KEY FOR CITRIC ACID PRODUCTION DISCOVERED

AN ACIB RESEARCH TEAM HAS RECENTLY FOUND THE RESPONSIBLE TRANSPORT GENE THAT ALLOWS THE PRODUCTION OF CITRIC ACID IN LARGE QUANTITIES.

Citric acid is – in terms of quantity – the most important microbially produced natural substance in the world with an industrial production capacity of approx. 2 million tons per year. A number of everyday products would be inconceivable without the versatile acid: It is used to acidify and conserve foods such as marmalades and desserts, as well as in cosmetics, cleaning agents, detergents and life-saving medicines. The growing demand for citric acid causes production volumes to rise by three to four percent a year. For industry it is a challenge to ensure ever higher product yields with consistently high quality.

Hundred years of process – comprehended for the first time

"Whereas until the beginning of the 20th century citric acid had been produced from lemons, for more than a hundred years the filamentous fungus *Aspergillus niger* has been regarded as an industrial fermentation vehicle for citric acid and fulfils this task very efficiently," says acib researcher Matthias Steiger. To this day, however, research has puzzled about how the process works in molecular biological detail - and how it can be optimized. Together with a research team from acib and BOKU Vienna, Steiger found a new transporter that for the first time revealed to biotechnologists which protein enables the fungus to release citric acid from the cell. This mechanism is the basis for producing citric acid in large quantities. The research results have recently
been published in the renowned journal "Metabolic Engineering".

Production of citric acid in detail

Steiger explains the production process: "Today so-called 'submerge processes' are used in the biotechnological production of citric acid. The fungus *Aspergillus niger* is cultivated in closed bioreactors to produce the substance as requested in a nutrient solution containing sugar. In order to make the fungal cells produce citric acid in large quantities, or in other words to over-produce it, the acid must be transported out of the cell. Now the gene, which encodes this transport protein has now been discovered: "This protein has the ability to secrete the citric acid produced in the cell via the plasma membrane. We were able to show that we could start or stop the production of citric acid by switching the gene on or off. This transport mechanism is the key building block for understanding the metabolic pathway that takes place in the organism," says Steiger. After further purification processes, the acid is available to industry as a raw material.

Impact and effects

The better understanding of this process means improved stability for production conditions and a fivefold production yield compared to production with wild strains, which corresponds to approx. 100 g citric acid per litre. According to the statements of the researchers, these insights give manufacturing industry a significant edge in the future. acib key researcher and BOKU-Scientist Michael Sauer comments: "By better understanding the individual process steps and process conditions, we hope not only to increase production but also to make it more robust. This, so the prognosis, could set new yardsticks in the quality of products and lead to price advantages for final consumers.

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