JÁN JAMROŠKOVIČ

Institute of Molecular Biology SAS

Project number
IM-2022-62

Project duration
1.11. 2023 - 31.10. 2028

"The IMPULZ program is poised to enhance my academic career and became more competitive in European grant schemes as ERC. Moreover, it will enable me to conduct highly qualified research and actively participate in the development of a more sustainable society through the lens of synthetic biology."

BIOGRAPHY

Ján Jamroškovič completed his master's degree in Genetics at Comenius University in Bratislava in 2009 and pursued PhD studies in Molecular Biology at the Institute of Molecular Biology of SAS in Bratislava, graduating in 2014. Subsequently, he undertook his first postdoctoral research position at the Laboratory of Environmental Microbiology at EPFL in Lausanne, Switzerland. In 2015, he relocated to Umeå University in Sweden, where he joined the research group of Associate Professor Nasim Sabouri as a postdoc, later assuming the role of a senior research engineer. During this period, he focused on studying the biology of DNA structures and contributed to drug development targeting DNA structures in cancer cells. Their efforts led to a patent for a promising cancer treatment, and this research project was later translated into Biotech Umea Incubator as a potential start-up. In 2022, he applied for a position within the prestigious IMPULZ program and was offered a position at the Institute of Molecular Biology of the Slovak Academy of Sciences in Bratislava. Starting from November 2023, he is establishing his own research group within the Department of Microbial Genetics. His research interests center around DNA structures in industrial bacteria and their integration into genetic engineering.

G-quadruplex DNA for Genetic Engineering in Bacteria

Synthetic biology is an interdisciplinary and rapidly evolving field that studies the biological functions of naturally occurring phenomena and applies this knowledge in genetic engineering. The main task of the field is to engineer microorganisms with specific properties in order to synthesize various products, to increase sustainability in a bio-based economy, and to provide solutions to environmental challenges. These methods combine cascades of genes into genetic circuits, which provide the microorganisms with novel functions. The current challenge in synthetic biology is how to increase the complexity of regulatory regions in short DNA fragments. Alternative DNA structures that act as genetic regulators can meet this need, and one type of such structures are the four-stranded DNA complexes called G-quadruplexes (G4s).

The main goal of the proposed project is to implement G4s as novel regulators in genetic circuits in bacteria and to combine these with other DNA-based regulators. To achieve this, I will study G4s to understand their biology, maintenance, and effects on basic cellular processes, such is replication and gene transcription. There is a substantial knowledge gap regarding the presence and function of G4s in bacteria, but studies in eukaryotic model systems provide strong evidence regarding their folding and biological functions during gene transcription. Therefore, I believe that the incorporation of G4s into genetic engineering methods will increase the tunability and versatility of the regulation of synthetic bacterial gene networks.
My strategy is to use the Gram-positive spore-forming bacterium Bacillus subtilis as a model system. B. subtilis is an industrially important bacterium and is considered a universal cell factory for industry, agriculture, biomaterials, and medicine and has been used as a model system for studies of basic cell processes for more than 60 years. Therefore, any positive outcomes of this project will be directly transferable to existing biotechnologies.

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PUBLICATIONS

1. Jamroskovic, J.; Deiana, M., Sabouri, N., Probing the folding pathways of four-stranded intercalated cytosine-rich motifs at single base-pair resolution. Biochimie 2022, 199, 81-91 https://pubmed.ncbi.nlm.nih.gov/35452743/

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3. Deiana, M.; Chand, K.; Jamroskovic, J.; Obi, I.; Chorell, E.; Sabouri, N., A Light-up logic platform for selective recognition of parallel G-quadruplex structures via disaggregation-induced emission. Angewandte Chemie 2020, 59 (2), 896-902. https://pubmed.ncbi.nlm.nih.gov/31644837/

4. Obi, I., Rentoft, M., Singh, V., Jamroskovic, J., Chand, M., Chorell, E., Westerlund, F., Sabouri, N.; Stabilization of G-quadruplex DNA structures in Schizosaccharomyces pombe causes single-strand DNA lesions and impedes DNA replication. Nucleic Acid Research 2020, 48(19), 10998-11015. https://pubmed.ncbi.nlm.nih.gov/33045725/

5. Jamroskovic, J.; Livendahl, M.; Eriksson, J.; Chorell, E.; Sabouri, N., Identification of Compounds that selectively stabilize specific G-quadruplex structures by using a thioflavin T-displacement assay as a tool. Chemistry-A European Journal 2016, 22 (52), 18932-18943. https://chemistry-europe.onlinelibrary.wiley.com/doi/10.1002/chem.201603463

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