NANOPLANT NEWSLETTER

NO. 5. FEBRUARY 2023

New discoveries

Suitability of Adenosine Derivatives in Improving the Activity and Stability of Cytochrome c Under Stress

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Nanostructured green solvents enhance efficacy of phenylalanine ammonia-lyase (PAL)

CeO_2-based nanoformulations for enhancing plant growth

The International Advisory Board Meeting

The specialists from Australia, the Netherlands, and Slovakia visited Poznań, Poland, for the second International Advisory Board Meeting. On September 12-14, they met the NANOPLANT team, visited the Institute of Plant Genetics laboratories, and shared their knowledge on sustainability.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no 856961. The information and views set out in this newsletter are those of the authors and do not necessarily reflect the official opinion of the European Union.

WP4

NEW TEAM MEMBER

Tadeusz Mirski

Tadeusz Mirski is a new PR Specialist in the NANOPLANT project. He is an experienced specialist in communication and management of innovative projects. He worked in three innovation incubators and a living laboratory, supporting various innovators in creating revelatory solutions. His primary role is to promote the project on social media, build relationships with potential stakeholders, and organize public relations to maximize the impact of NANOPLANT.

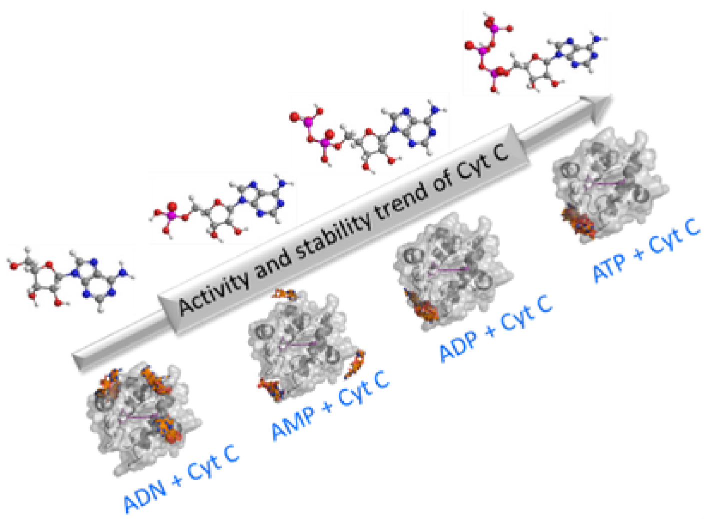
WP5

STEPPING UP RESEARCH EXCELLENCE

Suitability of Adenosine Derivatives in Improving the Activity and Stability of Cytochrome c Under Stress

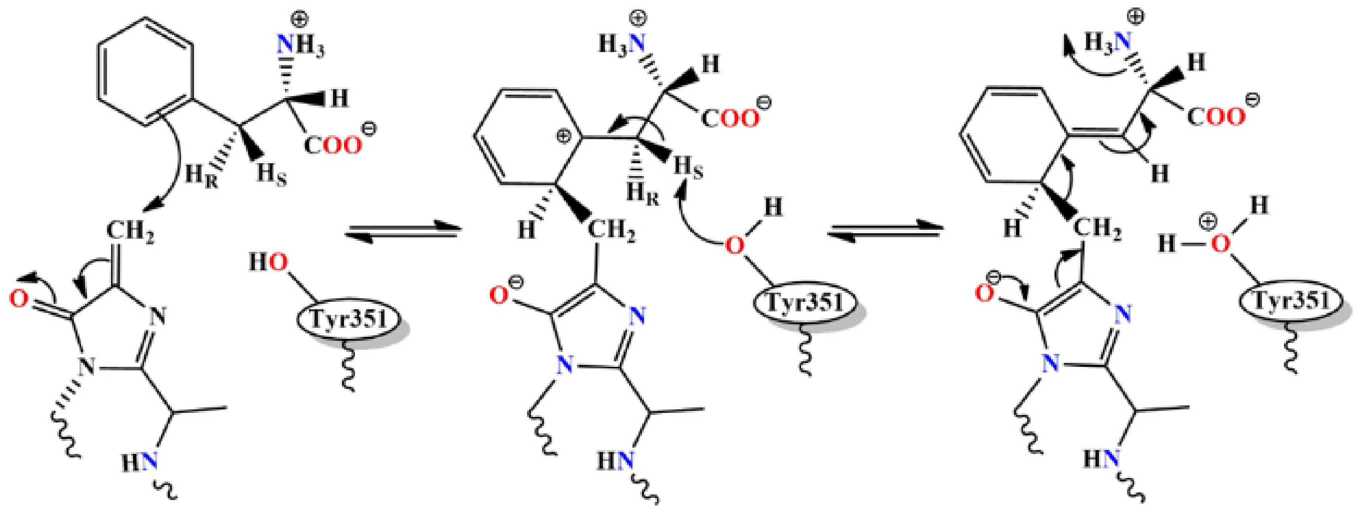
Research related to Adenosine-5'-triphosphate (ATP) has gained immense interest after its hydrotropic nature came into light *(Science, 2017, 356, 753-756)*. Thus it is very important to study the effect of ATP in its sub-millimolar as well as in its cellular concentration ranges. We have unveiled the plausible interactions of adenosine (ADN), AMP, ADP and ATP with the heme metalloprotein Cytochrome c and characterized though various spectroscopic and computational studies.

