

Future of Food.

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Where will we get our food in the future? A group called RethinkX did a wonderful job explaining this in a report called *Rethinking Food and Agriculture 2020-2030*. It is almost certain that our food will come from one or a combination of three production methods. The current plant-based craze is believed to be only a short-term fad until the following become commonplace. The following do not carry the terrible carbon footprint and unhealthy processing that comes with plant-based foods.

**Cell-based Meat:** Meat that consists of animal cells grown outside an animal in a stainless steel silo (bioreactor). Cell-based meat is genetically identical to conventional animal products and can be referred to as clean meat, lab-grown meat, cultured meat, or in-vitro meat.

**Food-as-Software (FaS):** Like software, food is designed using massive databases of molecules and tweaked for variations such as taste and texture based on consumer preferences or nutritional requirements. These creations can be downloaded and incorporated almost instantaneously, some of it distributed using a 3-D printer in the home.

**Precision Fermentation:** A process that allows us to program micro-organisms such as bacteria and fungus to produce almost any complex organic molecule.

All these processes move production to the molecular level, making the scale and amount of food that can be produced infinite. The only constraint will be the confines of the human imagination. We will be able to create foods with the exact attributes we desire in terms of nutritional profile, structure, taste, texture, and functional qualities.

Numerous questions abound, including tolerability, allergenicity, and what are the ramifications of putting so much power in the hands of so few. Are there going to be human trials? As we speak, stakeholders are working with the FDA and USDA to come up with

guidelines that will protect Americans. The crazy thing is that these foods will be here much faster than you think. They will first appear in pet foods, then presented to restaurants as unique offerings, and then in your supermarkets.

It is likely that initially, cell-based meat will be more appealing to the consumer because it is animal meat, which is something they relate to. Food-as-software and precision fermentation will follow. Because modern production methods free us from the constraints of livestock, this will lead to the creation of entirely new forms of food, and how we consume food will change just as much as what we eat.

What's exciting is that food will be individualized to our desired form and nutritional needs. Imagine a 3-D printed nutrition pod or even a complete meal bag that can be brewed like coffee at a supermarket, restaurant, or even at home.

Researchers at RethinkX purport that revenues of the U.S. beef and dairy industries and their suppliers, which together exceed \$400bn today, will decline by at least 50% by 2030, and by nearly 90% by 2035. The number of slaughterhouses and meat and dairy processors will drop by more than 50%. Consider the positives by pivoting to these modern food methods.

- Land currently used for livestock and feed production will be freed for other uses such as restore wildlife habitat, safeguard biodiversity, improve water quality, and combat climate change through reforestation.
- Huge opportunities will emerge in many areas of biotechnology and software, as long as they are not privatized and left open-sourced. We are talking about feeding a world

population, so this should not be left to a few monolith companies, like the pharmaceuticals industry exists today.

- The ideal would be for food production to become decentralized where production, distribution, and even retail will merge. RethinkX suggests grocery stores might have meat fermentation tanks on-site, just like many brew coffee and bake bread and cakes in store today. Pizza stores will be able to make fresh cheese onsite with their own proprietary blend of molecular taste, aroma, texture, and nutritional attributes (for example, more protein than a steak, ‘good’ fats only, and no sugar).
- Food delivery could make preparing food at home irrelevant. In a decentralized world of food production and distribution, the use of autonomous, electric, ride-hailing services could make food delivery so inexpensive and convenient that many will question the need to buy food to prepare at home. How about autonomous delivery robots and drones delivering your food? FedEx has announced a delivery robot and a partnership with Pizza Hut.
- Elimination of growth hormones, antibiotics, land pesticides, and other endocrine disruptors and toxins will have a positive effect on human health and the environment.
- Unlike animal waste, the outputs of modern foods can be far better contained throughout the production process to avoid release into the environment. The number of those sickened with contaminated food will drop dramatically as modern food production means eliminating animals and their fecal matter.

- Modern food production allows for individualization to maximize beneficial nutrients and minimize harmful substances. Diets would be dramatically improved and tailored to individual needs without the need for behavioral change.
- In theory, higher quality, healthier food will become cheaper and more accessible for everyone. Assuming researchers' projections are correct and there is an 80% drop in the cost of animal products, the poorest American families could save 8% of their income each year, equivalent to \$700, by 2030. That is, if enough competition is allowed so that a select few cannot control food prices.

We must ensure the right intellectual property and regulatory regime is in place that allows this to flourish. Patents should only extend to processes or production methods, not to the molecules, genes or life that represent the products themselves. A transparent, open, and accountable plan that encourages international collaboration and competitive networks will ensure that the benefits can be enjoyed by everyone everywhere, not just the privileged few.

In a utopian world, food will be designed anywhere, developed anywhere, downloaded anywhere, and produced anywhere. The science and technology for Food-as-Software (FaS) already exists, so there is no need to completely disrupt our current food system, especially when 75% of the world's food comes from just 12 plants and 5 animals.

Food as we know it will change. FaS model will allow scientists, food designers, and molecular chefs to develop food like we develop smartphone apps. Individualized nutrition, where specific proteins, fibers, and vitamins are developed on-demand to match our specific genetic, epigenetic, and metabolic makeup as well as lifestyle will become the norm.

Imagine it as providing code for microbes to create the ingredients necessary to create the products you need and want in days not years. If you want a patty to have more protein or lower fat you can simply change the protein coding from 15g to 30g and change the fat coding from 9g to 5g. Whereas it would take years to do this with a cow, these tweaks would happen like an app update on your phone.

Consumer safety, education, and emotion modification will play huge parts in accepting modern food production methods. A [Frontiers in Nutrition](#) study found that, despite having a great concern for the environment and animal welfare, 72 percent of Generation Z were not ready to accept cultured meat.

The view that modern food production processes are unnatural is one of the most pervasive barriers to consumer acceptance. Those with mistrust, fear and disgust sensitivity are more likely to view them as unnatural. Strong correlations between consumer acceptance and health and safety concerns are most important, and what will drive acceptance from Nutritional Concepts.

Some, like Kristopher Gasteratos, director of the Cellular Agriculture Society, predicts humanity will rapidly adapt to lab-grown meat, becoming “neomnivores”. That remains to be seen. While much of this seems like science fiction now, it will be here before you know it. You can’t say we didn’t give you ample notice. Get ready to be neomnivorous!