



ANVESHANA

RESEARCH PROJECTS 2022

Nurturing Researchers for Tomorrow

Table of CONTENTS

01

In vitro Analysis of Antibacterial Activity of Dombeya wallichii Plant Extracts against Food Pathogens

Dr. Venkata Krishna Bayineni, Suvratha Herur, Shreedadithya Kashyap (ANV - PR - 001)

02

Effect of Coating Seeds with Micronutrients and Bacterial Consortia on Stomatal Conductance and Yield of Cluster Bean

Dr. Venkata Krishna Bayineni, Sachin Vashisht, Punya Shree (ANV - PR - 002)

03

Can Copper Displace Zinc from its Solution?

Dr. K.S.Nagabhushana, Mr. Ramasimha, Sameer Jois, Pranav Sharma, Saathvik Bhaasadwaj (ANV - PR - 003)

04

Estimation of the Oxalate Content of Various Food Supplements and Analysis of Kidney Stones by FTIR Spectroscopy

Dr S. Athavan Alias Anand, Chinmaya Praveen, Varnika Kikkeri V (ANV - PR - 004)

05

Modulation of Stomatal Conductance in response to changes in External Factors for Plants grown in the Tropical Climate

Dr. Subhadip Senapati, Viswajit Adiga, Samanyu Chandra (ANV - PR - 005)

06

Isolation and Purification of Secondary Metabolites by Steam Distillation, Solvent Extraction and Chromatographic Techniques

Dr. Anamika Sharma, Dr. K. S. Nagabhushana, Vanisha Gupta, Umang Sultania, Gouri Naik (ANV - PR - 006)

07

Assessment of Quality and Antibiotic Residues in Pasteurized and Raw Milk Samples in the Region of Bengaluru

Dr. Venkata Krishna Bayineni, Amulya H Chidananda, Karuna Prakash, Nikita Shanbhag (ANV - PR - 007)

In vitro Analysis of Antibacterial Activity of *Dombeya wallichii* Plant Extracts against Food Pathogens



Dr. Venkata Krishna Bayineni
Senior Researcher, Prayoga



Suvratha Herur
Class 10, Samvida,
Bangalore



Shreedithya Kashyap
Class 9, Samvida,
Bangalore

Overview

The project aims to investigate the potential antibacterial properties of *Dombeya wallichii* plant extracts against common foodborne pathogens. This study seeks to contribute to the field of natural antimicrobial agents and their potential applications in food safety and preservation.

Key Results

We screened the antibacterial potential of bark, flower, stem, and leaf extracts against five strains of food spoilage-causing bacteria. Our results indicated that the ultrasonic-assisted approach effectively increased the extraction yield. We observed the highest antibacterial activity in the stem extracts, followed by leaf and bark extracts. The extracts were more effective against tested Gram-positive bacteria when compared with Gram-negative strains. Further research for potential therapeutic applications should be done in order to better understand the antibacterial activity of *D. wallichii*. This knowledge may help design future antimicrobial compounds.

Publication

This research work has been accepted by the Journal of Emerging Investigators (JEI) 2023, Vol 6, pp 1-8. <https://doi.org/10.59720/22-260>.
<https://emerginginvestigators.org/articles/22-260>

JEI is an open-access journal run by Harvard University that publishes original research conducted by middle and high school students.



“Learning science concepts or topics as a subject and through research experience is very different from one another. As I have experienced both reading about equipment and using it, I can confidently say that learning science through using it is much more. Identifying a problem, formulating a plan and a solution is a major learning point in research, which is also essential in learning other concepts.”

Suvratha Herur
Class 10, Samvida, Bangalore



“I take more precautions during experiments. Earlier I was not caring about some little things. But now I know that those little things are important. I organize things more neatly in my life which has motivated me to take biology in my future career. The experience was informative, fun and motivating.”

Shreadithya Kashyap
Class 9, Samvida,
Bangalore

Before arriving at Prayoga, students had no experience with research. These projects at Prayoga connects student researchers with faculty mentors to work on a research project. The purpose is twofold: to provide students with real-world research activities experience, as well as to encourage faculty mentorship of young researchers.