The results indicate that with changes in the secondary structural features, Cyt c is found to be stabilized via electrostatic and soft interactions. This endowed the protein to show over 6-fold higher peroxidase activity in presence of ATP and generally >1.5 times higher activity in the rest of the cases, which were further retained to a greater extent even under the harsh processing conditions like over exposure to hydrogen peroxide and guanidine hydrochloride. This work has been published in the reputed *Journal of Physical Chemistry B (J. Phys. Chem. B 2024, 128, 1, 86–95)*.



Nanostructured green solvents enhance efficacy of phenylalanine ammonia-lyase (PAL)

The importance of Phenylalanine ammonia lyase (PAL) enzyme lies beyond biological cycles (phenylpropanoid pathway) and can be effectively explored by several pharmaceutical industries. Yet, its lower specific activity and inability to sustain harsh processing conditions such as higher temperature and long-term incubation, limits its potential use as a biocatalyst. Hence, by taking green chemistry principles into consideration, we developed a greener, efficient and sustainable solvent manipulation strategy to enhance both activity and thermodynamic stability of *Rhodotorula glutinis* PAL (RgPAL) simultaneously by using plant growth regulators-based nanostructured green solvents. The manuscript is now under review in RSC *Green Chemistry* journal.



CeO_2-based nanoformulations for enhancing plant growth

The integration of nanomaterials into agriculture offers innovative solutions that improve nutrient delivery, optimize pesticide efficiency, enable targeted seed treatments, and support sustainable soil and water management. We develop nanostructured solvent modified CeO_2 -based nanoformulations and showed their efficiency in improving growth kinetics and biomass productivity in plants, particularly in tobacco.

In a controlled greenhouse experiment, foliar application of CeO_2-based nanoformulations showed significant increase in growth indices, including plant height, photosynthetic rate, leaf fluorescence, and biomass yield.

Further investigation is ongoing to underpin the mechanistic insights behind improved efficacy of the nanoformulations.

Prof. Ajayan Vinu

New Nanoporous Nitride Materials

On September 8, 2023, Prof. Ajayan Vinu gave an invited talk titled "A New Family of Nanoporous Nitride Materials for Energy and Environmental Applications". Prof. Vinu is a Global Innovation Chair Professor and Director of the Global Innovative Center for Advanced Nanomaterials at the University of Newcastle. The seminar took place in the conference room of the Institute of Plant Genetics.

ABSTRACT

WP6

KNOWLEDGE TRANSFER AND SPILL-OVER

Spectrometers tested

The team of the NANOPLANT project took part in two trainings, having a chance to test different spectrometers.

On September 19-20, the scientists familiarized themselves with operating the most compact TXRF spectrometer for ultra-trace element analysis, the S2 PICOFOX.

On October 10, training on NanoDrop™ One Microvolume UV-Vis Spectrophotometer was conducted. This device measures the quantity and quality of DNA, RNA, and protein samples in seconds with only 1-2 µL. Both trainings were organized at the Institute of Plant Genetics.

Spectometers tested: the S2 PICOFOX (above) and NanoDrop™ One (below)

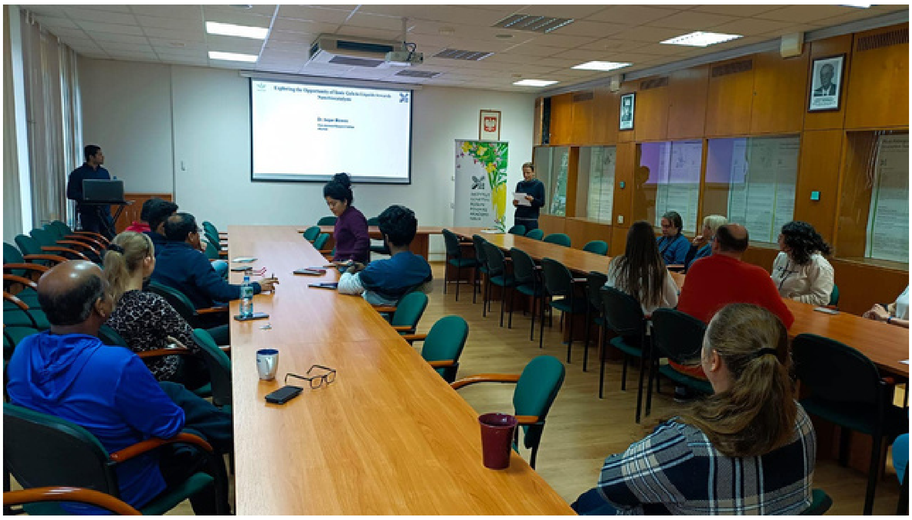
Intellectual Property Rights in Nanotechnology

