Gesamter Artikel (PDF, DE): www.tum.de/faszination-forschung-27

Palmöl aus dem Bioreaktor

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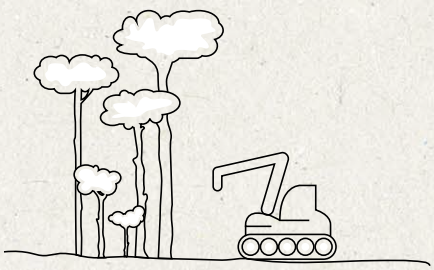
Auf der Suche nach einer umweltfreundlichen Alternative zu Palmöl hat der Biochemiker Dr. Mahmoud Masri ein Verfahren zur Gewinnung von Öl aus Hefekulturen entwickelt – gentechnik- und lösungsmittelfrei, basierend auf organischen Abfällen. Mit seinem Start-up Global Sustainable Transformation will er bald Hefeöl in großen Bioreaktoren produzieren. □

How to Grow Palm Oil **in a Bioreactor**

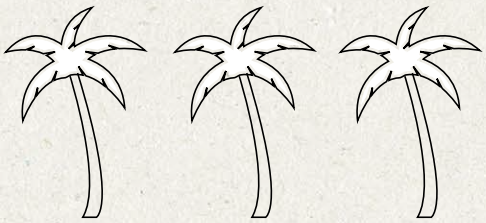
Palm oil would be a great product – if it wasn't for the huge tracts of rainforest that are cut down for oil palm cultivation. Biotechnologist Dr. Mahmoud Masri has now developed a palm oil substitute that can be produced in a yeast culture. He has founded a start-up with the aim of making his vision of environmentally friendly yeast oil a reality.

Eleven years ago, Greenpeace released a gruesome video raging against the use of palm oil in food. In it, a young man, taking a break from the office, reaches for a chocolate bar. He absent-mindedly tears open the packaging, but fails to notice that it contains not a chocolate bar but the finger of an orangutan, into which he unwittingly bites. The ape's blood is then seen running down his chin. The video was intended to draw attention to the fact that his chocolate bar contains palm oil, and that the orangutan's rainforest habitat is being destroyed to make space for oil palm cultivation. In addition to its impact on biodiversity, palm oil cultivation also releases large volumes of CO_2. In 2018/19, the EU decided it was time to take action. From 2030, palm oil, once considered a sustainable product, will no longer be permitted in biodiesel. Despite its image problems, the global market for palm oil is booming. Since 2010, production has grown by nearly 50 % to 74 million tons per year.

For manufacturers of processed foods in particular, palm oil has some very appealing properties. It is tasteless, keeps well, can be used for pan and deep-frying, and is cheap, cholesterol free and vegan. It is also used in skin creams, lipsticks, detergents, shower gels, paints and varnishes. In addition, by comparison with oilseed crops such as soya, rape and sunflower, yields from oil palms are a great deal higher. Much less land is required to obtain abundant harvests. This land, however, has primarily been obtained by clearing rainforests in Indonesia and Malaysia – a process that is still going on today.



Rainforest logging



Palm oil cultivation

74 million

tons of palm oil were produced worldwide in 2018/19

Palm oil

As a result, those looking for palm oil alternatives have a very high bar to clear. But that hasn't deterred Mahmoud Masri at TUM. He is using a tiny single-celled organism – yeast – to produce oil in huge culture vats. "Bioreactors take up a lot less space than oil palms. Yeast cultures are able to produce 50,000 times more oil per hectare than oil palms," explains Dr. Masri.

That yeast can be induced to produce oil has long been known. But the oil produced is a long way from being able to compete with palm oil. Yields are low, oil extraction requires the use of toxic solvents, and the yeast require very specialized nutrient media.

Dr. Masri started by turning his attention to the solvent problem. "I tried a number of enzymes to break open the yeast and extract the oil without using solvents," he explains. "None of them really did the trick." Finally, he tried an enzyme extracted from a specific fungus. The result was as much a surprise to him as it was to his supervisor, Werner Siemens Professor of Synthetic Biotechnology Thomas Brück. "Following enzyme treatment and centrifugation, the test tube I held in my hand had a clear oil layer on top," says Masri. "'What's that?' asked Thomas, and I replied 'It's the oil'. This was a major breakthrough, since it meant we had succeeded in entirely dispensing with organic solvents."

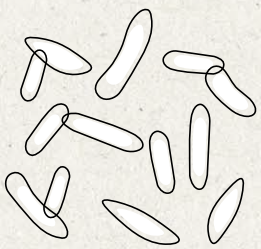
The second problem was a bit trickier. As Masri explains, "Yeasts can grow on practically any type of organic waste if that waste has first been treated with enzymes to break it down into some basic building blocks. That's the big advantage of using yeast." The sticking point is nitrogen concentration. Too low and the yeast grow too slowly, too high and the yeast switch to producing carbohydrates rather than oil. Masri tried many different approaches, before coming up with the idea of adding small quantities of organic acids to his cultures, which the yeast rapidly metabolize into fatty acids. "The yeast cultures grew incredibly dense and thick, irrespective of the amount of nitrogen."

The end of the story brings us back to the beginning. The team submitted patents, founded Global Sustainable Transformation, was awarded the TUM's IDEAward 2020 innovation prize and received financial support in the form of a TUM Bridge-to-Innovation Grant. Masri is now negotiating with investors and carrying out research to determine the best organic waste to use for large-scale oil production.

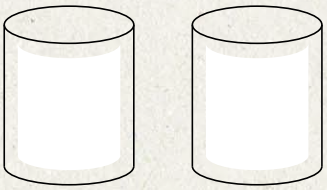
■ *Markus Bernards*

50%

more palm oil was produced in 2018/19 compared to 2010



Yeast cultures …



50,000

times more oil per hectare of space

… produce oil in a bioreactor

Enzymes help in extracting a palm oil equivalent

Graphics: ediundsepp