Dr. Venkata Krishna Bayineni
Senior Researcher, Prayoga



Effect of Coating Seeds with Micronutrients and Bacterial Consortia on Stomatal Conductance and Yield of Cluster Bean



Dr. Venkata Krishna Bayineni
Senior Researcher, Prayoga



Sachin Vashisht
Class 10, Samvida school,
Bangalore



Punya Shree
Class 10, Samvida school
Bangalore



Dhruva Shankara
Class 10, Samvida school
Bangalore

Overview

The study aims to evaluate the effect of coating seeds with micronutrients in combination with Plant growth-promoting rhizobacteria consortia on stomatal conductance and yields of cluster beans.

Key Results

Plant growth-promoting rhizobacteria (PGPR) are known to influence plant growth by various direct or indirect mechanisms. In search of efficient PGPR strains with multiple activities, a total of 10 bacterial strains were isolated from different rhizosphere soil and plant root nodules in the vicinity of Prayoga's campus. These test isolates were screened for their plant growth-promoting traits and three isolates were selected to develop consortia in different combinations. The micronutrients and bacterial consortia were applied to the seeds in combination as per the studied treatments and drought stress was created during growth stage. The study result revealed improved seed yields with a decrease in stomatal conductance due to plant adaptation to the stress induced by drought. This approach can serve as an effective strategy to enhance cluster bean crop performance.

Publication

This research work has been accepted by the "Journal of Research High School (JRHS)", USA [Vol. 2022(2), ISSN:2688-3651].

JRHS is an international open-access online research journal that aims to publish academic work prepared exclusively by high school researchers—the future scientific community—under the guidance of research advisors. The acceptance rate is approximately 30%.



"I have become more curious and more able in terms of handling experiments, problem-solving, and coming up with an experiment to verify our hypothesis. Most importantly I have become a more patient and persevering individual. I have loved taking up in these projects and now I am much more interested in science."

Sachin Vashisht

Class 10, Samvida school,
Bangalore



"Doing research has improved my thinking skills. I have understood that we don't always need to get positive results. We should be able to handle both positive and negative results. My patience has increased to a large level. My skills of doing teamwork have also increased a lot. After doing research now I am able to listen and understand other people's views. Now I am able to work better with chemicals, equipment and I am able to understand the procedures better. I am also able to analyze the procedure and work according to it."

Punya Shree

Class 10, Samvida school
Bangalore

"It has impacted me in a unique way. I have learned to use and master some instruments in the lab. It is a whole different world from school. This will surely be a memorable experience and a lesson for life to me. I am grateful that I got the opportunity to work for these projects."

Dhruva Shankara

Class 10, Samvida school
Bangalore



Can Copper Displace Zinc from its Solution?



Dr. K.S. Nagabhushana,
Research Director, Prayoga



Mr. Ramasimha,
Researcher, Prayoga



Sameer Jois,
Class 10, Samvida school,
Bangalore



Pranav Sharma,
Class 10, Samvida school,
Bangalore



Saathvik Bhaaradwaj,
Class 9, Samvida school, Bangalore

Overview

This project focuses on the utilization of Cashew Nut Shell Liquid (CNSL), a byproduct of cashew nut processing in India. CNSL contains valuable components such as Anacardic acids and Cardanol, with diverse industrial applications including automotive brake linings, paints, and coatings. With India being a significant producer of cashew nuts, harnessing CNSL presents an opportunity to reduce waste and carbon emissions while maximizing the potential of this underutilized renewable resource.

Key Results

Cashew (*Anacardium Occidentale*) is one of the important agricultural crops in India. The cold pressing of cashewnut gives Natural CNSL while heat treatment gives Technical CNSL. Natural CNSL mainly comprises biologically active Anacardic acids (AA) (70-75%), along with toxic principles called Cardol (20-25%) and 2-methyl Cardol (2%). An insignificant amount of Cardanol (<2%) is present in natural CNSL. Cardanol is the chief component of technical CNSL. CNSL is an underutilized renewable raw material. For 100 kg of CNSL heat treated, 12.5 kg of CO₂ is released.

