

Science Reporter

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Will consumers have a beef with test-tube meat?

By ANNE McILROY SCIENCE REPORTER

Scientists can grow frog and mouse meat in the lab, and are now working on pork, beef and chicken. Their goal is to develop an industrial version of the process in five years.

If they succeed, cultured or in vitro meat could be coming to a supermarket near you. Consumers could buy hamburger patties and chicken nuggets made from meat cultivated from muscle cells in a giant incubator rather than cut from a farm animal.

Home chefs could make meat in a countertop device the size of a coffee maker. Before bed, throw starter cells and a package of growth medium into the meat maker and wake up to harvest fresh sausage for breakfast.

You could feel good about eating a healthy breakfast; the meat would have the fat profile of salmon, not pork. One day, the truly adventurous may be able to grow ostrich, wild boar, or other game.

First, however, meat researchers in the United States and the Netherlands must find a way to replicate on an industrial scale a process that works in a petri dish. The price will have to be right. It is hard to imagine consumers paying more for an in vitro burger than they pay for a regular one.

They will also have to overcome the "ick" reaction. Many find the idea of cultured meat unappealing or downright disgusting. How would it taste?

"I don't find it hard to believe that in vitro meat can be produced that tastes like hamburger or chicken nuggets," said Jason Matheny, one of the founders of Vive Research, a U.S. firm working on growing meat for the global market. Most of the flavour in burgers and nuggets now sold in grocery stores or restaurants comes from seasoning or filler, he said.

Researchers have succeeded in growing bits of meat, the type that could be used in burgers or spaghetti sauce.

Growing a test-tube steak or pork roast will be more challenging, said Henk Haagsman, professor of meat sciences at the University of Utrecht. He is part of a team of Dutch researchers who are leading the world in the meat-making field.

He and his colleagues grew mouse meat in their lab because the stem cells they could turn into muscle fibres were easily available. Now they are working on pork.

Australian researchers have grown muscle tissue from a frog, which they served with Calvados sauce at an exhibition in France in 2003. The frog steaks, they said, tasted like jelly on fabric.

In 2001, U.S. researchers, funded by the National Aeronautics and Space Administration, grew muscle tissue from a goldfish -- a kind of carp -- as part of an experiment on whether it is possible to grow fish for astronauts on long space journeys. Morris Benjaminson and his colleagues at Touro College in New York bathed pieces of goldfish muscle in fetal bovine serum -- which contains growth factors that spur muscle growth.

The fish muscle grew nearly 14 per cent over a few weeks. It smelled normal, the researchers reported. But they didn't taste it.

NASA, however, has decided against space burgers -- fish or beef -- for astronauts on long missions.

This has cut off an important funding source for U.S. researchers interested in cultured meat, said Vladimir Mironov, a tissue engineer at the Medical University of South Carolina.

He said mass production of cultivated meat will be difficult, and expensive, at the least in the short term. But smaller, countertop bioreactors, or incubators, could more easily mimic the meat-making experiments scientists have done in petri dishes.

"It would look like a coffee maker -- this is my dream," he said wistfully. "No one wants to fund it."

One group, which he would not name, did offer him money, but they wanted him to grow meat from human cells, so they could grow pieces of themselves to eat.

"I don't want to participate in high-tech human cannibalism," he said he told them.

Theoretically, he said, it would be possible. Researchers have harvested human myoblasts, cells that can grow into muscle fibre.

Even without the stomach-turning notion of a human burger, cultured meat is not an appetizing idea for many people.

"There is no demand," said Mr. Mironov, who came to the United States from Russia. During the Cold War, he said, Soviet scientists developed bacteria that could produce protein. But no one wanted to eat the final product, because it smelled revolting.

Cultured meat burgers will probably taste and smell no different from conventional products, Mr. Mironov said. Eventually, he said, the world will need it.

"I believe it is inescapable."

A public educated about the benefits of in vitro meat might come around to the idea, said Mr. Matheny, a doctoral student at the University of Maryland.

Last year, he and other researchers published a paper on how to grow affordable meat for the modern dinner table.

The health and environmental benefits could be significant, they reported.

Cardiovascular disease and diabetes are associated with the overconsumption of animal fats. Cultivated meats could be engineered to be healthier.

