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Lab Meat Won't End Factory Farms — But Could Entrench Them

In late 2020, Singapore's Food Agency became the first regulatory body to approve cell-cultured meat for commercial sale. Diners could visit an exclusive Singapore restaurant and pay $23 for a handful of nuggets cultured in a lab using chicken cells. These "no-kill" nuggets were the product of startup Eat Just — and hundreds of millions of dollars from investors. Eat Just, like many similar startups, hoped to reduce or replace meat from farms with cultured meat.[1]

This one pricey example aside, cultured meat largely remains the stuff of science fiction. A recent peer-reviewed analysis found little evidence that meat grown in a lab can ever economically compete with real meat from living animals — raising doubts that it could ever scale up enough to replace even a sliver of current meat consumption.[2] Moreover, investing in cultured and other meat alternatives as solutions to the climate crisis not only distracts us from the real fights ahead but entrenches the existing factory farm system.

Lab to Fork

Not your mother's veggie burger

Meat alternatives are nothing new. Tofu, a minimally processed plant protein, has been a dietary staple for a thousand years.[3] Lentils, beans and grains have similarly substituted for or supplemented meat in people's diets. But encouraging people to cook more lentils or homemade veggie burgers provides little opportunity for corporate profit. Nor might these options appeal to people who prefer the taste and texture of meat.

Next-generation meat and seafood alternatives (what we call "lab meat") seek to lure health- or eco-conscious consumers by more closely mimicking meat products. These largely fall into two camps. First, cellular agriculture (cultured meat) extracts tissues from living animals and separates muscle stem cells, which are grown into muscle fibers. The process takes place in a sterile laboratory environment and uses growth mediums such as fetal calf serum or chicken embryo extract, as well as various

additives, to help the muscle fibers look and taste like familiar meat and seafood products.[4] This technology remains in its infancy; to date, no country aside from Singapore has approved cultured meat products for commercial sale.

In contrast, the second camp — plant-based meat — has seen an explosion of brands mimicking familiar meat products like burgers, sausages and seafood. U.S. sales rose 37 percent between 2017 and 2019 alone. Plant-based dairy products such as creamer and yogurt also saw huge growth — 193 percent and 129 percent, respectively.[5]

However, these are not your mother's veggie burgers made with beans and other whole plant ingredients. Many plant-based meats rely on ultra-processed food additives to provide nutrients such as proteins, as well as qualities like texture and juiciness that closely resemble meat. For example, the Impossible Burger transfers DNA from the roots of soybeans to a genetically modified (GMO) yeast to produce a protein called "heme", which is added to make the burger "bleed" like rare ground beef.[6] Given the reliance on ultra-processing and genetic modification, the term "lab meat" is apt; we use the term to describe both these ultra-processed meat/seafood alternatives, as well as cultured meat/seafood.

Sustainable? Not Necessarily....

Corporate greenwashing of lab meat

We know we need to dramatically change the way we produce food, especially meat and dairy, to stop climate chaos. Claims that lab meat — and cultured meat in particular — is better for the climate are speculative; we do not know the full impact of scaling up production in terms of energy use and other inputs.[7] Even so, the companies investing in these products make unfounded claims that such meat alternatives are essential in the fight against climate change.[8] But they are often not looking at the entire production system, making the claims dubious at best.

For instance, cultured meat requires sterile, highly industrialized settings and substantial amounts of energy — perhaps even more than livestock farming.[9] In one lifecycle analysis of various meats and meat

alternatives (cultured beef, farmed chicken, plant-based meat substitutes and insects, among others), cultured meat scored the highest in each impact area excluding land use and ecotoxicity; it also had the highest overall impacts and the greatest contribution to climate change.[10] Another study shows that while cultured meat may reduce methane emissions associated with enteric fermentation (cattle's digestive processes), it may increase carbon dioxide (CO_2) emissions when it uses fossil fuels as its energy source. This gives cultured meat an even greater long-term climate footprint thanks to the accumulation of CO_2 in the atmosphere.[11]

Likewise, sustainability claims from plant-based meat companies are suspect, given their reliance on ultra-processing.[12] Moreover, shifting pasture-based livestock systems to monocultures producing plant-based inputs like corn and soy could harm our climate and ecology.[13] More lifecycle analyses are needed to understand the environmental impacts of next-generation meat alternatives; it is too early to make sweeping claims that they are more sustainable than existing protein sources.

