USING SYNTHETIC BIOLOGY FOR FLAVONOID PRODUCTION

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Dr. Juan Nogales is the head of System Biotechnology Group at Centro Nacional de Biotecnología-CSIC in Madrid. He studied Biology and Biochemistry at the University of Extremadura and received his Ph.D. in Biochemistry and Molecular Biology focused on microbial biodegradation from the University Complutense of Madrid. His Postdoc training was performed at University of Iceland and University of California, San Diego, where he delved into systems biology approaches to whole understanding microbial metabolism and its biotechnological potential. His current research spans multidisciplinary approaches, including Systems and Synthetic Biology, whose common goal is the whole understanding of microbial living systems, from the molecular characterization of their fundamental components and their interrelationships, to their systems properties. He possesses a large experience in metabolic reconstructions and metabolic engineering. Moving forward from cells to microbial communities, his group is developing new protocols for synthetic microbial ecosystems designing and engineering. Currently he is PI in several projects, including three H2020 research projects being main coordinator of SynBio4Flav, a cutting-edge endeavor pursuing the standardized and cost-effective biotechnological production of functionalized flavonoids in the context of synthetic microbial consortia.

What are the flavonoids and what is the scientific challenge of SynBio4Flav project?

Flavonoids are phytonutrients occurring naturally in plants. They are an integral part of the human diet and their wide range of industrial applications includes food & beverage, dietary supplementation, nutraceuticals and cosmetics. There are over 6,000 types of flavonoids, each with its unique set of benefits. Depending on the type they can exhibit anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties. They also support our immune and cardiovascular systems and help to modulate key functions of enzymes in our cells.

SynBio4Flav consortium includes 11 partners under the lead of the Spanish National Research Council and aims to go further in the standardization of high complexity synthetic biology parts. SynBio4Flav pursuits to produce flavonoids by breaking down their complex biosynthetic pathways into standardized specific parts, which can then be transferred to engineered microorganisms to promote flavonoid assembly and functionalization through distributed catalysis.

In your experience, what have been the key challenges in industrial flavonoid production?

Industrial production of flavonoid is limited by the sheer availability of flavonoids. Market suppliers are constrained by a narrow range of suitable plant sources containing low concentrations of flavonoids. On the other hands, traditional microbial biotechnology approaches face the challenge of the complex flavonoids biosynthetic pathways which avoid the cost effective production of these metabolites. SynBio4Flav's is facing these challenges going deeper in the concept of decoupling, one of the foundations for Synthetic Biology. Thus Synbio4Flav lies on the synthetic de-convolution of the complex biosynthetic flavonoids pathways into minimal functional modules and its further combinatorial reassembling in novel synthetic pathways at multisystem level, within the context of Synthetic Microbial Consortia (SMC). The individual components of the SMC are genetically programed to deliver optimal outputs for subsequent biosynthetic steps along the distributed catalysis process. This groundbreaking approach is expected to deliver significantly improved yields and cost efficiency.

What potential do you think synthetic biology has for complex chemical production?

Complex secondary metabolites, such as flavonoids, terpenoids, alkaloids, polyketides etc., have incredible health benefits. However the large scale production of these compounds and feasible analogous is challenging. Following SynBio4Flav approach and going further in the development of Synthetic Biology foundations, these are the optimization of Standardization, Abstraction and Decoupling, it will be possible to stablish formatted and systematic platforms for the industrial production of such compounds in the near future. In addition, Synthetic Biology promotes component troubleshooting and re-usability which largely will allow the systematic exploring of the chemical space and thus the expansion of complex metabolites and their feasible analogues being accessible to industrial bioprocesses.

What do you intend to get out of attending the Synthetic Biology Congress in London in November?

Synthetic Biology is a rapidly growing field but still in its infancy. At this point, there is not a complete consensus about standard procedures in Synthetic Biology but alternative approaches and parallel developments are in place. In any case, Synthetic Biology is well positioned to become in a key discipline in biological sciences. My main expectations for the meeting are not only keeping my updated with the new technologies and trends in Synthetic Biology but to get a good coverage of the field in terms of biotechnological applications, and to identify the key players in the field. An intangible added value is the possibility to discuss on the ground about bioethics and safety aspect around Synthetic Biology applications with expert in the field.