass Spectrometry (HRMS) and Fourier Transform Infra-red Spectroscopy (FTIR). Studying their structures for drug-like properties revealed hazardous natures. Toxicology studies with Daphnia pulex demonstrated significant toxicity to the aquatic ecosystem.

These findings underscore the urgent need for safer thermal paper alternatives to mitigate ecological and health impacts.

Nature to Nanotech: Saponin-capped Green Nanoparticles for Environmental and Biomedical Applications

Mentors

Dr. Subhadip Senapati, Senior Researcher, Dept. of Chemistry.

Mr. Parikshit Kumar, Research Associate, Dept. of Physics.

Mrs. Vagdevi Rao K C Research Associate, Dept. of Biology.

Students

Ms. Yamini S, 9th Std, Sai Krushna Vidya Mandir

Ms. Lakshmi G, 9th Std, Kaggalipura Public School

Ms. Kirat Kaur, 9th Std, Guru Nanak Public School, Bidar

Ms. Reshma J V, 9th Std, Viveka Tribal School

Overview

In recent years, green synthesis of nanoparticles coated with different plant components has emerged as a sustainable approach with multifaceted applications.

Saponin was isolated from soapnut in aqueous medium via several methodologies. Green synthesis of saponin-capped copper oxide (CuO) nanoparticles was optimized, characterized, and tested for different applications such as photocatalysis, antioxidant activity, and antibacterial activity.

Outcomes

Several spectroscopic and microscopic methods (UV-Vis, FTIR, XRD, and AFM) confirmed the formation of saponin-capped copper oxide nanoparticles.

These nanoparticles showed promising potential in three critical domains: photocatalysis of methylene blue dye, antioxidant activities using DPPH assay, and antibacterial applications against pathogenic bacterial strains. In general, saponin-capped nanoparticles exhibited much better efficiency compared to nanoparticles without saponin.

Lake sedimentology and hydrogeology for efficient rainwater harvesting and artificial recharge in Bengaluru

Mentors

Dr. Ajit Singh, Principal Researcher, Dept. of Earth Sciences.
Dr. Biraj Borgohain, Researcher, Dept. Earth Science.
Dr. Omprakash S S, Researcher, Dept. of Physics.
Ms. Padmapriya Rajan, Research Associate Dept. of Physics.

Students

Ms. Nila Nagraja, 12th Std, The Valley School, Bengaluru
Mr. Gurunath Rao, 9th Std,Government High School, Kaggalipura, Bengaluru
Ms. Harini Baskaran, 12th Std, PSBB Learning Leadership Academy, Bengaluru
Mr. Nitesh C, 12th StdMES PU College of Arts, Commerce & Science, Bengaluru

Overview

The project addresses issues on water scarcity, and increasing demand-supply gap in Bangalore district. There is a huge volume of water available as Bangalore receives 948 mm of annual rainfall but the problem is lack of storage.

As a solution for increasing storage capacity both at surface and subsurface, we mapped changes in number, area, and volume of lakes using remote sensing and GIS approach. We also mapped lake stratigraphy to estimate thickness of alluvium using a geophysical method.

Outcomes

The project offers a sustainable solution for rainwater harvesting and groundwater recharge by suggesting lake rejuvenation through the mining of a 5-7 meter thick layer of alluvium at the lake bottom. This approach aims to increase the overall storage capacity for rainfall water and enhance groundwater recharge.

The mined material, which has economic value in agriculture (for soil nutrition) and the building and construction sectors, can be used beneficially.

Consequently, leasing out lakes for alluvial mining can generate revenue for the State.

Mineral-Microbe Interaction: Exploring through Milk Fermentation Experiment in Pots Made of Different Minerals

Mentors

Dr. Biraj Borgohain, Researcher, Dept. of Earth Science.
Dr. Venkata Krishna B, Senior Researcher, Dept. of Biology.
Dr. Ajit Singh, Principal Researcher, Dept. of Earth Sciences.

Students

Ms. Ananya P, 10th Std, PSBB Learning Leadership Academy, Bengaluru

Mr. Ayyappa, 10th Std, Viveka tribal school

Ms. Aprameya SK, 11th Std, Real learning centre

Overview

Mineral-microbe interactions (MMI) have been a key factor for sustaining life on our planet. The science of MMI is an invaluable tool and promising application in increasing crop productivity, biorestoration and bioremediation technologies.

Through this project, students will indulge in studying MMI through milk fermentation experiments. Milk contains diverse microbiomes and curdles under specific conditions. Can minerals help create conditions to ferment milk? Is the resultant curd (fermented milk) consumable?

