

**BioTech Research
& Innovation Hack**

2021

ERA CoBioTech Funded Projects at A Glance: BestBioSurf

**Synthetic Biology for the development of novel, cheap and efficient
biosurfactants**

PART OF

**EUROPEAN
BIOTECH
WEEK**



INNOVATION IS IN OUR GENES



BestBioSurf

Synthetic biology for the development of novel, cheap and efficient biosurfactant

BestBioSurf project aims at producing novel and eco-friendly biosurfactants in a cost-effective manner through lab-scale validation to a bio-process demonstrator within a real environment.

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Project duration:

1 May 2018 - 31 December 2021

Total budget: 1.5 €M

To reduce the cost price of surfactin by developing optimised cell factory, culture medium and bioprocesses for its production, to develop novel surfactin-like molecule by synthetic biology approach

Surfactin is a amphiphilic lipopeptide, composed of a fatty acid chain linked to a circular ring of 7 amino acids, produced by several strains of *Bacillus subtilis*. Surfactin is synthesized by multienzymatic proteins called NonRibosomal Peptide Synthetases. This mechanism is responsible for the diversity of surfactin produced, on the fatty acid chain and on the amino acid present in the circular peptidic chain. Surfactin has huge interest for industrial application due to their chemical and biological proprieties. It can be used as a biosurfactant, antimicrobial and anti-tumour compound. Despite all these properties, the production of surfactin at the industrial scale is challenging because the biological production is too low.

The objectives of this project were (1) to produce by synthetic biology new non-natural surfactins with best surfactant properties (2) to optimize by genetic engineering the metabolic pathway leading to the precursors of surfactin to increase the production of this lipopeptide and (3) to use a sustainable and cheap medium (Protiwanze) to grow the mutants.

The results obtained allows to consider the use of lipopeptide in several applications instead of less biodegradable chemical surfactants.

Bioinformatics, synthetic biology, metabolic engineering

The BestBioSurf project used bioinformatics to modelling the best biosurfactants and define the best approach to get the novel surfactin-like molecules. Metabolic engineering was used to develop an optimized cell factory for the production of lipopeptide. Synthetic biology approach was used to modify the biosynthetic mechanism of surfactin and get novel biosurfactants.

Main results

The project has demonstrated the low ecotoxicity to algae of Surfactin and that Protiwanze and the cell tainer are respectively a cheap substrate and a bioprocess well adapted to its production. The optimizing of the surfactin precursor biosynthesis leads to a strain able to produce more than 5 g/l of surfactin.

A new glass cleaner formulation was developed with surfactin.

The Best BioSurf project also shown that the overproduction of surfactin leads to an increase biodiversity of compounds and that the remove of the fifth module of the surfactin synthetase deeply disturbs the efficiency of the synthetases.

Future prospect

Surfactin has a huge power of surfactant and has many applications as foam creation and stabilization in food processing, detergents for household cleaning, phase dispersion for cosmetics and textiles, or solubilisation of agrochemicals. Surfactin can also be used in the process of bioremediation. Reduction of its cost price will increase its use in these different applications. In addition, the new surfactin-like compounds produced could by increasing the surfactant efficiency and reducing the ecotoxicity and toxicity lead to the development of novel applications. Moreover, the use of recyclable medium to grow the strains and produce the surfactin is an eco-friendly approach.



One review, involving the different partners and describing the state of the art related to the general strategy of the project, has been published on the subject: "The Surfactin-Like Lipopeptides From *Bacillus* spp.: Natural Biodiversity and Synthetic Biology for a Broader Application Range" Theatre et al., 2021, *Frontiers in Bioengineering and Biotechnology*.

Three other publications related to the optimisation of cell factory for surfactin production, LCA of surfactin production, synthetic biology applied to the obtaining of novel surfactin-like molecule are in preparation.

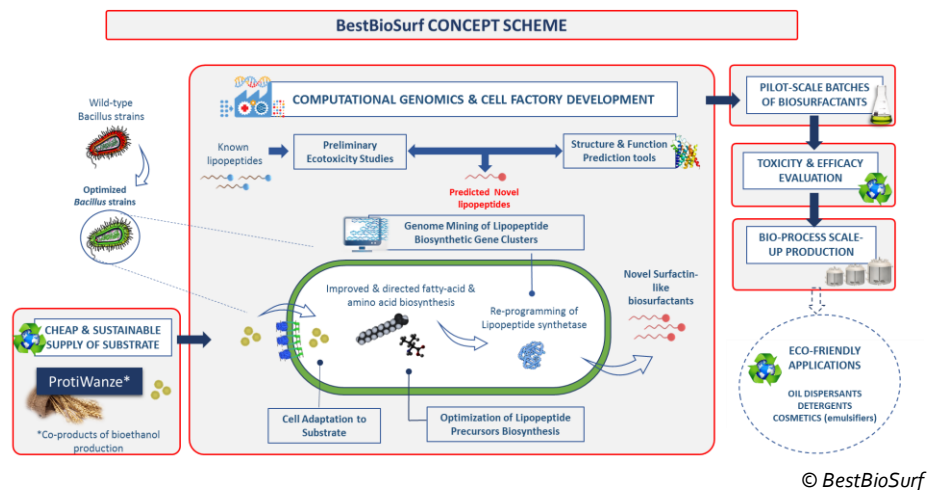


Figure 1: Concept scheme of the project.

Website: <http://www.bestbiosurf.eu/>

