

The End of Meat and Dairy?

Earth911

By all measures, commercially produced meat is bad for the environment. The most comprehensive study on the impact of food products to date, published in the journal [Science](#), determined that a vegan diet is the single most effective way for individuals to minimize their environmental impact. But for meat lovers, tofu can be a hard sell, despite a centuries-long [tradition](#) of using it to create meat-like foods.

Now a surprising new report claims that meat is on its way out, thanks to a technology called precision fermentation (PF). Precision fermentation is a microbiological process for programming micro-organisms to produce specific proteins, which can mimic meat proteins. It's not a new technology. PF has produced insulin since the 1980s. But falling prices allow its use in an ever-widening array of applications.

The report authors claim that replacing only a small percentage of beef and dairy products with PF products will disrupt conventional agriculture. Are PF proteins really that much greener than meat? And will they really revolutionize agriculture?

The Second Domestication

Titled, "Rethinking Food and Agriculture 2020-2030 — The Second Domestication of Plants and Animals, the Disruption of the Cow, and the Collapse of Industrial Livestock Farming," the report was released by [RethinkX](#), a think tank specializing in industry disruptions.

The report claims that precision fermentation will change human diets on a scale comparable to the agricultural revolution — the prehistoric hunter/gatherer transition to settled agriculture. They predict a 70 percent drop in demand for cow products by 2030 due to inexpensive PF alternatives. According to RethinkX, a "food-as-software" model of distribution will allow a decentralized, sustainable production model for proteins. Craft brewery-like PF facilities would utilize global databases to design products the way software developers design apps.

The report even goes so far as to co-opt the word "modern," defining "modern food" as:

Food produced ... using the new technologies we discuss in this report, be it precision fermentation, cell-based meat, Food-as-Software (which many plant-based foods utilize), or a combination of all."

According to the report, dairy will be affected first. It will be followed by beef before cascading to other meats and the grain farmers who supply feed. The economics of agriculture will, they say, ensure that industrial cattle farming will collapse long before the arrival of a competitively priced, "perfect" cellular steak.



Cattle confined in feedlots on large farming operation. Image: Adobe Stock

Holes in the Theory

There is no question that industrial farming methods like concentrated animal feeding operations (CAFOs) need to be replaced by much more sustainable methods. But claims that leveraging PF food production with reforestation of former farmland could offset all U.S.

greenhouse gas emissions are so bold as to trigger suspicion.

The report acknowledges that cost prediction for meat and PF proteins are based on very limited data from emerging technology. After all, the first microbe-generated meat replacement, the [Impossible Burger](#), is only three years old. Even small errors or changes in the data could have dramatically different results from those predicted.

The report is also clear that the technology development and industries studied both depend on complex and interacting policy, social, and economic factors that are difficult to model. For example, “modern production” methods may not be as open-source and distributed as described. In fact, on page 46 of the report, the authors say, “The winners in food production are likely to be biotechnology and software companies.” They identify Coca-Cola and Amazon as well-positioned to move into PF food production. These are not businesses that operate on a craft-brew scale or localized model.

Some of the assumptions are uncertain as well. They claim that disruption “... does not rely solely on the direct, one-for-one substitution of end products. In some markets, only a small percentage of the ingredients need to be replaced for an entire product to be disrupted. The whole of the cow milk industry, for example, will start to collapse once modern food technologies have replaced the proteins in a bottle of milk — just 3.3 percent of its content.”

But will consumers stop pouring milk on cereal when substitute milk proteins become available? Protein powders have not turned the world vegetarian yet. If the TV dinners of the 20th century have taught us anything, product quality decreases as production methods deviate from nature and expand in scale. It's not a given that consumers will choose new products over the “real thing.”

Combine the uncertain assumptions, limited early data, and inherent complexity of the systems being modeled and the forecast for disruption begins to look more like a vision of an imagined — yet possible — future.

Future Vision or Nightmare?

The report doesn't describe its methodology. But press releases explain that RethinkX reports use the Seba Technology Disruption Framework, an analysis intended to capture the complex and dynamic interactions of disruption. They claim the framework has forecast major industry disruptions before. They cite the example of coal and natural gas industry losses. And they cite a 2009 prediction that the price of solar per kilowatt-hour would be 2.5 cents by 2020. Today it is about [16 cents per kilowatt-hour](#) — much higher than predicted, but prices have dropped [more than 60 percent](#) in recent years.

In conventional food production, single molecules such as whey are expensive to produce. But these are the easiest and cheapest products to produce by PF. So PF will likely replace those sorts of ingredients even if fake steak never takes off. If it's true that eliminating a small segment of the market is enough to destroy the industry, disruption of agriculture may be inevitable after all.

In that case, the report may serve as a warning. If the cattle industry collapses from a few milk proteins, consumers could find themselves with nothing affordable to pour on their cereal.

Some of the other possibilities proudly announced in the report — manufacturing proteins from extinct species, designing proteins that do not exist in nature and may not break down under normal circumstances — raise the same specters as [GMO foods](#). We've already learned from [plastic](#) that indestructible new materials are likely to become real-life environmental disasters.

Still, there are upsides. According to the report, PF generates 92 percent fewer pollutants than comparable animal products. A shrinking beef industry would free millions of acres of [federal rangeland](#) for restoration and conservation. And inexpensive protein could improve health, especially in impoverished areas.

The Future of Meat and Dairy

If disruption occurs without a one-to-one substitution of products, industrial animal agriculture could collapse due to PF. That would result in meat and dairy becoming luxury items. That is also a likely result of climate change. It looks like Americans should get used to the idea that the era of the 100 percent beef hamburger is coming to an end.

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