Part 2

CULTIVATED MEAT: BIOMASS HYPE OR REALITY?

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Against All Logic

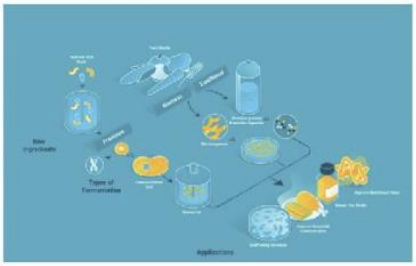
The unrelenting growth and use of meat producing animals as prime food providers can be seen as the main reason of the catastrophic collapse of biodiversity in ecologically sensitive regions such as the Amazon and Borneo, thus mainly responsible for irreversibly damaging the fragile ecosystem. By aggressively reducing livestock animals as food providers, the rapid decay of atmospheric cattle methane emissions will effectively improve climate conditions. To reinvent the current industrial-driven food manufacturing, it will be important to halt the biodiversity collapse and slow down climate change.

The controversy between meat consumption and climate change is heating up. The most frequently heard arguments on eating less slaughtered animal meat are because it is healthier and better for the environment. Especially cattle and hog farmers are an easy prey for the anti-meat activists and are being subjected to criticism that's often deeply unfair. Yet, most -if not all- western countries are under pressure to significantly reduce greenhouse gas emissions by 2050. Adhering to the EU and UK targets, it will be necessary to tackle emissions head-on from including the traditional agricultural methods. After all, agriculture is the second-largest emitter at approximately 14.5 % of the total emissions. However, reality is that after a few years of meat consumption standstill and growth in plant meat consumption in developed countries such as the UK, US, EU and Australia, eating conventional meat is showing increased consumption patterns, including for the young adult generation.

3D Bio-Printing Technology

Meat in the shape and form of whole muscle appearance is probably the most challenging food product to create. Meat, not only in its raw form but also in its transition during cooking, certainly creates complex sensorial parameters delivering much-preferred eating experiences. As for cultivated meat, it is far more difficult to create a perfect whole-muscle beef steak than a simple finely ground hamburger. 3D bio-printing for cultivated meat can provide unique solutions to the key problems by not only adjusting protein cells, fat, and other nutrient components, but also providing the desired textures. Crucial to creating a cultivated whole-muscle steak is the use of multi-material 3D bioprinting technology

Biomanufacturing of Food.



allowing multiple different meat, connective tissue, and fat cells to be layered in one single simultaneous printing process.

It looks like the 3D manufacturing technology called "stereolithography" will be a possible contender to create a specific structure of muscle fibrosity, and fat marbling of a "real" beefsteak. 3D bio-printing technology has now entered the cultivated meat vocabulary, and it specifically allows combining simultaneously all the cells that make up traditional meat fibers, the fat, the blood vessels, and connective tissue material (collagen). "Blood vessels" have an important role to play in replicating the structure of the grown meat, which impacts its texture. Using the four different cell types found in traditional cuts of meat creates a holistically grown three-dimensional meat product that is more identical to its traditional meat counterpart that people recognize and crave for.

Name Calling Anyone?

Looking at it from a negative perspective, it can be said that there is an ongoing tension

between mission-driven and market-driven issues of the feasibility of cultured meat production. It is quite logical that cultured meat companies first want to operate in countries that provide a supportive regulatory environment. Singapore, Qatar, and Israel are one of these outposts. It is projected that around the year 2035, full industrial commercialization of cultivated meat will be introduced in most developed countries and affluent societies.

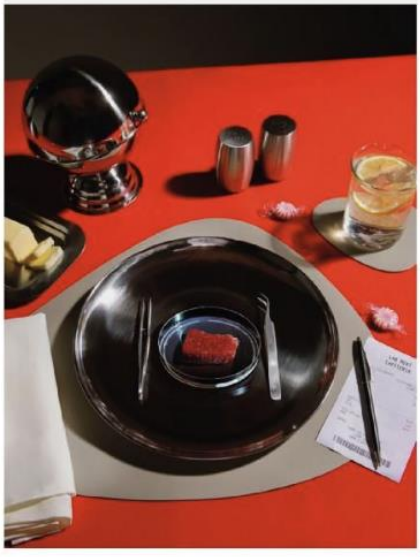
How does one call a food that is made by cultivating animal cells in a tank? There is some urgency to define a name for the rapidly emerging industry of cultivated meat. Transparency in the cultivated meat space is important to build consumers' trust as well as align regulators and industry. It is not an easy task for government regulators to adequately differentiate cell-cultured products from the traditional meat products. There are opposing views between the animal farming community and the cell-cultivated meat disruptors. It is no surprise that animal farmers prefer keeping the monopoly of using the word "meat" so as not to confuse consumers with emerging biotechnology methods of assembling or growing a group of cells together in a bioreactor.

