Lab-Gro

Food Savior of The Futur

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Illustrated by

One afternoon in London, an audience saw something like a movie scene unfurl before their eyes. A lab-grown burger was unveiled, cooked, and eaten in front of the crowd, and was broadcasted internationally as well. This event not only proved the feasibility of the experimental foodstuff, but accelerated research thereof, and increased interest in lab-grown meat.

Lab-grown meat, also called "cultured" or "in vitro" meat, consists mostly of skeletal muscle containing a variety of cell types. This combination of cells is made possible by the combination of proliferation, differentiation, and fusion techniques. Through experimentation, researchers have found that each proposed cell type for producing in vitro meat—embryonic stem, myosatellite, and adult stem—has its own set of advantages and disadvantages. Embryonic stem cells have infinite regenerative capacity, yet are prone to genetic mutations that could restrict production. Some adult stem cells hold the ability to transform into one specific cell, and some into a multipotent cell. Certain adult stem cells can differentiate into a specific type of cell, such as an epithelial stem cell, which could form muscle. Others, like adipose tissue-derived adult stem cells, are multipotent, meaning they can develop into more than one cell type, but their susceptibility to malignant transformation prevents usage of this cell type. Myosatellite cells form a rare muscle tissue with limited regenerative capabilities, but are considered the best cells for cultured meat due to their efficiency in repeating myogenesis (the formation of muscle tissue during embryonic development). These cells are the most popular choice for the production of in vitro meat. Once myosatellite cells are extracted from the animal, a growth serum is added in order for the cells to multiply and grow into lab meat.

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The growth stimulant used is called fetal bovine serum. Fetal bovine serum (FBS) is a commonly used animal cell culture medium, though the method of retrieving FBS has often come under attack for being inhumane and unethical. In order to obtain FBS, live fetuses removed from pregnant cows in the dairy industry undergo cardiac puncture—a process that involves inserting a needle into the heart of the fetus and draining the blood until it dies, which takes about five minutes and is performed without anesthesia. The extracted blood is then refined, resulting in FBS. FBS is especially well-known for its low levels of immunoglobulin, an antibody that neutralizes pathogens. Low immunoglobulin lessens the chance of these antibodies mistaking bovine cells for a pathogen and destroying them. The growth factor in FBS helps prevent the cultured bovine cells from dying, ensuring they grow into a substance that replicates meat.

The cells are then grown on a scaffold within a culture medium in a bioreactor to form myofibers, or muscle fibers. Cell processes necessary for the growth of lab meat, such as cell attachment, proliferation and differentiation, are dependent on anchors, and scaffolds function as substructures for these processes. Ideally, a scaffold should have a tissue-like flexibility in order to stimulate cell differentiation. Scaffolds used for lab-grown meat, however, are currently beads placed in rotary bioreactors that lack stretching capability. The cells must be "exercised" to replicate the muscle texture from an animal and to increase its protein content. After the growth process is complete, muscle fibers are pulverized, mixed with flavors and nutrients, and cooked.

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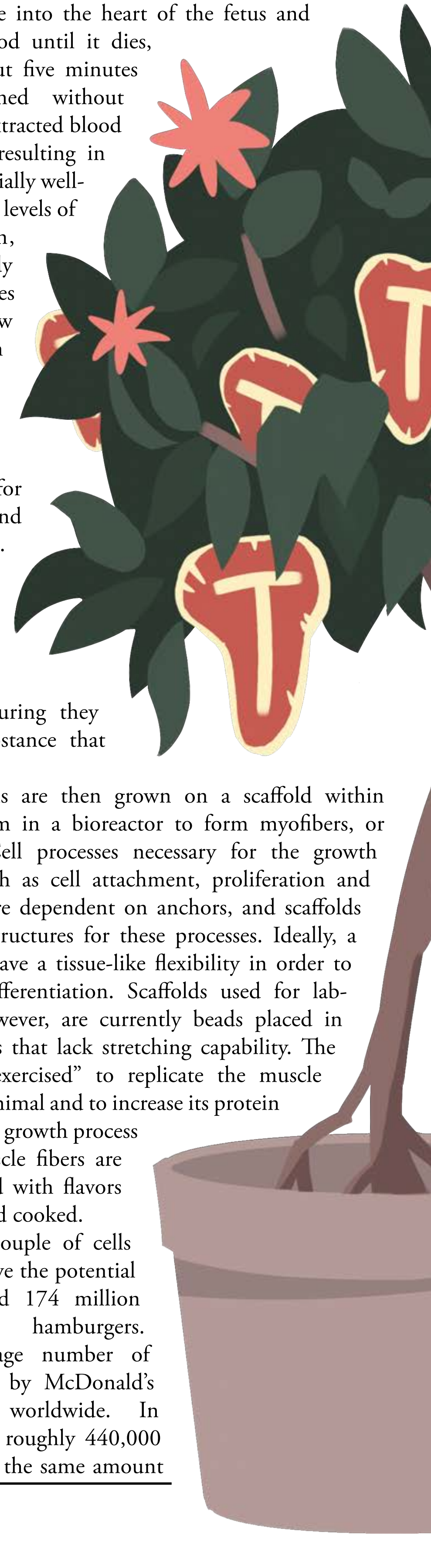

