Micro-organisms m

A Wageningen research team has made mayonnaise with the help of yeast, moulds and bacteria. Although the researchers say the product tastes good, it is not necessarily destined for the market. The main aim is to get the food industry interested in replacing plant and animal protein with microbial protein.

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'We are trying to use bacteria, moulds and yeasts to make foods that are very similar – or maybe even identical – to existing food,' says Jeroen Hugenholtz, who leads the Fermentation expertise group at Wageningen Food & Biobased Research, and is also special professor of Industrial Molecular Microbiology at the University of Amsterdam.
Foodstuffs that contain animal proteins are of particular interest, says Hugenholtz, in view of the rising global demand for animal protein. 'To show that it's possible, we started with a simple product that consists mainly of oil and protein and a little acid, namely mayonnaise.'
The Wageningen research team made the ingredients using fermentation, a sophisticated rotting process in which bacteria, yeasts and moulds convert raw materials such as sugars or cellulose into other substances such as oil, alcohol or organic acids. 'It is not a new discovery that you can make oil and other substances in this way. What is new, and a challenge, is that you can use various fermentation processes to make tasty products with the right nutritional value.'

OIL, PROTEIN AND ACIDITY

For the oil component of the microbial mayonnaise, the team used *Yarrowia*, a yeast that makes oil that resembles palm oil. Several different micro-organisms can help produce the protein, including the bacterium *Bacillus subtilis*, yeasts such as *Yarrowia* and *Pichia pastoris*, and the mould *Penicillium roqueforti*. The acid component comes from bacteria that produce lactic acid. 'At present we still have to make the three components in separate fermentations and then combine and mix them. But we might find fermentation processes with which we can produce all three components in one go.'
Although the microbial mayonnaise tastes pretty good in Hugenholtz's opinion, it won't be found on the supermarket shelves. Nor will test panels be asked to subject the mayonnaise to taste testing. 'That's not what it's all about for us. Our aim is to show the food industry what the possibilities are for using microbial food components created through fermentation, and that these are affordable pro-

ake mayonnaise

cedures.' One option is to grow the micro-organisms on cheap waste streams: household waste, compostable waste, potato peelings, the waste products from the paper industry, or surface water from sewerage systems. There are loads of options. As long as it contains sugars, or carbohydrates, cellulose, or organic acids such as butyric and acetic acid.'

COMPETING WITH MEAT

Microbial mayonnaise is all very well, but Hugenholtz's real aim is to make products that can compete with meat for nutritional value and taste. There are already quite a lot of meat substitutes available, but the protein in them usually comes from plants. 'We want to show that you can use micro-organisms for that too. We always check which micro-organisms grow best on which material, which ones produce the best protein for the intended purpose, and which protein is the easiest to isolate.'

Hugenholtz expects that bacteria, moulds and yeasts will play a crucial role in meeting the increasing demand for protein. A 2019 report by the United Nations predicts that we shall have 10 billion mouths to feed in 2050. There will not then be enough of the major sources of protein –meat, fish and dairy products – to meet the global demand for safe, high-quality protein-rich food. 'We've got to start eating less meat and getting more of our food directly from plants, insects and micro-organisms. There are huge benefits to that in terms of sustainability,' says Hugenholtz. 'To me, that is the main reason to work on this.'

Nor is he afraid of competing with protein from plants. 'Plants are often seen as a source of protein, but they are a very inefficient one,' says Hugenholtz. 'You need an awful lot of plants to produce sufficient protein. And for that you need large areas of land. Or you source protein-rich ingredients such as soya from far away, but that is not very sustainable.'

Microbial production can be done anywhere, he explains. 'Cheap waste streams are available everywhere. By fermenting them, you produce the raw material you need. And given that we produce a lot of waste streams globally, the potential for microbial food components is huge. In Africa and Asia, where the demand for protein is biggest, there are also gigantic volumes of waste that are going unused at the moment.'

'We want to show the food industry what the possibilities are'

COMMERCIAL PARTNERS

Hugenholtz's lab pays attention to flavour too. Breakdown products of amino acids, for example, can be converted into flavour components using fermentation. 'We are working with several companies on using fermentation to develop flavourings for use in meat substitutes.'

Commercial partners are important to the Wageningen research team. 'We are brimming with ideas,' says Hugenholtz. 'We produce various kinds of oils and proteins and develop new fermentation products every day. But in the end you are dependent on having a client who can launch the products commercially.' ■

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