ERA-CoBioTech: Bioprocesses for the optimized, integrated production of butyl esters from sustainable resources (BESTER)

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Industrial Biotechnology is a key enabling technology to produce a plethora of different bio-based products from sustainable resources and a driver for developing the bio-based economy in Europe. Systems biology and Synthetic biology are recent additions to the biotechnology toolbox that in interplay with bioprocess and chemical process technology can help developing competitive industrial bioprocesses for new valuable product manufacturing.

The specialty chemical industry is a $450 billion market, and is a part of the $5.4 trillion global chemical market. Within this market, butyl esters, derivable from n-butanol (BuOH) and suitable organic acids by esterification, have diverse uses as commodity chemicals and drop-in biofuels, but also represent high value opportunities within the fragrance and flavour industry, cosmetics, specialty polymers and coatings. The production of BuOH in the anaerobic clostridial ABE fermentation process is well established, and has in 2016 reached commercial scale in the US by UK-based company and BESTER project partner Green Biologics Ltd. (GBL). What is needed to produce butyl esters for the commodity market are efficient processes to produce suitable organic acids from renewable resources as counterparts for BuOH in catalytic esterification. In combination, the use of esterase enzymes as natural, sustainably producible biocatalysts for ester formation will allow entirely green bioprocesses for the production of different butyl esters, thus increasing market value of the ABE process and reducing GHG emissions.

The ERA-CoBioTech project BESTER establishes clostridial bioprocesses for an optimized integrated production of a range of different butyl esters using lignocellulosic sugars as a sustainable feedstock for the commodity chemicals market. Efficient organic acid production processes will be developed, which can be

linked to ABE fermentation processes as a source of BuOH. BESTER will thereby address in a coordinated way the two key handles for efficient production of the three acids, i.e. a) Systems biology driven strain engineering using Synthetic biology principles to establish new acid production in suitable clostridial chassis strains and mitigate key metabolic bottlenecks hampering high productivity, and b) smart process design and integration to prevent inhibitory effects of the acids produced and the BuOH added in efficient bioprocesses with continuous enzymatic ester product formation and recovery. Lignocellulosic feedstock hydrolysate will be used as the main feedstock in BESTER. The primary project deliverable will be a set of scalable, robust, and highly productive manufacturing processes for selected butyl esters.

The BESTER project connects six project partners with highly complementary expertise from four different ERA-CoBioTech partner countries, i.e. Norway, UK (2), Germany (2), and France, in order to maximise project output and share risks, costs and skills. The project is substantially industry-driven with large enterprise GBL (UK) and SME Processium SA (FR) participating as active partners. Furthermore, Borregaard AS (NO) will support the project by providing both expert advice from the project's Advisory Board and fermentation feedstock. The three companies are positioned along the butyl ester value chain, which will ensure that project results are efficiently taken further towards commercialization. In this way, BESTER will contribute to tackle the 21st century societal challenge to reduce the reliance on fossil feedstocks for chemical production and to achieve sustainable industrial development in Europe.