SynBio4Flav - Press release

September 2023

Made by Microbes

Changing the chemical manufacturing game with synthetic microbial consortia

- Research was conducted into microbial production as a sustainable alternative to massive exploitation of natural resources by traditional production practices.
- The European research project SynBio4Flav provided proof of concept for effective bioproduction using synthetic microbial communities.

Invisible allies have played a decisive role in generating the rich environment that supports human life on Earth. All visible life forms evolved in intimate proximity with the world of microbes and benefit from engaging in multiple symbiotic relationships with them.

The European research project SynBio4Flav explored the potential of microbial communities for alternative production of natural substances such as flavonoids, which have great potential as medicine or food supplement but cannot be extracted in sufficient quantities from plants. Suppliers are constrained by a narrow range of suitable plant sources containing low concentrations of flavonoids. Resource-intensive cultivation and extraction processes cause economic and ecological bottlenecks for large-scale applications and fundamental research into their highly promising properties. Novel biomanufacturing techniques relying on the ability of microbial communities to mimic the way in which plants synthesise flavonoids have great potential to narrow the growing gap between demand and supply.

Microbial biomanufacturing technologies have become well established over thousands of years to make cheese, bread, beer, wine and many other culinary specialties at the heart of local traditions in all cultures worldwide. Fermentation is the key underlying bioprocess driven by the intricate set of metabolic connections displayed by microbial communities. Fermentation is in fact the oldest biotechnological tool known to humans. Nowadays it supports groundbreaking advances in life sciences such as the advent of synthetic biology, which promises to provide sustainable solutions to tackle global challenges set by a fast-growing world population. Synthetic biology opens up a vast new ground for the arrival of alternative bioproduction systems designed for traditional as well as novel applications. Research is accelerated by major milestones such as CRISPR-Cas9, a Nobel-prize-winning genome editing tool derived from a natural bacterial defence system against viral attacks.

Rather than optimising complex biosynthetic pathways using a single microbial species, SynBio4Flav has implemented an innovative approach whereby flavonoid biosynthesis is split into its basic steps and distributed among several microbial species - each specialising in a particular step - to power the production process. The complex sequences of biochemical reactions involved in flavonoid production are carefully coupled within the microbial network.

Breaking down complex biosynthetic pathways into standardised parts and transferring them to microbial producers introduces the flexibility and robustness of a modular system. Importantly, it also supports a virtually infinite number of variations by recombining bio-modules in a plug and play manner. The SynBio4Flav approach supports the delivery of multiple outcomes using a restricted number of modules.

At the end of the project in August 2023, SynBio4Flav has provided proof of concept for flavonoid bioproduction displaying positive interactions within synthetic microbial consortia. Microbial strains were optimised to produce essential precursor compounds and a selection of key flavonoids at gram-scale. Lab tests have delivered promising results in terms of strong anti-tumour and anti-inflammatory activity for certain flavonoids biosynthesised in the project. In addition, SynBio4Flav has made a major contribution towards the standardisation of synthetic biology and the adoption of computational design solutions dealing with complex chemical processes.

The ambition of the eleven partner organisations behind SynBio4Flav reaches beyond the production of flavonoids. Through variations in the composition of synthetic microbial consortia, microbial cell factories have the potential to produce many other complex organic substances, thus delivering a promising, sustainable, cost-efficient and long-term alternative to traditional extraction from crops.

Indeed, microbial biomanufacturing promises to become a key player in the race towards meeting the needs of a growing world population with production methods that care for the preservation of precious natural resources.

"Revolutionary in this project is that we are trying to change completely the paradigm in the synthesis of complex chemicals." Juan Nogales, project coordinator, CSIC

"Distributing the biosynthesis of complex chemicals within engineered microbial communities—the trademark of our project—leaves behind the strategies of production of high-added value molecules that have dominated biotechnology for too many decades." Victor de Lorenzo, research professor, CSIC

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Further information on the project SynBio4Flav can be found on the website:
https://synbio4flav.eu/

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