Test tube meat on the menu?

By 2022, consumers could be tucking into 'VatBeef' grown in a lab, at least according to a report from the Food Ethics Council released earlier this year. The UK independent think tank and advisory body has identified *in vitro* cultured meat as a possible means of easing food supply worries in the future. A recent report from the Wildlife Conservation Research Unit at the University of Oxford also touts *in vitro* meat as an important approach for reducing the carbon footprint of livestock and easing the pressure on agricultural land and water use.

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Burgers, chicken nuggets, sausages—the first lab-grown meat is likely to be muscle cell mince.

Cultured meat has been garnering increasing attention ever since the People for the Ethical Treatment of Animals (PETA), a Washington, DC–based activist organization, offered a $1-million prize "to the first scientist to produce and bring to market *in vitro* meat." And although research on creating a palatable *in vitro* cultured myocyte alternative to meat remains in its infancy, investors are beginning to show interest, including the venture capital firm Kleiner Perkins Caufield and Byers of Menlo Park, California.

But the mere mention of lab-grown meat—an assortment of projects to produce beef, pork or chicken proteins in industrial-scale cell cultures—evokes enthusiasm at one end of the spectrum and caustic criticism at the other. "I wonder if you can get people to eat that stuff," says Michael Hansen of Consumers Union in Yonkers, New York. "There are safety questions, technical problems and a very huge 'yuck' factor to deal with," he says.

Enthusiasts are persuaded by its 'green' credentials. "My main concern is environmental," says Stig Omholt of the Norwegian University of Life Sciences in Ås. "If meat consumption doubles by 2050, many forests will go and the calculations are very grim." Omholt cites a 2006 United Nations Food and Agriculture Organization report, "Livestock's Long Shadow—Environmental Issues and Options," to buttress those arguments. Indeed, initial findings from a study published in August by the Wildlife Conservation Research Unit at the University of Oxford and funded by New Harvest suggest *in vitro* meat would result in "an 80% decrease in greenhouse gas emissions, and a 90% decrease in land and water use," he says.

In Europe, three close-knit university-based groups in the Netherlands are actively pursuing the basic technology. According to Bernard Roelen, who is a member of one of those groups, at the Faculty of Veterinary Medicine at Utrecht University, the Ministry of Economic Affairs in 2005 funded these projects with industrial partner Stegman (Rotterdam), then part of Sara Lee. But Stegman ownership recently transferred to another international food consortium, Madrid-based Campofrio and the London-based Smithfield Group, and the research is now in 'waiting' mode, with other industry partners apparently "hesitant to cooperate," Roelen says. "The technology is not 'already there,' and we need to do a lot more research."

Although at least two companies are active in this area, they are currently in "stealth mode," says Jason Matheny, a US proponent of *in vitro* meat production. Matheny, who is board member of New Harvest, a Baltimore-based nonprofit organization founded in 2004 to "support the development of meat substitutes" is also associated with the Bloomberg School of Public Health at Johns Hopkins University in Baltimore.

As a measure of recent progress, he cites success in producing growth factors in genetically engineered bacteria at the University of Amsterdam as well as initial efforts to produce animal cell-growth media from algae. The price of cultured meat can be competitive too when produced large scale, Matheny suggests, citing an economic analysis commissioned by Omholt (http://new-harvest.org/img/files/culturedmeatecon.pdf).

One key challenge remains, and that is how to induce embryonic stem cells from cows and pigs to differentiate into muscle cells, according to Roelen. The main problem is that the process is only 20% efficient, too low to meet scale-up demands. Ultimately, it is hoped muscle cells could be "harvested and rolled up to turn into something edible, which is something for people who specialize in food technology and meat processing to solve—first by making sausages or burgers," Roelen continues. "Many people ask 'what's it taste like?' I've never tasted it, but I imagine that differentiated pig cells are very similar to real meat because it has the right proteins and fatty acids."

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