STEAK EXPECTATIONS FOR ALTERNATIVE PROTEIN SOURCES

The pursuit of more sustainable food is creating an entirely new form of agriculture.

Modern food technology is getting a shakeup. Food scientists can manipulate DNA, grow meat from scratch, and 3D print food into otherwise impossible shapes. Yet food scientists are also in a race against time. How quickly and effectively can the promise of modern food-tech translate into edible, affordable, nutritious food?

One dilemma for the food-tech industry is finding alternative sources of protein. Excessive production and over consumption of meat, particularly beef, is linked to environmental damage, climate change and, in industrialized countries, poor health through high levels of obesity.

The most widely accepted form of alternative protein is soy, used for tofu and other meat substitutes. But the solution can also become a problem: in Brazil, the largest producer of soy in the world, the crop has been linked to significant deforestation.

According to Alexander Mathys, Head of the Sustainable Food Processing Laboratory at ETH Zurich, Switzerland, successful alternative protein sources, and all food technology, will have to solve problems across three critical domains. "The three dimensions of sustainability need to be addressed; not only environmental sustainability, but also social and economic sustainability," says Mathys.

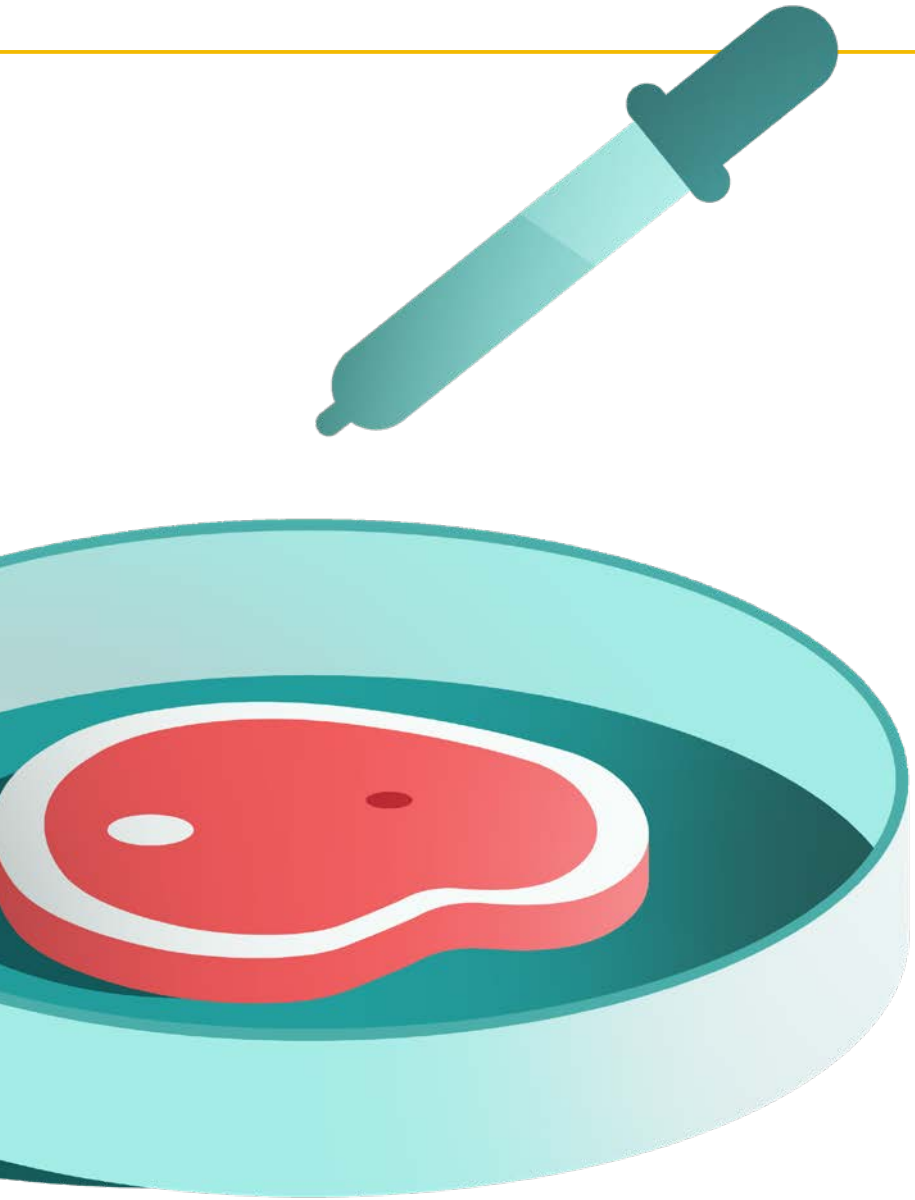
If it looks like steak and tastes like steak