On November 30, the IPR seminar entitled "Legal Framework of Intellectual Property Rights in Nanotechnology" was held at the Institute of Plant Genetics. Mr. Jan Dobrzański appeared as the lecturer. He is a Polish and European patent attorney and litigator for European patents. Mr. Dobrzański is also a partner at AOMB Polska, one of the leading patent law firms in Poland.

Jan Dobrzański

Ionic Gels and Liquids Towards Nanobiocatalysis

Dr Sagar Biswas, Adjunct Assistant Professor in the Institute of Plant Genetics, featured the relations between chemistry and nanobiotechnology during a lecture on December 13. The presentation was titled "Exploring the Opportunity of Ionic Gels and Liquids towards Nanobiocatalysis."



Presentation of Dr Sagar Biswas

NEW STAKEHOLDERS

In recent months, we have engaged two recognized companies to cooperate in the project as stakeholders. The companies are the Polish INTERMAG sp. z o. o. and the Dutch Croptivate.

INTERMAG

The main activity of the first company is the development and production of modern preparations for agriculture. INTERMAG is one of the largest producers of fertilizers and biostimulants. We will take the opportunity to understand farmers' expectations and discuss our ideas for the development of a nano-fertilizer and the elaboration of joint proposals in this field of research.

CROPTIVATE®
ADVANCED CROP TECHNOLOGY

Croptivate is renowned for producing top-class fertilizers and biostimulants for agricultural markets, with its base in the Netherlands and production facilities in Germany. Our collaboration with Croptivate will focus on two key areas: developing new green formulations for sustainable agriculture and biostimulant/biocide-plant interactions.

STAKEHOLDERS

A new open path to cooperation

On January 16th, we held an online meeting with Brunel University London staff, prof. Justin Fisher and Dr. Eliza Kania, who work in the Brunel Public Policy Unit. We discussed the possibilities of cooperation under the Horizon program in the following areas:

1. Equity, including gendered perspective,
2. Research dissemination strategies,
3. Social & Political Science approach,
4. Policy advice and implementation in the EU.

We are looking forward to further calls for proposals so that we can jointly submit a project.

WP7

MEETINGS AND CONFERENCES

The International Advisory Board Meeting

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Meeting of the NANOPLANT team and IAB members in the IPG PAS

Beginning of the IAB meeting

During the first day of the International Advisory Board (IAB) meeting, the coordinator, the ERA chair holder, the innovation specialist, the specialist for PR, and the laboratory manager presented the overall performance, scientific excellence, and other activities of the NANOPLANT project. IAB members visited the Nanoplant laboratories and collaborators laboratories at IPG PAS.

Presentations and meetings on the first day of the event

Presentations and discussions at the IAB meeting

On the second day of the IAB meeting, the team members presented the scientific research progress of the NANOPLANT project. The highlight was the presentation of our interns, Wiktoria Frątczak and Alicja Szychulska. Dr. Monia Martins and Dr. Meena Bisht, two former postdocs in the NANOPLANT project, connected with the meeting participants remotely and presented their research performed during their association with the project.
Following the presentations, the IAB members met with the director of IPG PAS, the ERA chair holder, and the coordinator. They discussed together the sustainability of the project and possibilities for the future.
The last day of the meeting was dedicated to a final discussion and a summary report preparation.