But we lack the luxury of time to bet on unproven technology. We need to act now to reduce greenhouse gas emissions. This includes enacting policies to ban factory farms and support a transition to more sustainable forms of agriculture.

Unknown Risks and Murky Regulatory Environment

Highly processed, poorly regulated

Companies developing lab meat want consumers to believe their products are safer than meat from factory farms, which confine thousands of animals in cruel conditions, use antibiotics irresponsibly and can spread pathogens like Salmonella and *E. coli*. Such claims are misleading.

Cultured meat, for instance, may also require antibiotics to ensure sterile growing environments. Antibiotic residue may persist in products and contribute to the spread of antibiotic-resistant pathogens. Additional hazardous materials are used throughout processing, from scaffolding materials that cells proliferate on to disinfecting chemicals, which may also leave residue in the final product. Also, growth mediums such as fetal calf serum can carry communicable diseases. A cultured meat facility would also require continuous monitoring to ensure that cell lines do not mutate or become contaminated, to reduce human health risks.[14]

These technologies are being developed by private companies that do not have to tell consumers what processes and additives they are using. This means that the risks have not been clearly identified or studied. For example, inducing cells to proliferate makes them behave like cancer cells, and we do not know whether they are safe to consume.[15] We similarly do not know the risks of consuming the numerous untested additives and processing aids used to make these products, and whether they can induce allergic reactions. Some processing aids may not even be required to show up on food labels.[16]

Similarly, plant-based meats are marketed as healthy alternatives to meat, taking advantage of growing consumer interest in plant-based eating.[17] However, many plant-based meat alternatives are ultra-processed with few whole plant ingredients. They rely on various additives (such as saturated fats) to mimic the flavor and texture of meat, as well as on fortified nutrients, which may not be readily absorbed.[18] Health experts are raising the alarm on ultra-processed foods and their contribution to diet-related disease. We are just beginning to understand, for instance, the connection between high consumption of processed foods and the imbalance in the human gut microbiota.[19]

Both cultured and plant-based meat may incorporate nanotechnology, a controversial technology with potential human and ecological health risks. Nanomaterials are products containing tiny, unbound particles measuring less than 100 nanometers (for scale, human hair is approximately 80,000 nanometers wide). The tiny particle size makes nanomaterials useful in a range of food processing and packaging, given that they dissolve more quickly and can penetrate cell membranes.[20] Plant-based meat developers, for instance, may use nanotechnology to manipulate plant proteins into products more closely resembling the texture of meat.[21] These same properties, however, make them risky to humans when ingested. Our bodies' cells can absorb and accumulate nanoparticles, which may lead to toxic effects. Alarmingly, the potential toxicity of nanoparticles remains "insufficiently investigated" despite their widespread use in food processing and packaging.[22]

It is not even clear which government agencies can or will regulate these novel lab meat products. Emerging cultured meat technologies triggered a turf war between different federal agencies. A complicated deal between the U.S. Department of Agriculture and the Food and Drug Administration (FDA) gives some responsibility to both.[23] One of the many questions that remains is whether companies making cultured products need to first register with federal regulators or can just begin manufacturing.

But no matter which agency is in charge, our current regulatory system cannot ensure the safety of these next-generation meat replacement products, relying on outdated tools that predate the first wave of GMO foods.[24] The FDA, for instance, commonly relies on industry-submitted safety studies of novel food ingredients rather than conducting independent testing. The agency also treats most GMO products on the market as "substantially equivalent" to non-GMO ingredients, meaning that they do not go through rigorous safety assessments or evaluations as a new type of food.

Moreover, no federal agency monitors these products once they come to market in order to screen for potential adverse health effects. Controversy over inadequate federal oversight has erupted following the aggressive marketing of some plant-based meat alternatives, such as the Impossible Burger. Meanwhile, advocacy groups have challenged the FDA's failure to conduct sufficient testing to rule out possible allergic reactions.[25] We need to fix our regulatory system and engage appropriate federal agencies before companies make any claims about the safety of these next-generation meat alternatives or put them on the market.

Meat Alternatives Will Not Solve the Problem of Factory Farms

Market-based solutions are a dangerous distraction

It is clear that the dominant model of raising livestock in the United States — on crowded, polluting factory farms — is environmentally unsustainable and leads to animal suffering. But can next-generation meat alternatives actually replace factory farms, as some supporters boldly claim?[26]

Consumers would first need to accept these novel products. They must appeal to people who enjoy meat and be comparable in taste and cost.[27] This is a tall order. Scaling up cultured meat requires expensive facilities and equipment and sterile environments — such as those used in the biopharmaceutical industry.[28] Moreover, consumers are increasingly interested in not just sustainability but nutrition; they are seeking fresh, minimally processed foods with short ingredient lists.[29] Cultured and plant-based meats are neither.

