University of Stuttgart

Stuttgart Research Center Systems Biology

SRC SB

Systems Biology Seminar Talk

Bringing fluorine into the (essential) chemistry of bacteria

Prof. Pablo Iván Nikel
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22.01.2024
14:00 CET

Lecture Hall 0.106
Allmandring 31
Stuttgart

Abstract:

Fluorine (F) is a key element for the synthesis of molecules broadly used in medicine, agriculture and material applications. 'Decorating' organic structures with F atoms onto is a unique strategy for tuning molecular properties—yet organofluorines are rarely found in Nature, and approaches to integrate fluorometabolites into the core biochemistry of living cells are scarce. In this talk, I will also discuss how synthetic metabolism can be implemented to expand the chemical landscape of bacteria, thus providing alternative biosynthetic strategies for fluorinated building-blocks. Such general approach will be illustrated by showing how synthetic gene circuits can be engineered in the platform bacterium *Pseudomonas putida* for organofluorine biosynthesis. To this end, fluoride-responsive riboswitches, orthogonal RNA polymerases and novel fluorinating enzymes mined from extreme environments were combined to drive *in vivo* biofluorination reactions. Biosynthesis of fluoronucleotides and fluorosugars in engineered *P. putida* is demonstrated with mineral fluoride both as the only F source (i.e. as a substrate of the pathway) and as inducer of the synthetic circuit. Building on these results, prospects for bioproduction of fluorinated building blocks and materials will be likewise discussed at the light of 'F-addiction' strategies.

CV:

Pablo I. Nikel earned a Ph.D. in Biotechnology and Molecular Biology (2009) in Buenos Aires, Argentina. During graduate school, his research focused on repurposing two-component signal transduction systems in engineered *Escherichia coli* to produce biopolymers and biofuels. After working in USA (Rice University, supported by the ASM), Pablo moved to Europe as a post-doctoral fellow in Prof. de Lorenzo's laboratory in Madrid, funded by the European Molecular Biology Organization (EMBO) and the Marie Skłodowska-Curie Actions (MSCA) of the European Commission. During his post-doctoral training, he came across the fascinating world of environmental bacteria—and, in particular, that of *Pseudomonas putida*. Inspired by the unique possibilities that these bacteria offer for bioengineering, he is now leading the *Systems Environmental Microbiology* Group at DTU Biosustain. Pablo's team aims at rewriting *P. putida*'s core biochemistry through synthetic metabolism for biosynthesis of novel compounds with a focus on new-to-nature fine chemicals (www.sem-cfb.com). The ambition of this research programme is expanding the very limits of microbial biochemistry—granting access to compounds that, as of today, are exclusively produced *via* traditional chemistry nowadays. Pablo coordinated the H2020 project *SinFonia* (www.sinfoniabiotec.eu), establishing fluorine biocatalysis using different SynBio approaches, and he is Full Professor of the Technical University of Denmark (since 2023).