PRESS RELEASE

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Yeast instead of crude oil: on the way to renewable plastics

Carbon is the basic building block of life on earth. We eat carbon in the form of carbohydrates, consume fossil fuels and produce many things, such as plastic, from carbon. All in all, life without carbon would not be possible. But with the start of the industrial revolution, carbon's extensive use fueled one of the biggest problems of our age: climate change. In response to the ongoing climate crisis and the increasing need for renewable resources, the recycling of CO_2 into a feedstock is becoming an interesting solution. The CO_2 can in fact be captured and transformed into raw material, contributing to a decrease in the carbon emissions of hard-to-abate industries and their dependency on fossil import.

This is where the European research project VIVALDI comes into play. The project develops a set of innovative biotechnologies that transform real off-gases from key bio-based industrial sectors (Food & Drinks, Pulp & Paper, Bioethanol and Biochemicals) into 4 industrially relevant organic acids: lactic acid, succinic acid, itaconic acid and 3-hydroxypropionic acid.

The bioproduction of these organic acids is carried out with a specifically engineered yeast strain (*Pichia pastoris*), which can utilize methanol and formic acid as a carbon and/or energy source. The University of Natural Resources and Life Sciences, Vienna (BOKU), part of the 16 project partners, leads the development and validation of this integrated yeast-based fermentation process.

Research advancement

Recently, BOKU's research group led by Professor Diethard Mattanovich was able to modify the CO_2-producing heterotrophic yeast, *Pichia pastoris* (also known as *Komagataella phaffii*), so that it can build its biomass from CO_2.

"*Now we have taken a significant step further: we were able to produce raw materials for industrial products such as bioplastics, polymers or absorbents from CO_2 by introducing additional genes from lactic acid bacteria and molds into the modified yeast*," explains Diethard Mattanovich, head of the research group and department head at BOKU.

This ground-breaking work was recently published in the scientific journal "The Proceedings of the National Academy of Sciences (PNAS)". PNAS is one of the most cited journals with a high impact factor. The more than 3500 articles published annually in this journal cover a wide spectrum of content from biology, physics to social sciences.

First success on a laboratory scale

By applying synthetic biology methods, the metabolic pathways for the production of itaconic acid and lactic acid could be introduced into the modified yeast *P. pastoris* and both products could be produced from CO_2. Using ^{13}C isotope labeling, the researchers were able to demonstrate that the desired products were made from CO_2.

With a yield of almost 2 grams of itaconic acid per liter, the first successes have already been celebrated.

"*Until we reach industrial maturity, we need to further optimize the strains and processes*", says Michael Baumschabl, a doctoral student in this project.

Özge Ata, Senior Scientist at BOKU and the Austrian Centre of Industrial Biotechnology (acib), summarizes the enormous potential of this work: "*There is still a long way to go, but we have now been able to show that greenhouse gases can indeed be used as raw materials for important chemicals*."

Contact person	Univ.Prof. Diethard Mattanovich
Partner organisation	University of Natural Resources and Life Sciences, Vienna
Mobile number	+43 1 47654-79001
E-mail address	diethard.mattanovich@boku.ac.at

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