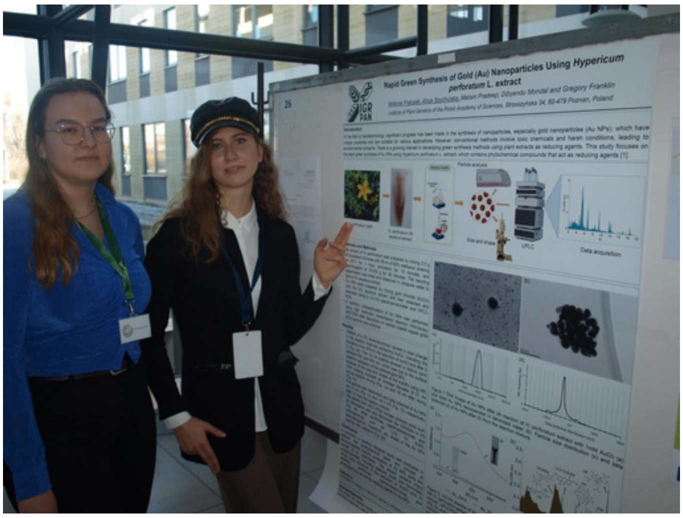
Thanks to the participants

We thank everyone involved in the event.
We thank the Director and Deputy Director for Research for their presence and Professors Robert Malinowski and Arkadiusz Kosmala for interacting with the IAB members and explaining their research and laboratory facilities. We thank our former postdocs, Dr. Monia Martins and Dr. Meena Bisht, for their commitment despite other duties. Our special thanks go to all the IAB members for visiting us, irrespective of their busy schedules.

Final discussion with the IAB members

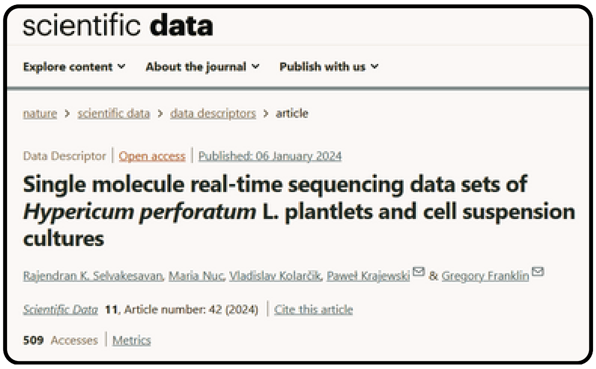
Our Faces of Biotechnology

"The Many Faces of Biotechnology" biotechnology conference was held in November at the University of Life Sciences in Poznań, Poland. Our interns, Wiktoria Frątczak and Alicja Szychulska, took part and won 2nd place for their educational poster. They presented the green synthesis of nanoparticles with the plant extract of Hypericum perforatum L. Congratulations!



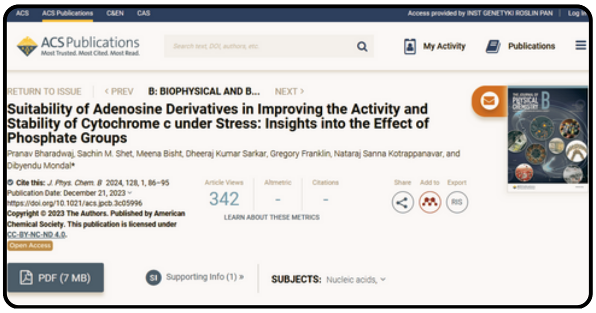
Alicja Szychulska and Wiktoria Frątczak presenting the poster

PUBLICATIONS



Nature:
"Single molecule real-time sequencing data sets of Hypericum perforatum L. plantlets and cell suspension cultures"
Pranav Bharadwaj, Sachin M. Shet, Meena Bisht, Dheeraj Kumar Sarkar, Gregory Franklin, Nataraj Sanna Kotrappanavar, and Dibyendu Mondal

READ



Journal of Physical Chemistry B - ACS:
"Suitability of Adenosine Derivatives in Improving the Activity and Stability of Cytochrome c under Stress: Insights into the Effect of Phosphate Groups"
Pranav Bharadwaj, Sachin M Shet, Meena Bisht, Dheeraj Kumar Sarkar, Gregory Franklin, Nataraj Sanna Kotrappanavar, Dibyendu Mondal

READ

Our Article Was Appreciated

Our research article published in Green Chemistry was selected by the journal as one of the 2023 Green Chemistry Hot Articles. The article was on the nano-structured hydrotrope-caged cytochrome c with boosted stability in harsh environments. Congratulations to all the authors!

READ

UPCOMING EVENTS

We have started preparations to organize an international conference summarizing the project and the subject of plant nanotechnology. The International Conference on Plant Nanotechnology will be held in October. In the upcoming months, we will present more details. Stay tuned for our events, which will be announced on the NANOPLANT website and social media:

- nano-plant.eu
- facebook.com/nanoplanteu
- linkedin.com/company/nanoplanteu

Nanoplant Work Packages:

WP1 Ethics requirements
WP2 Coordination and management
WP3 ERA Chair holder selection
WP4 Strengthening scientific potential
WP5 Stepping up research excellence
WP6 Knowledge transfer and spill-over
WP7 Promotion and dissemination

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