"Using this technology, you could grow ground beef or pork or chicken that had the fat profile of salmon. That would have an enormous public health impact."

Cultured meat could also reduce the risk of diseases such as bovine spongiform encephalitis -- or mad cow disease -- and avian flu.

Growing meat in an incubator would cut down on the cropland, water, fertilizer, pesticides and energy now required to produce animals for slaughter. It would also reduce the millions of tonnes of manure and other waste produced every year in North America.

Demand for meat is growing in the developing countries, and alternative animal farming might help meet that need, Mr. Matheny said.

He and his fellow researchers established a non-profit, New Harvest, as a clearinghouse for information on cultivated meat. Last month, they set up Vive Research, which Mr. Matheny said is backed by angel investors. It involves numerous skeletal muscle tissue engineers in the United States, who plan to collaborate with the Dutch scientists. They want to develop a technology to produce ground meat in vitro in five years.

Most attempts to grow meat require cells cultured from an animal. They can be stem cells, originally taken from an embryo, which can develop into any kind of cell -- skin, bone or muscle fibre, for example. The trick is coaxing them into muscle fibre with special growth factors.

Cells known as myoblasts, which are on their way to becoming muscle fibre, are also being used.

The Dutch researchers have embarked on a five-year state-funded project to cost-effectively produce pig meat.

They face challenges. The first is to isolate the best starter cells for meat production.

They also need to develop a culture medium that doesn't require fetal bovine serum, a blood product extracted from embryonic calves that has a seemingly magical power to make muscle cells grow.

Calf serum is expensive, costing \$10,000 (U.S.) per kilogram of cultured meat, according to one estimate. Using it doesn't make sense, Dr. Haagsman said.

"It is ridiculous to make meat using meat products," he said. The whole idea is to reduce the resources that now go into producing the 240 billion kilograms of meat humans around the world eat every year.

The scientists, from three universities in the Netherlands, are also figuring out the best way to exercise muscle fibres to get them to grow. Electrical stimulation works, but so does stretching, then shrinking the fibres.

Taste is another issue. Scientists don't know whether lamb meat tastes like lamb meat because of characteristics of its muscle cells. Perhaps the flavour comes from the grass an animal grazes on, or the food it is given to eat.

They should know in five years whether growing meat on an industrial scale can be done, Dr. Haagsman said. He said he believes consumers are open-minded enough to try cultured meat.

Modern farm factories, he said, have essentially turned animals into meat-producing machines. And avian influenza and other diseases may drive consumers away from conventional sources.

He is hopeful that vegetarians, or partial vegetarians, would give cultivated meat a try.

Charles Miller, part-owner of the Green Door Vegetarian Restaurant in Ottawa, said he wouldn't try a bite.

"It is still an animal product," he said. "I wouldn't touch it. I wouldn't eat it."

Churchill predicted it

An idea whose time has finally come? In 1932, Winston Churchill predicted that in five decades, people would be eating cultured meat.

"Fifty years hence, we shall escape the absurdity of growing a whole chicken in order to eat the breast or wing by growing these parts separately under a suitable medium."

Researchers say he might have been inspired by Nobel Prize winner Alexis Carrel, who put a hunk of heart muscle cut from a chicken embryo in a bowl of nutrients and kept it alive for more than 30 years.

In the past few years, scientists have grown more than meat in their labs. In 2002, researchers in Japan reported they had grown tadpole eyeballs from scratch. In 2003, scientists in the United States announced that they had successfully grown a rabbit penis in the lab.

Anne McIlroy

How to make your own meat

Vladimir Mironov, a tissue engineer at the Medical University of South Carolina, wants to build a device the size of a coffee maker that would allow people to grow meat in their kitchens.

Here is how it might work.

1. Myoblasts, immature cells that develop into muscle fibre, would be harvested from a pig, cow, chicken or turkey and cultured.
2. Cooks could buy these starter cells, and add them to a growth medium, which would contain water, sugar, salt vitamins, amino acids and growth factors that would stimulate them to reproduce. (Scientists now use fetal bovine serum, but say they would have to come up with a product that was more affordable).
3. The mixture would be put into a counter top incubator, where it would be warmed to encourage growth.
4. The cells would develop into muscle fibre.
5. Hours later, small pieces of meat could be harvested, washed and cooked, either in a patty or a sauce.