Proteins for **Singapore**

The Southeast Asian city-state of Singapore wants to produce one third of the food it needs locally by 2030. Sounds ambitious? Researchers at TUM are helping make the dream come true.

Link

www.tum-create.edu.sg/research/proteins4singapore

www.lse.ls.tum.de/en/bgt/home

Oliver Watkins opens the door to the growth chamber, an enclosed plant cabinet as high as a full-sized refrigerator. Inside the chamber, soy plants are growing in orderly rows stacked on four levels, one on top of the other. “My colleagues can regulate the supply of light, water, and fertilizer independently and thus control how the plants grow. No additional pesticides are necessary,” the chemist says on his tour through the laboratory in the CREATE Tower, a high-rise research complex in the southwest of Singapore. “The decisive advantage is that vertical farming requires so little space.”

A high-tech metropolis short on resources

Singapore’s approximately 5.7 million residents live in an area roughly the size of the city of Hamburg. The Southeast Asian metropolis lacks farmland: Residential development and infrastructure projects have consumed all but one percent of the arable land. In response to this situation, Singapore’s government has announced the goal of locally producing one third of the food consumed here. In 2019, the figure was still less than 10 percent. The city-state hopes to cut down its dependence on imports and to soften the impact of supply bottlenecks and price fluctuations on the international food market. As part of its “30-by-30 initiative”, Singapore is heavily investing in research projects on sustainable aquaculture, urban farming and new food technologies.

A vision of the final food product

One of these projects is Proteins4Singapore. About 40 researchers from TUMCREATE, Nanyang Technological University and other academic and industrial partner institutions are working on protein-rich foods. “We’re not trying to optimize familiar foodstuffs, we’re starting at the finish line and asking ourselves: What do we want to produce, and what raw materials and processes can be used to achieve that best?” says Thomas Becker, program lead and Professor of Brewing and Beverage Technology. This approach is referred to as Reverse Food Engineering. “Our objective is healthy, high-protein food products, which taste good to the people here in Singapore and which can be produced right here as sustainably as possible. It should taste like chicken and when you bite into it, the texture and consistency should remind you of chicken,” Becker says. The researchers are evaluating the food production process from the beginning to the end, looking for suitable raw materials and cultivation technologies. They are experimenting with various processing methods, ranging from protein hydrolysis to fermentation and even to 3D printing. The special thing about the project is its comprehensive approach: The team covers the entire production process. The researchers can look at all the different perspectives.

Picture credit: Israel Tan Si Lie/TUMCREATE

Algae that taste like chicken

Nadyssa Willanda is one of the researchers responsible for the flavor of the target protein products. Based in Singapore, she is working on her doctorate with Prof. Corinna Dawid from the TUM School of Life Sciences, another investigator in the project. Nadyssa does research on algae, which is one of the most interesting resources for alternative protein products. The only nutrients they need are nitrogen, phosphorus and some micronutrients. "In the first step, we identify and quantify the components of the microalgae biomass which are active in taste and aroma," Nadyssa Willanda explains.

In a second step, the growth and extraction conditions are optimized to obtain algae proteins that resemble chicken meat in terms of the sensory perception of the product. "You have to know how taste perception works on the molecular level before you can specifically influence it," says Willanda. "For example, you can modify manufacturing conditions or add enzymes." The researcher can imagine that the finished protein product will be well-accepted later in Singapore: "Soy and algae products have long been a part of Southeast Asian cuisine." But people in Singapore are also very open to other cultures and their food. The best example of that are the hawker centers: These food courts are listed as UNESCO World Heritage Sites. It's easy to feel the influences of Chinese, Malay and Indian cuisine combined.

A small city-state with big ideas

High diversity in a small space – according to Michael Rychlik, that holds true for research in Singapore as well. "Singapore is an academic hub. Many international top universities maintain a presence here. The city-state knows how to attract cutting-edge level researchers from all over the world," says the TUM Professor of Analytical Food Chemistry, responsible for food safety aspects in the Proteins4Singapore project. In addition to his research, he has also taught at TUM Asia, the TUM teaching campus in Singapore. Modern classrooms, a high degree of digitalization and the enthusiastic participation of the students in this city have impressed him from the very start. "Singapore is highly competitive, but the fact that everything takes place within such a small space almost automatically results in collaboration and interdisciplinary approaches."

"Singapore is so tiny. You easily come into contact with other research topics and you turn into a real all-rounder," Oliver Watkins confirms. Together with colleagues from TUMCREATE, he's responsible for the analytical instruments like the high-resolution mass spectrometer. He appreciates the broad approach of the Proteins4Singapore project: "People from around the world work together, from widely differing disciplines – that's incredibly inspiring." ■

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