Second, even if lab meat gains widespread acceptance, there is no guarantee that it will replace consumption of farmed meat, which is deeply embedded in Western culture. One study found that even if price and taste were equal, most consumers would still choose a beef burger over a cultured or plant-based one. This might help explain why fast food sales of plant-based alternatives are flatlining and chains are dialing back their offerings; as the novelty wears off, customers are choosing the familiar.[30] Meanwhile, U.S. per capita meat consumption reached an all-time high in 2020.[31] Lab meat seems to be complementing — not replacing — meat in people's diets.

Finally, factory farms are baked into the U.S. food system through various federal policies and economic incentives.[32] This dooms any market-based solution from the very start. For instance, U.S. meat production already outstrips domestic demand, and surpluses are exported. So even if everyone in the United States switched to lab meat, Big Ag would continue to produce meat. Likewise, reducing or eliminating meat consumption will not affect incentives to stick with the current ecologically depleting farming systems that prop up factory farms, such as the overproduction of commodity crops on monocultures.[33] Both cultured and plant-based meat rely on many of the same commodities used in livestock feed and may further entrench these systems.[34]

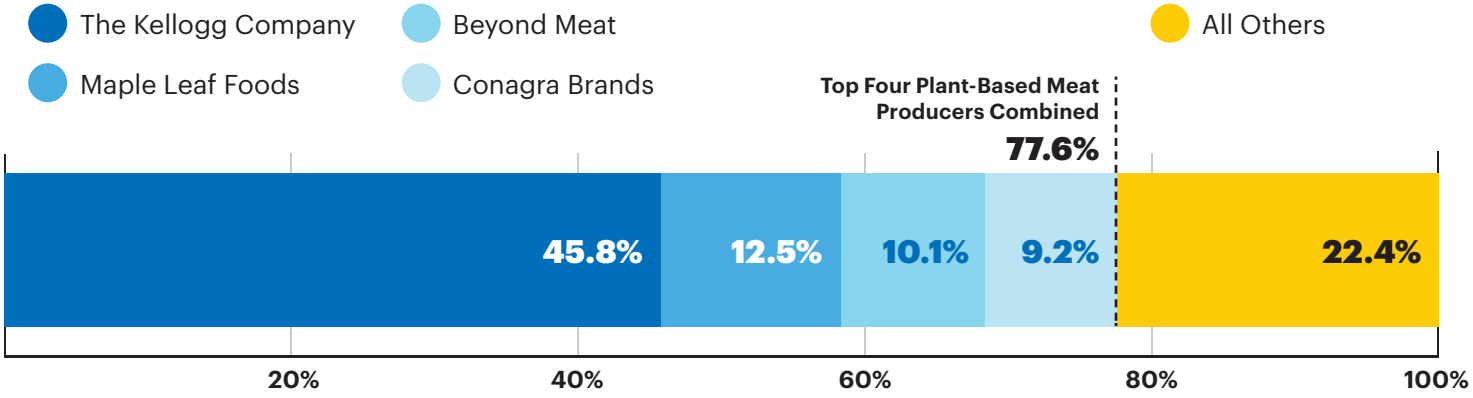
A Lab Meat Future Is Still Corporate Controlled

Big meat corporations are capturing the market

Corporate control is behind many of the environmental and social problems in the current food system. In turn, corporate power makes structural change exceedingly difficult.[35] We cannot expect to make even a dent in these problems if we leave it to corporations; greenwashed "solutions" will not solve factory farming.

FIG. 1: Just Four Companies Control Three-Quarters of the Lab Meat Market

Market shares of the top plant-based meat producers



DATA SOURCE: MARKET SHARE REPORTER

When you think of lab meat, you might think of startups like Beyond Meat and Impossible Foods. But the sector is, in fact, already highly consolidated; just four companies take in over three-quarters of all U.S. sales of plant-based meat (see Figure 1).[36] Among the biggest players are the same agribusiness behemoths that have long dominated the grocery aisles. The Kellogg Company alone takes in nearly half of all U.S. sales of plant-based meats. These are sold under its Morningstar Farms brand, acquired in 1999.[37] Conagra owns the second leading brand, Gardein, acquired in 2018.[38] Even Boca, one of the oldest and most well-known veggie burger brands, has been a subsidiary of Kraft (now Kraft-Heinz) since 2000.[39]

High levels of corporate consolidation make it difficult for newer or smaller companies to enter the market.[40] Even startups like Beyond Meat only managed to launch thanks to millions from investors as wide-ranging as Tyson Foods, Bill Gates and Snoop Dogg.[41] Plant-based meat brands are hardly an alternative to the current system if they continue to entrench corporate power — including the very same meatpacking conglomerates perpetuating the factory farm system (see Figure 2).

