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Plant and Fungal-based Meats and Cultured Meats Are Claimed to Be Better for the Planet, and for Our Health – But Is That Really True?

Part Two



“Fake meat” products can be divided into these three categories:

1. Products that are produced by combining ingredients derived from plants and fungi to create a product that mimics meat
2. Products created by culturing animal cells (from beef, poultry, fish, and others)
3. Products produced by culturing genetically modified plant and fungal cells

Because this topic covers a substantial amount of information, it will be published in two consecutive weekly issues. Last week's issue discussed products in category 1. This week's issue will discuss products in categories 2 and 3.

Recapping the main points from last week's issue:

We noted that conventional plant and fungal-based foods are manufactured by mixing ingredients derived from plants and fungi, to produce products that mimic products made from animal-based meat. We found that while they may be suitable for use in most peoples' diet, categorically, they can't be used by individuals who have food sensitivities, because most of them use protein sources such as soy, other legumes, or wheat gluten to bolster their protein content, and even then, some of them are significantly lower in protein than the meat products they mimic. Some are also zinc deficient, and many are deficient in vitamin B-12.

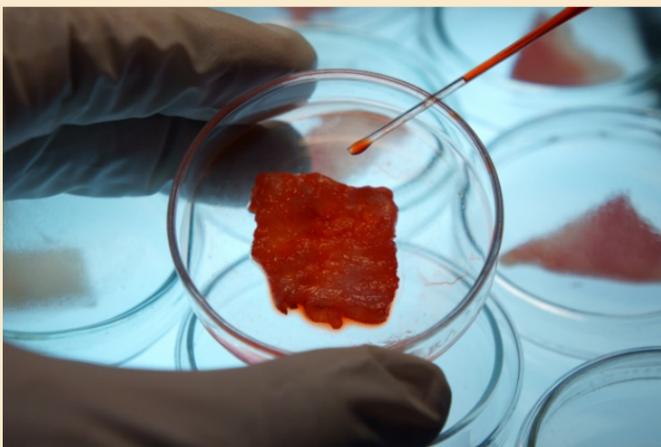
Plant and fungal-based meats are ultra-processed foods

Probably the biggest problem with this category of meat substitutes, is the fact that they are classified as ultra-refined foods, which tends to make them relatively unhealthy choices for long-term human health, and although they might require somewhat lower input requirements from the planet, they can hardly be considered to be environmentally friendly, due to the fact that ultra-processed foods in general impose significant demands on the planet, due to the fact that their production requires energy inputs, generates greenhouse gas emissions, and requires a significant allocation of land-use.

Ultra-processed foods have been shown to be associated with health issues such as diabetes, heart disease, high blood pressure, obesity, and other health issues such as declining mental health, and colorectal cancer. Consequently, foods in this category appear to be poor choices for maintaining long-term health.

Products made by culturing animal cells

Cultured meat, or meat grown from animal cells in a laboratory setting, is a horse of a different color. Meat produced by culturing animal cells would essentially be cloned from animal cells so it's tempting to assume that meat produced by this technology would be identical to animal-based meat, and indeed many articles written about this topic imply that this is true. Unfortunately, though, although it should have advantages over meat made by combining plant and fungal-based ingredients, it still will not be identical to the animal-based meat available in supermarkets.



Here is how cultured meat is currently grown.

A piece of muscle is dissolved and the precursor cells that can make new muscle cells are purified. These are placed in a bioreactor where they attach to the provided surface, usually small glass beads. They are grown for several weeks where they multiply and mature

into muscle fibers. These fibers are harvested by detaching them from the glass beads with enzymes. They form a gooey paste that is then combined with various binders, fillers and other ingredients to provide an approximate texture of ground meat. These products are then used in such products as hamburgers and chicken nuggets. These are starting to become available in stores.

The future goal is to be able to grow cultured meat that has the appearance and texture of real cuts of meat, like steak, and lots of research is going toward this. Muscles are organs, and all of the cells in all organs in mammals (and all higher animals, for that matter) are held together, and formed into their respective shapes, by matrices of collagen. Without these collagen matrices, the cells of our body, for example, would simply collapse in a heap on the floor.

The market for cultured steak would be huge.

In order to create a steak by culturing cells, so that the final product resembles a real steak, the cells would have to be grown on a matrix such as the collagen matrix in real meat. Although the matrices used wouldn't necessarily have to be based on collagen (plant and fungal-based gelatins from sources such as seaweed could be used, for example), whatever material is used would definitely have to be edible, and devoid of any detracting taste or texture issues. There has been some limited success in small-scale pilot projects.

But even if this technology ultimately becomes successful, the resultant products still will be a far cry from real meat. This is because the characteristics of meat from animals are determined not only by what the animal eats, but also from how much exercise it gets, and the genetics of the breed, for example. The meat from a steer raised under free range conditions will obviously taste differently, and have different nutritional characteristics, when compared with a steer that has been fattened in a feedlot. Obviously then, although cells in a bioreactor might have the same nutrition available to them, the meat produced by this technology won't be an exact match for meat from a live animal. And needless to say, exercise patterns of live animals would be difficult to duplicate in a bioreactor. Consequently, meat produced by this technology would almost surely need additional processing before it could match the characteristics of animal-based meat. And even then, it won't be identical to animal-based meat.

Will the cultured meat industry actually be as ethical as claimed?

Culturing muscle cells means that the starter muscle cells have to come from real animals. Right now, a big point is made that cows, for example, don't need to be slaughtered to obtain these cells, but just would have a small amount of muscle removed surgically, similar to a biopsy. That can work with the small volume of cultured meat produced right now. However, scaling up the process is going to require that some cows be slaughtered to provide enough starting material. The rationale is that many fewer cows would need to be slaughtered than is the case now, so it is more ethical. But it's hard to see vegans and others swayed by this explanation.