Publication

A detailed report of the project findings has been submitted to Prayoga Institute of Education Research.



"The research projects were very exciting. It has allowed me to think more logically. I have been looking at things from different angles. Now I am more passionate about science than ever. I would like to perform further research projects."

Sameer Jois,
Class 10, Samvida school,
Bangalore



"The project sessions made me more curious about science. It has made me think of more possibilities. It has helped me to learn the current science more easily because of the interest built-in science by research."

Pranav Sharma,
Class 10, Samvida school,
Bangalore

"These projects have made me more capable of doing things independently. My thinking skills have improved a lot. In research, thinking only in one way doesn't help at all. You need to think about different aspects of the topic you are researching. I have improved on that a lot. I am also more confident in the work I do."

Saathvik Bhaardwaj,
Class 9, Samvida school,
Bangalore



Estimation of the Oxalate Content of Various Food Supplements and Analysis of Kidney Stones by FTIR Spectroscopy



Dr. S. Athavan Alias Anand
Senior Researcher, Prayoga



Chinmaya Praveen
Class 10, Samvida school,
Bangalore



Varnika Kikkeri V
Class 10, Samvida school
Bangalore

Overview

Nephrolithiasis is one of the most prevalent urologic diseases in Asia. Calcium oxalate renal stone disease is a painful and potentially dangerous condition and is one of the most frequent causes of acute surgical admission. The purpose of this research work is to find the list of common vegetables, fruits and other food items which are not suitable for calcium oxalate renal stone patients and also to analyze the chemical composition of kidney stones by Fourier Transform Infrared spectroscopy (FTIR).

Key Results

In the current project, students did a literature survey to learn more about types of kidney stones, mechanism of formation, chemical components of kidney stones, cause and treatment for kidney stone diseases, etc. Later, the students collected two different kidney stones from the health care centre and analyzed the chemical composition of the kidney stones using Fourier Transform Infrared Spectroscopy (FTIR). The data collected from the FTIR spectrum helps students to suggest to the patients about their diet plan.

Publication

The World Kidney Day Committee (Belgium) approved the Anveshana researchers' kidney stone research poster presentation event as an awareness for kidney stone diseases. This poster is available on their webpage.



“These projects have increased my scientific curiosity. They have improved my analytical and problem-solving skills. I have learnt how to handle some instruments which are very useful and how to behave in a laboratory. These research projects have taught me to always have an open mind. I have been inspired and want to continue doing research. It has increased my wonder for science. I think these skills that research has taught me will be useful not only while doing the project, but in my life as well. I learnt a lot and thoroughly enjoyed doing these projects.”

Chinmaya Praveen

Class 10, Samvida school,
Bangalore



“I am sure and confident that I can handle some equipment at the research lab. And I am sure this will help me a lot in the future.”

Varnika Kikkeri V

Class 10, Samvida School
Bangalore

By participating in research activities, they have improved their experimenting and analysing skills. The results of the post-research questionnaires and interviews revealed a considerable shift in participants' perceptions of science and their enthusiasm for it. When students choose science as a career path, these will surely set them apart. In addition to this valuable exposure, students frequently take the lead on their own experiments. Having these powerful experiences also gives them a sense of independence and self-efficacy.

Dr. Venkata Krishna Bayineni

Senior Researcher, Prayoga



Modulation of stomatal conductance in response to changes in external factors for plants grown in the tropical climate



Dr. Subhadip Senapati
Senior Researcher, Prayoga



Viswajit Adiga,
Class 10, Samvida school,
Bangalore



Samanyu Chandra
Class 10, Samvida school
Bangalore

Overview

Plants are greatly modular organisms that can adapt efficiently to changes in external environmental conditions. The effects of light intensity, humidity, and temperature on the stomatal conductances of five plants (*Ficus elastica*, *Ficus microcarpa*, *Tilia Americana*, *Acalypha wilkesiana*, and *Jatropha gossypifolia*) grown in the tropical or sub-tropical climate were investigated.