It will also be important to communicate via label disclosure if growth support "additives" are used when producing cell-cultivated foods. The consumer has the right to know, so that informed purchasing decisions can be made based on the presence or absence of various support- or processing additives in cell-cultivated products. Whatever the regulatory outcome, it is important to acknowledge that scientific innovation and progress should not be stymied. If cultivated meat products are organoleptic and nutritionally equivalent to their non-biotechnologically counterparts, the new wave food disruptors should not be burdened with any further hurdles of regulatory requirements.

Regulatory Hurdles

To achieve regulatory standardization and building public trust the common term "cultivated" is a scientifically accurately identifying name in the English language for meat and seafood and other products grown directly from animal cells. In the early days of "lab-grown meat" many descriptive name suggestions were floated in articles and publications. It seems that in 2025 there is likely a consensus within the USDA to agree on "cultivated meat" as the

Lab-Grown Meat Has a Bigger Problem Than the Lab



Complete fermentation installation

name of choice for consumer identification and recognition. The main rationale to choose this name identification is that the cultivated meat is made in a bioreactor. These names also help most consumers to understand that the new food products are produced in a different way from traditional slaughtered animals.

Under EFSA regulations, Novel Foods are those that have not been widely consumed in the EU before 1997, and thus first need to undergo a scientific assessment before they can be marketed. The precision fermentation process of receiving regulatory approval in the EU can be best described as lethargic. The EFSA is not really known for expedient and efficient Novel-food process approval that throws up many roadblocks, much to the chagrin of the startups that develop alternative methods to make proteins more sustainable and affordable. There is no question that EFSA lags establishing a regulatory framework for cultivated meat and non-animal milk protein ingredients. There has been a steep rise in applications for novel foods in the EU over recent years. The EFSA regulatory committee is known for its thorough risk assessment which is usually cited for its delay in granting approval.

Fortunately, for the cultured meat startup companies the UK has a higher urgency level to regulate and allow the sales of cultured meat and fish foods. It can be expected that once prices of cultured meat reach par, consumers will become more motivated to try these food innovations,

More Pushback

Even though the FDA / USDA have approved cultivated meat to be sold by Upside Foods and Good Meat, there is still (unexpected) major opposition by a US State going so far as to criminalize the production, sale, or consumption of cultivated meat. Case in point is Florida who has introduced two legislative bills in February 2024 that could significantly impact the availability of cultivated meat within the State. The verdict is still out, though by means of restrictive legislation these actions have a direct impact on protein biotech research which will be needed to feed and nourish the growing world population. For reference: the FSIS Notice 38-24 (October 2, 2024) "Cell-cultured Meat and Poultry Food Products Sampling Program.

Even though production and marketing of cultured meat is at least a decade away, US States such as Nebraska, Alabama and Florida have implemented a ban to prohibit the sales using this groundbreaking technology. These States are citing consumer safety protection, although both the USDA and FDA have published a formal agreement in 2019 to allow cultured meat for market introduction. Arizona might be another State that will require strict legislation of cultured meat product labeling. It looks as if the States who are actively opposing the sales of cultured meat are not really driven by protecting consumer' safety but rather protecting livestock farmers from a biotechnological breakthrough that may become a threat. Come to think of it, demonizing new technologies is a proven strategy, something that has also happened to the developments of plant and (protein) ingredients using genetically modified organisms (GMOs).

The Marketing Dilemma

As frequently proven in the past, consumers are usually hesitant to embrace new technologies, which is also true for food products that are still on the drawing board. Most consumers have difficulty envisioning reality when they are not physically able to see and try the new product. Consumers are usually notoriously skeptical of food tinkering, especially when it is called "biotechnology". For cultivated meat companies, it is therefore smart marketing strategy to take sufficient time to commercially introduce their products. Guided public relation efforts are key to engage the eco-consumer and share the advantages of the meat product which has always been deeply embedded in religion, socio-culture, and eating enjoyment.

The right marketing framing of cultivated meat is a delicate exercise which essentially needs to positively influence consumers. Although cultivated

meat technology is a gigantic step forward in human food security, it will fail in the market unless it can reach consumers at scale. Price parity or better will propel consumption and thus accelerate global growth. To reach these hefty goals, it will be important that significant government investments become available.

The demand for a more sustainable food system is truly global and growing fast, with much of the shift being led by the sub-30-year age generation. However, when the new product that looks and tastes great becomes commercially viable, consumers are likely to switch from old to new and start enjoying the meat product that can now be eaten without the environmental and animal welfare negative overhang. Initially, cultivated meat will cater to those consumers who prefer the texture and taste of conventional meat but do not want to think about the animal suffering and the environmental burden. Specifically, the younger generation of consumers are seen as the real decision-makers on whether cell agriculture is going to become a successful part of the global food industry. However, when everything is said and done, cultured meat ultimately needs to achieve societal benefits, not just for the happy few but for the entire global population.