# TRAINING BACTERIA TOGETHER

**Train a bacterium to turn sucrose efficiently and with great specificity into a useful feedstock for the production of bioplastics. That is in short what Jonas Contiero from the São Paulo State University and his partners Aljoscha Wahl and Karel Olavarria Gamez from TU Delft set out to do a couple of years ago. Contiero and Olavarria Gamez tell the tale of their collaboration.**

***You are working on a joint FAPESP/NWO project. How did that come about?***

**Karel Olavarria Gamez (KOG),** who was a post doc researcher on the project when at TU Delft, and is currently working at Wageningen University and Research: 'Aljoscha and I have been working together since 2013 on the metabolic engineering of Escherichia coli to produce certain compounds. We wanted to use sucrose for the bacteria to grow on. That is why Brazil is a perfect match for us, since it is the largest producer of sucrose. When the joint FAPESP/NWO call came, we reached out to Jonas.'

**Jonas Contiero (JC):** 'Aljoscha and Karel contacted me and invited me and my group to write a joint proposal. We thought this was a nice opportunity to start a collaboration, since I have a long-standing interest in the microbial production of polyhydroxyalkanoates (PHA), which represent an excellent source to produce bioplastic materials. Aljoscha and Karel were interested in using molecular tools with E. coli, a kind of lab rat for microbiological studies. The FAPESP/NWO call gave us the opportunity to combine the two to optimize the use of sucrose towards the synthesis of PHA under anaerobic conditions.'

***What is the biggest challenge in this research?***

**KOG:** 'We need to genetically modify E. coli to take sucrose and efficiently turn that into a precursor for the production of biobased, biodegradable plastics under anaerobic conditions, so without oxygen. With oxygen present, the bacterium would use part of the sucrose to produce water, instead of the desired molecule.'

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***How does your expertise complement each other?***

**JC:** 'In Brazil, sugarcane is cheap and abundantly available. Its product sucrose is an excellent source of carbon to produce complex carbohydrates by bacteria via fermentation. My group works on the genetic mechanisms to improve the use of sucrose by E. coli, while the Dutch group dissects the biochemistry of PHA-synthesis.'

***What has the project resulted in so far?***

**JC:** 'From our side, the most promising results are related to the genetic establishment of the sucrose consumption by E. coli. We are isolating genes that allow the bacteria to grow

faster by using the sugar as an energy source. Now we are combining these genes to obtain a strain that is optimized to propagate on sucrose.'

**KOG:** 'We established proof of concepts for some of the essential synthesis steps. For example, we managed to assemble a cluster of genes that enable the bacteria to accumulate (poly)-3-hydroxybutyrate under oxygen limiting conditions. And on both sides of the ocean, we trained a myriad of bachelor, master and PhD students in the field of biotechnology, which in my view is an essential result of such a research project.'

***Has there been any exchange of students between both countries?***

**JC:** 'So far not. There was of course the problem of the pandemic. Also the fact that Aljoscha left TU Delft for a position in Germany did not make things easier. However, since we have one and a half year left on the project, there is still time to collaborate with his successor in this project Mark van Loosdrecht at the TU Delft Department of Biotechnology.' KOG: 'Under the umbrella of this project, I expect a colleague from Brazil to come to the Netherlands in Spring 2023, financed by FAPESP under the SPRINT (São Paulo Researchers in International Collaboration) scheme. Personally, I visit Brazil regularly. I always use those trips to meet with colleagues and present my work.'

***How do you look back on the collaboration within this project?***

**KOG:** 'I find these types of international collaborations to provide very good opportunities for personal growth. Together you can develop new ideas, and educate the next generation in tackling complex, global challenges. As far as I am concerned, in these types of projects, exchange of personnel should be mandatory though. The fact that I have been working as a researcher at the University of São Paulo for some years myself certainly helped in understanding the daily reality of my colleagues across the ocean.'

**JC:** 'I would definitively recommend my Brazilian colleagues to pursue such a collaborative project under any FAPESP/NWO call. They are well organized and give an excellent opportunity to seed a collaboration with a Dutch group. The Dutch science, like the one produced at the TU Delft Department of Biotechnology, ranks among the best in the world. We can always learn from this excellence. The Dutch biotechnology is also very much oriented towards practical applications, like it is here in Brazil.'

**KOG:** 'Even though I am not at TU Delft anymore, together with Mark van Loosdrecht I try to keep this collaboration alive. This research is important, both from a basic science and from an applied research point of view.'

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> ***Jonas Contiero***
> *São Paulo State University*

### A NOVEL STRATEGY FOR ANAEROBIC PRODUCTION OF POLYHYDROXYALKANOATES (PHA)

Plastics play a central role in modern life. The current production has surpassed 300 million tons per year generating problems with its deposition and penetration in the food-chain. The substitution of persistent plastics by bio-based and bio-degradable plastics is an excellent opportunity to reduce environmental contamination. For several reasons, polyhydroxyalkanoates (PHAs) are attractive alternatives. However, current production costs of these environmentally-friendly plastics are not yet competitive, especially at low fossil-fuels prices. A radical technological change is required to make industrial production of PHAs economically feasible. In their joint project, São Paulo State University and TU Delft genetically reengineer Escherichia coli in such a way that the bacterium can synthesize PHA under anaerobic conditions.