Key Results

The leaves obtained from these plants were different in morphology, and yet the adaptive trends were found to be similar across the species. Our data showed the light intensity, humidity and temperature significantly affected the stomatal conductances, with humidity having a greater effect on conductance than temperature. Our data also suggested that the peak in stomatal conductances for these plants occurred at a relative humidity range of ~60-80%. Even though the average stomatal conductances of the red colored leaves were higher than the green leaves from the same plant, the difference was not statistically significant.

Publication

The project results have been published in the “Journal of High School Science (JHSS), USA” JHSS is a peer reviewed STEAM Journal that publishes research and ideas of high school students.

Modulation of stomatal conductance in response to changes in external factors for plants grown in the tropical climate. P Samanyu Chandra, Vishwajit Adiga, Chimaya Praveen, Varnika Venkatesh Kikkeri and Subhadip Senapati, Journal of High School Science, 2022.



"These research projects have made me think in many ways and also it has increased my patience."

Viswajit Adiga,
Class 10, Samvida school,
Bangalore



"If I make some mistakes, I try to rectify immediately instead of dwelling on the matter that I have made a mistake. It has also developed curiosity and passion towards science and research."

Samanyu Chandra
Class 10, Samvida school
Bangalore



Isolation and purification of secondary metabolites by steam distillation, solvent extraction and chromatographic techniques



Dr. K.S. Nagabhushana
Research Director, Prayoga



Dr. Anamika Sharma
Senior Researcher,
Prayoga



Gouri Naik,
Class 11, Sri Kumarans Children's
Home, Bengaluru.



Vanisha Gupta,
Class 11, Sri Kumarans Children's
Home, Bengaluru.



Umang Sultania,
Class 11, Sri Kumarans Children's
Home, Bengaluru.

Overview

Plants produce a vast and diverse variety of organic compounds, majority of which do not emerge to participate clearly in growth and development. The volatile organic compounds were isolated using steam distillation technique from 6 different plant sources, Citrus limetta, Mentha, Lavandula, Pimenta dioica, Salvia rosmarinus, and Eucalyptus globulus.

Key Results

All the extracts were evaluated using TLC and UV spectrophotometry. Combination of spots appeared on TLC in different mobile phases for Pimenta dioica, and Eucalyptus globulus. In the UV experiment, λ_{max} was found to be in range 270-300 nm, clearly indicating the presence of aromatic heterocycles along with conjugation present in the extracted volatiles. In the case of Eucalyptus globulus, another approach for extraction (apart from steam distillation) was also adopted. A known quantity of leaves was cut and mixed with a known amount of n-hexane. The system was closed and kept in dark for 7 days. The TLC and UV clearly indicated that the later method was quite comparable to the steam distillation technique.

Publication

A detailed report of the project findings has been submitted to Prayoga Institute of Education Research.



"This project has taught me a lot. It has made us learn how to be with your team as well as work alone. It also made us understand how we should be with our mentors. It has shown us how far science is and keeps asking questions to understand in detail. It has shown us not only that we should learn chemistry but other subjects as everything merges after a point."

Vanisha Gupta

Class 11, Sri Kumarans Children's Home, Bengaluru.



"The practical research projects have given us hands-on experience on how research is carried out. It has given me exposure to how scientists conduct experiments and the following protocol after conducting the experiment. This has been the most important aspect for me as I am keen on joining research."

Umang Sultania,

Class 11, Sri Kumarans Children's Home, Bengaluru.

"It gave me an understanding about how research is conducted in a procedural manner. It made me realise the importance of observation and patience. It cultivated a great deal of interest for me in the field of organic chemistry."

Gouri Naik,

Class 11, Sri Kumarans Children's Home, Bengaluru.