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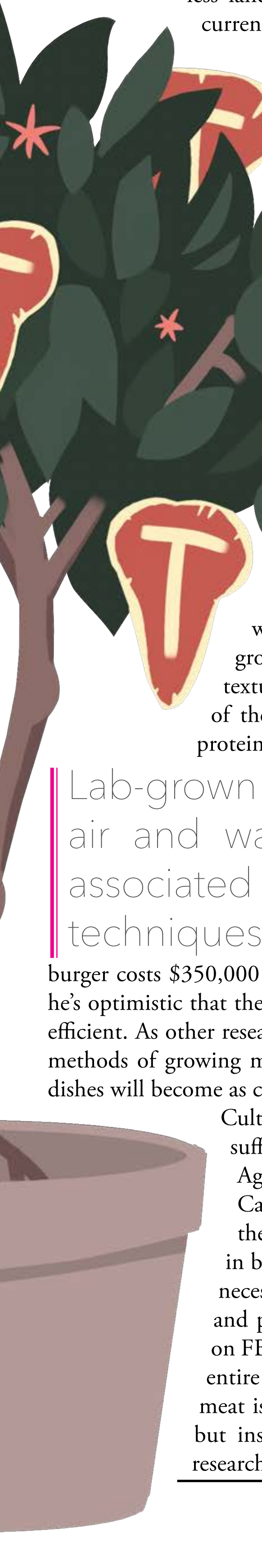

of beef. Lab-grown meat would not only utilize around 90 percent less land and 70 percent less energy in comparison to current cattle farming methods, but also help decrease air and water pollution and waste associated with animal farming techniques. It could eradicate meat quality inconsistencies and the possibility of foodborne illness. These possibilities are what continue to inspire Dr. Mark Post and his team at Maastricht University to continue researching cultured meat. After his live taste reveal of the first cow-less burger in London in 2013, Dr. Post has become the public face of lab-grown meat. He hopes that by the year 2020 it won't be strange for consumers to purchase in vitro burgers for $10. Privately funded by a Google co-founder, Dr. Post and his team are working on producing a burger without using an animal-derived growth medium, growing fat tissue separately for added flavor and texture, and using oxygen levels to influence the color of the meat (meat's color comes from myoglobin, a protein that turns red in the presence of oxygen). His

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burger costs $350,000 to produce due to the technology expenses, but he's optimistic that the price will decrease as the process becomes more efficient. As other researchers work at finding faster, more cost-effective methods of growing meat, Dr. Post has confidence that in vitro meat dishes will become as commonplace on a menu as animal-based ones.

Cultured meat could help reduce environmental suffering, but it isn't without its own costs. Christina Agapakis, a synthetic biologist at University of California–Los Angeles, says cell cultures are one of the most expensive and resource-intensive meat bases in biology, and a large amount of labor and energy is necessary to ensure the cells remain warm, alive, fed, and protected. Dr. Agapakis reminds us that reliance on FBS, a byproduct of cattle farming, undermines the entire purpose of cultured meat. Therefore, cultured meat isn't helping to destroy slaughterhouse industries, but instead is relying on them to create FBS. While researchers, including Dr. Post, experiment with non-animal derived growth stimulants, such as algae, they're much more expensive than FBS. Skeptics of in vitro meat argue that the true allure of cultured meat is its seemingly easy solution to a larger problem at hand—the inequality of food distribution worldwide and the strain of heavy global meat consumption.

There are numerous arguments for and against cultured meat, but most agree that the biggest hurdle is actually convincing people to eat it. Even if enough cultured meat could be produced easily, ethically, and at an affordable price, the idea

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of consuming a product grown within a lab is still often viewed as an unsettling prospect. The support and investment of billionaires and large corporations, including Bill Gates, Richard Branson, agricultural company Cargill, and capital firm DFJ, are, even unintentionally, helping to desensitize and normalize lab-grown meat. By giving their support to companies and researchers working to perfect in vitro meat, they not only inspire startup companies in the cultured meat arena such as Good Food Institute, Hampton Creek and Memphis Meat, but publicize the idea that consuming in vitro meat should be expected in the near future.

In the past, the appeal for lab-grown meat stemmed more from curiosity than urgency. With the onset of climate change, as well as a rapidly growing population, the question of food availability has resurfaced. The curiosity in lab-grown meat has returned at a time when the world's food supply is in jeopardy due to climate change and population growth. Will lab-grown meat become the new normal? Are we heading towards a world that will rely on food grown in petri dishes? Is this even the best solution? As researchers continue to work toward answers, only time will tell.