The project aims to find the answer to these questions. Towards this, an interaction between minerals from different rocks and microbes of milk will be studied to understand the role of minerals in milk fermentation.

Outcomes

Milk fermentation experiments were carried out in four pots. These pots are made of different minerals/ substances, such as clay, Habur stone (sandstone-limestone), soapstone (talc-schist), copper, and steel. The result shows a similar trend in pH variation in all pots, however, experiments in soap-stone pots reveal a slight disparity during the process of milk fermentation.

Moreover, a variation in the growth of microbial colonies was also observed in experiments conducted in the Habur stone pot. This suggests that minerals present in the pots may play a role in the fermentation of milk, however, consumability of fermented milk products using different pots needs further investigation.

Tree leaves as a separator for graphene based supercapacitors.

Mentors

Dr Omprakash S S, Researcher, Dept. of Physics.

Mr. Adarsh V N, Research Associate, Dept. of Physics.

Students

Mr. Bhargava Manu Srivatsa, 11th Std, Samvida.

Mr. Shashank C K, 10th Std, Rashtrotthana Vidya Kendra, Banashankari.

Mr. Shreyovardhan L, 10th Std, PSBB Learning Leadership Academy, Bengaluru.

Overview

Supercapacitors (SCs) have been extensively used in advanced energy applications due to their superior energy storage capacity and rapid charge-discharge rate.

The fabrication, characterization, and energy storage capacity of a graphene-oxide (GO)-based supercapacitor device is discussed. The separator material for ion transport is plant-sourced to enhance the sustainability and eco-friendly nature of these devices.

Outcomes

The developed supercapacitor uses environment-friendly material. The electrode material is a conductive carbon ink and graphene oxide acts as a current collector, the separator material used in this study is leaves of banana and ginger.

The capacitive properties of the fabricated devices are investigated in Sodium Sulfate electrolyte. The electrochemical characterization of the device revealed proper capacitive performance and the separator displayed promising results.

Engineering the cerium oxide nanoparticles with enhanced hydrophobicity

Mentors

Dr. Ramya Prabhu B, Researcher, Dept. of Chemistry.
Ms. Swetha, Research Associate, Dept. of Chemistry.

Students

Ms. Ojaswin Sastry, 9th Std,Purnapramati Girinagar
Mr. Karthik N, 9th Std, Sai Krushna Vidya Mandir
Mr. Sachith M V, 10th Std, Rashtrotthana Vidya Kendra, Banashankari
Ms. Tanesha Kumaraswamy, 11th Std, Vijaya Bharathi PU College, Bengaluru

Overview

The designing and synthesis of nanomaterials with distinctive physical and chemical properties provide novel opportunities for utilizing them for a wide variety of applications. The structures and surface characteristics of the nanomaterials have a major influence on their physicochemical properties.

We provide a simple and effective wet chemical method for the controlled synthesis of functionalized cerium oxide nanostructures by varying the reaction parameters.

Outcomes

The synthesized cerium oxide nanoparticles (NPs) are characterized using XRD, Raman spectroscopy, FESEM, TEM, and FTIR to study the crystal structure, morphology, and functional groups.

We investigated surface wettability for various functionalized cerium oxide NPs by contact angle measurements. The functionalization of cerium oxide resulted in the enhancement of the contact angle.

For Anveshana Student-Researchers, the learning experience includes

- Exposure to Scientific Research in Contemporary Domains
- Experience the Joy of Discovery
- Expert Guidance from Prayoga Research Mentors
- Develop Reports with Opportunities for Publication
- Access to State-Of-The-Art Laboratory Facilities
- Interaction with Eminent Scientists

This is a unique opportunity for students interested in pursuing scientific research as a career to engage with senior researchers, explore their areas of interest and hone skills and competencies required to strive in a research and academic environment.

> *I could see in the students an interdisciplinary approach to the projects undertaken. The students have truly developed into inquiring minds, equipped with terms and concepts, in a bold search for new insights and truths.*
>
> **Dr P R Krishnaswamy**
> Former Chief of Pathology, Jaslok Hospital
> Visiting Professor, Cornell University
> Special invitee - Nobel Committee for Physiology and Medicine, 1985
> International Cancer Union Fellow

Applications for Anveshana are open once a year between January and March.

To learn more about the program, visit: **www.prayoga.org.in/anveshana**

For further information and queries, contact: **anveshana@prayoga.org.in**

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