Assessment of Quality and Antibiotic Residues in Pasteurized and Raw Milk Samples in the Region of Bengaluru



Dr. Venkata Krishna Bayineni
Senior Researcher, Prayoga



Amulya H Chidananda,
Class 11, Sri Kumarans
Children's Home, Bengaluru.



Nikita Shanbhag,
class 11, Sri Kumaran Children's
Home, Bengaluru



Karuna Prakash,
Grade 11, Delhi Public School,
Bengaluru

Overview

Milk quality is determined by physicochemical properties, hygienic standards, and nutritional quality; however, animal husbandry techniques, as well as unsanitary harvesting and processing, may have an impact. A cross-sectional study was conducted in and around Bengaluru to assess the hygiene of the dairy farms, physicochemical characteristics, microbial quality, as well as the prevalence of antimicrobial residues in raw and pasteurized milk samples.

Key Results

A total of 19 milk samples were examined. In general, sources of risks appeared in the existing milk production and supply chain. Some milk samples had abnormal color, abnormal smell, and pH below or above normal, clotted on the alcohol test (79%), and had a specific gravity below normal (9.2%). Preservatives were not detected in any of the milk samples. The mean total bacterial count, total coliform count, yeast and mold count (YMC) of milk container surfaces, person's hand, and milk samples are significantly high which demonstrates the unhygienic practices at the farm. Antimicrobial residues were found in 21% of the samples, with the majority of them coming from pasteurized milk. Microbial contamination is accelerated by an unhygienic milk production chain, and antibiotic residues in milk constitute a major problem that requires immediate attention from the responsible authorities.

Publication

The study results have been published in the "International Journal of High School Research (IJHSR)". The IJHSR is a publication of Terra Science and Education (New York, United States). This is the leading high school research journal. All manuscripts published by IJHSR are indexed internationally by EBSCO. IJHSR selects the highest quality of high school student research work in all areas of science.



"The independence provided helped me to be more efficient. Provided a platform to provide research at a young age and learn about the methodology of conducting the research. Analysis of results was something I learnt. Making many tables to get a comparative studies between all the samples. Presenting the project with people who already know a lot about science, getting inputs about our project in something that will help me to grow and learn"

Amulya H Chidananda,
Class 11, Sri Kumarans
Children's Home, Bengaluru.



"Knowing how research works and its methodology and more practical knowledge helps me relate and understand theory better. Logical thinking Making me more interested in pursuing a research career. Knowing that there can be many outcomes to an experiment\ Gaining knowledge from taking to experts"

Karuna Prakash,
Grade 11, Delhi Public School,
Bengaluru

"This research gave me an idea of how scientific research actually works. There is a lot of hard work and patience involved and things may not turn out how you want them to .This experience was a learning curve and I am grateful for it"

Nikita Shanbhag,
class 11, Sri Kumaran Children's Home,
Bengaluru



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.

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 thrive in a research and academic environment.

Anveshana is a program which has originated from a lot of experiments and thought processes which have been put in by the group at Prayoga. The emphasis would be to encourage these students to take up an innovation or for that matter a repeatable research program in such a way that their knowledge is improved in the particular area with respect to doing experiments and in theoretical evaluations. This therefore brings the students to a level where they can compete with researchers at higher levels.

Prof T N Guru Row

Professor Emeritus, IISc, Renowned crystallographer

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

Prayoga is a not-for-profit organisation,
registered under the Indian Trusts Act

80G ✓ FCRA ✓ CSR ✓ 35(1)(ii) ✓

Prayoga is a recognised **Science and
Industrial Research Organisation** by the
Government of India

Survey No. 133, Ravugodlu, Bolare Post
Off Kanakapura Road, Bengaluru South
Bengaluru - 560 116

<http://www.prayoga.org.in>

+ 91 94491 03270





PRAYOGA™
Research to Transform Learning



ANVESHANA

RESEARCH PROJECTS 2022

Nurturing Researchers for Tomorrow

<http://www.prayoga.org.in>