Feeling the threat of competition, the big meat companies are embracing a mantra of "if you can't beat 'em, join 'em."[42] Tyson Foods' venture capital fund has invested in several lab meat startups. Among these are the cultured meat startups Upside Foods (previously Memphis Meats) and Future Meat Technologies; the plant-based shellfish startup New Wave; and MycoTechnology Inc., which produces mushroom-based proteins. Tyson Foods also launched its own plant-based meat brand, Raised & Rooted.[43] These investments are part of Tyson's goal of becoming the "global protein leader" by 2030.[44]

JBS, the largest meatpacking company in the world, recently acquired cultured meat startup BioTech Foods and is investing millions in cultured meat research and development. It also owns several

FIG. 2: Big Meat Is Gobbling Up the Lab Meat Market

Cultured and plant-based meat portfolios of the four largest meatpackers, ranked by U.S. market share of meat and poultry

MEATPACKER	COMPANY/BRAND
* Indicates minority stake	
1 JBS S.A.	BioTech Foods Incrível Planterra Foods Vivera
2 Tyson Foods	Beyond Meat* First Pride Future Meat Technologies* Updside Foods* MycoTechnology Inc.* New Wave* Raised & Rooted
3 Cargill	Aleph Farms* Bflike* PlantEver Upside Foods*
4 WH Group (Smithfield)	Pure Farmland

plant-based meat brands, including its unique OZO brand (sold under the name of its subsidiary, Planterra Foods) and recent acquisition Vivera. Executives express similar goals of leading in the plant-based sector.[45] Cargill, one of the largest privately held companies in the United States and a major beef processor, owns stakes in the cultured meat startups Aleph Farms and Upside Foods, as well as the "vegan fat and blood" producer Bflike. Cargill also recently launched a line of plant-based chicken at select KFCs in China and is developing plant-based proteins from corn.[46] Lab meat proponents might think they are helping the planet by choosing plant-based meat over conventional meat. However, the acquisition frenzy within the lab meat sector shows the futility of "voting with your fork." As Big Ag continues to devour the market, consumer dollars spent on both lab and conventional meat will line the pockets of the same corporations destroying our climate.

"We need to keep all protein options on the table. Whether you are eating alternative or animal protein, Cargill will be at the center of the plate."

– Brian Sikes, Cargill Chief Operating Officer [47]

The Future Is in Diverse, Family-Scale Farms

Organizing for policy change

The solution to our factory farm problem is not going to come from a technological fix. Instead, we can make our food system more sustainable through the tried-and-true methods of organic, regenerative farming. Animals do not belong in a lab or factory but on pasture, where they play an integral role in smaller, diversified farming systems.[48] They can help control weeds while providing sustainable amounts of fertilizer that would otherwise come from fossil fuels.[49] Ruminants like cattle can graze on lands unsuitable for crop production, potentially even restoring soil health lost to industrial crop farming.[50]

These fixes are not novel and, therefore, are less alluring to investors looking for the next big disruptive innovation.[51] But that is precisely the point. Solutions need to be led by farmers, not corporate boards. There is no one-size-fits-all approach; each farm must be attuned to local geography and climate. Additionally, we need to rebuild our local and regional food hubs in order to connect farmers to their local economies. Consumers will also benefit from a "less-but-better" approach to meat consumption by purchasing high-quality meat from local farmers.

Achieving these goals requires fighting back against the corporate powers that have a stranglehold on the current food system. We must elect leaders who are not beholden to corporate interests and who pressure them to enact policies that will truly transition us off the factory farm model. This includes banning new and existing factory farms, pausing agribusiness mega-mergers and undoing past ones, and revamping the farm safety net to encourage organic, regenerative farming systems.[52]

We can win — if everyday people commit to organizing for farm policy change at the local, state and federal levels, rather than just buying a new type of burger.

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