The most likely contender for alternative protein could come from cellular agriculture, in which food products are created from cell cultures. Currently, the most hyped form of cellular agriculture is lab grown meat, which has drawn the attention and the marketing energy of numerous Silicon Valley companies — despite the formidable technical challenges of creating meat without an animal. The direct costs of lab grown meat don't yet stack up but many manufacturers claim its cost will fall.

The sustainability potential of lab grown meat is less clear. Currently, it relies on animal products, like calf serum, but its greatest challenge is likely to be social. Even if it becomes technically possible to create an object that looks like a prime steak, says Michael Siegrist, Professor of Consumer Behavior at ETH Zurich, the threshold of consumer acceptance will likely be higher because manufacturers of lab grown meat are attempting a kind of verisimilitude that other meat alternatives are not. Bean-based products might be called 'meats', but consumers usually assume they will taste a bit different, Siegrist explains. "For cultured meat, the benchmark will be meat." He believes that if manufacturers produce something that looks like a prime steak but doesn't taste quite like a prime steak, it's unlikely to work. "Cultured meat will always be an imitation, and the imitation is always less valued than the original."

Green algae and ham?

Microalgae, a form of single cell protein, is the least developed of the alternative protein sources — in particular, it is not well-developed in terms of optimization,



says Mathys — but it has great potential. It is one of the most nutritious biomass that can be produced in a single cell system. On the environmental front, its production can bypass the need for arable land as it can be grown in buckets and on rooftops, making it a great candidate food source for cities.

Socially, microalgae may be more acceptable than lab grown meat. There is little research but, according to Siegrist, microalgae have no inherently negative associations, unlike artificial meat. But for consumer acceptance, the look, taste and feel of a food are critical. The chlorophyll in algae makes it a deep green colour that is hard to change and so limits its potential enormously. "Would you eat green meat?" asks Siegrist.

However, in a recent feasibility study, Mathys produced nutritious yellow algae with no chlorophyll. Yellow foods can be readily coloured, thus avoiding the problem of products having a green tinge. Also, without chlorophyll the new yellow algal products can be flavoured more easily.

Currently, the direct costs of microalgae compare poorly with traditional protein. Soy costs less than US$1 per kilogram to produce and beef costs approximately US$3 per kilogram, but microalgae is US$10 per kilogram. Nevertheless, food giants like Nestle and Unilever have recently partnered with small startups to develop products using algae. Some marketing firms predict that the global market will be worth anything from US$1-3 billion by the end of 2025.

Waiter, there's a fly in my soup

Insect farming has grown as a protein source in recent years. Many insects are naturally high in protein and the production costs of insect farming are relatively low. Some cultures in Asia, South America, and Africa already have a tradition of insect consumption. But in the West, insects often evoke a sense of disgust, a significant hurdle to overcome.

Although the insect food industry is rapidly growing in the US and Europe, insect products are still regarded as a novelty. Mathys suggests that insects might be more readily utilized in feed rather than food. Part of the world's food problem includes feeding not just 10 billion people but also the 19 billion chickens and 1 billion cows that feed us. One option, suggests Mathys is fewer animals that are fed with insects.

For Mathys, there is no single answer or alternative to the challenges of protein and food in general. Diversity is important for the health of a system, he says. Growing up in East Germany, his family used to decide what was for dinner by going to the supermarket and seeing what was available. He remembers driving to West Germany for the first time and being surprised by the amount and variety of food on display.

"There is always a huge portfolio of solutions," he says. "But we should also question the fundamental idea in wealthy, western societies that one should be able to buy any kind of food at any time." Mathys notes that lab-grown meat is a solution for people with high incomes who can afford any type of food. "Lab-grown meat is a very innovative solution, however, so far, it is only affordable for people with very high incomes. Food security and more sustainable food systems need resource efficient, affordable solutions. "

This leads to the burning question — not what is the solution, but who is it for? "I don't want to create only solutions for people who can already afford any type of food they want," says Mathys.