

Nature's own chemical plant

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Petroleum is the feedstock for many products in the chemical industry. However, this fossil fuel is becoming increasingly scarce and expensive. Renewable raw materials are an alternative. But can the likes of bioethanol be obtained from sources other than foods such as sugar cane or cereals?

The answer is yes. Thanks to white industrial biotechnology, chemical substances can also be derived from waste products generated by the food industry, leftover biomass from agriculture and forestry, and residual materials. Researchers of the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart are demonstrating how this biotechnical recycling works, using colza, whey and crab shells as examples.

When producing biodiesel from colza oil, raw glycerol is accrued as a byproduct. Scientists at the IGB have now developed a method of converting this raw glycerol into 1,3-propandiol – a chemical base for producing polyesters or wood paint. Until now, 1,3-propandiol has always been chemically synthesized, but it can also be derived from glycerol by certain micro-organisms. *Clostridium diolis* bacteria, for example, can produce a comparatively high yield of chemical feedstock. However, these bacteria cannot convert raw glycerol. This is because raw glycerol contains fatty acids left over from the colza oil, and these have to be separated out.

"Furthermore, high concentrations of both the glycerol substrate and the 1,3-propandiol product inhibit the growth of the bacteria," says Dr.

Wolfgang Krischke of the IGB, pointing out another challenge in developing this biotechnological process. "We have managed to solve this problem to a large extent by keeping the bioreactor in continuous operation, because once the glycerol has been almost fully converted, it loses its inhibiting effect. In this way, we have achieved a stable process with high product concentrations." The fatty acids can be converted by yeasts to long chain dicarboxylic acids providing novel building blocks for polymer industries.

One of the byproducts obtained from the manufacture of dairy products is acid whey, which until now has always been disposed of at considerable cost. However, the milk sugar (lactose) contained in the whey can be converted into lactic acid (lactate) with the help of lactic acid bacteria. Lactate not only serves as a preservative agent and acidifier in food production, but can also be used as a feedstock in the chemical industry – for example in the production of polylactides, which are biodegradable polymers. Such polylactic acids are already being used to make disposable crockery and screws for surgical operations.

Source: Fraunhofer-Gesellschaft

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