That said, any large-scale production resulting from this technology is at least several years down the road, if indeed, large-scale production is even possible. Although the concept has been proven, an online article posted on GreenBiz describes the problems that may prevent this technology from ever achieving substantial production (Klein, (2022, February 22)).¹

Huge problems remain to be solved.

But despite the huge amount of investment money that has been poured into this technology because of the promise it offers, and the fact that numerous facilities to develop this technology, and even some speculative production facilities,



have been constructed, there are some apparently insurmountable roadblocks that are likely to prevent the realization of large-scale production. The investors, of course, view these as simply typical development issues that will need to be worked out, whereas those who are more pessimistic, insist that these issues will prevent the production of substantial quantities of affordable meat.

One obstacle is price.

At this point the technology is extremely expensive. Investors assume that with time and scaling, the costs will come down. Until then, though, the cognoscenti are well aware that if cultured meat is ever going to be a huge success, it will have to be competitively

priced with the current competition, namely, real meat.

Can this process be scaled up for mass production?

But the biggest obstacle to scaling, and therefore, ultimate success, may be limitations inherent to the culturing process itself. There is a practical limit to how large the bioreactors can be, and how many cells they can hold, without compromising the culturing process.

Investors are pouring money into this concept.

Despite all these problems presented by attempting to scale up biological cell growth, some of which may be impossible to overcome, there are startup ventures all over the world, and huge production facilities are being constructed. Investors are hoping that they will be able to produce tons of cell cultured meat. But problems such as these, and others, will have to be overcome, before this technology will be capable of producing commercial quantities of meat, let alone capture a significant percentage of the protein market. But there's a lot at stake here, because cultured meat probably would live up to most of the lofty promises that have piqued everyone's interest, if it ever becomes a reality, but obviously, that remains to be seen.

Products made by culturing genetically modified plant and fungal cells

Some facilities will bypass the problems associated with mammalian cell-based meat, by using fungi or some other plant cells on which to base their culturing process. But the problem with this, of course, is that these products won't be identical to real meat, because they will be limited to the nutritional characteristics of plants, rather than meat. Mushrooms for example, are low in protein (compared with meat), so any meat produced by culturing plant cells, will need to source protein from either wheat gluten, or soy, or other legumes, or a combination. And even when this is done, compared with real meat, the products will probably be short of protein, and other important nutrients, such as vitamin B-12.



GMO to the rescue.

Theoretically, at least, it should be possible to use GMO techniques to implant some or most of the nutritional attributes of real meat into appropriately selected plant cells, and then culture those cells to provide a plant and fungal-based "meat" that is virtually identical to animal-based meat.

And the products might possibly be improved even beyond that, to create meat options that minimize or eliminate undesirable characteristics of animal-based meat. That technology, of course, would be even more complex, and if the concept can be proven, it will likely happen in the distant future, not tomorrow.

Politics usually trumps science.

Will plant and fungal-based meat, or cell cultured meat be able to gain a substantial market share, or someday be able to dominate the world market for meat? Probably not, unless some unforeseen breakthrough occurs, although it will almost surely be able to maintain a niche market. But ultimately, the success of these products will probably be determined by politics. History shows that when science-based issues are confronted by politics, politics usually wins. So the fact that plant and fungal-based meat may not be as

healthful as real meat, may be irrelevant.

Will there be religious objections?

Religious considerations can create barriers to cultured meat. For example, for meat to be permissible under Islamic and Jewish laws, there are strict rules on how animals are slaughtered and how the meat is prepared. Would cultured meat be approved? There is controversy surrounding this already.

Survey results are not so promising.

However public surveys seem to indicate otherwise. For example, a survey taken by Yahoo Finance on Twitter last year in September, showed that 59% of respondents intend to stick with farm-raised meat, only (Yahoo Finance, 2021, September 24).² And sales of at least some of these products, appear to be currently declining. When plant and fungal-based meats were initially introduced, they managed to chalk up some impressive sales gains. But that momentum seems to be fizzling out, and the current trend appears to be downward,

There are no free lunches.

Perhaps the ultimate consideration might be, “is the hit to the health of the general population worth the slight reduction in environmental demands (and the added expense)?” The bottom line is, if we intend to continue living on this planet, we have to accept the fact that our mere existence will require certain concessions from the environment. As the saying goes, "There Are No Free Lunches". The best we can hope to do, is to minimize our impact upon this planet. But trading the security of our long-term health for perceived planetary environmental benefits would almost surely be counterproductive.

On a lighter note, here's a question for your consideration.

If a researcher who happened to be a descendant of Darth Vader, or maybe Frankenstein, conducted an experiment using human cells to culture meat, would eating this meat constitute cannibalism?

Hollywood explored these issues almost 50 years ago.

Interestingly, the 1973 movie, "Soylent Green" deals with a lot of the issues discussed in this article, such as running out of protein, environmental issues, associated political issues, cannibalism, etc. Even more interesting, is the fact that the movie, although it was released almost 50 years ago, was a fantasy portrayal of life in 2022.

In the movie, the most popular food option available (because it was the tastiest), known as “Soylent Green”, was manufactured from plankton, but as environmental conditions worsened, and the seas became incapable of producing plankton, the manufacturers of Soylent Green secretly began making the product using human corpses from euthanasia centers.

References

1. Klein, J. (2022, February 22). Lab meat has 3 big problems. Is it time for a pivot? Retrieved from <https://www.greenbiz.com/article/lab-meat-has-3-big-problems-it-time-pivot>
2. Yahoo Finance. (2021, September 24). 59% say they won't eat lab-grown meat: YF Twitter Poll. Retrieved from <https://nz.news.yahoo.com/yf-poll-59-wont-eat-163802846.html>

